Activity 4 – Operational Safety

Final Report

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### Review

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14 Contributors

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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
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
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<th>Abbr.</th>
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<td>MARPOL</td>
<td>International Convention for the Prevention of Pollution from Ships</td>
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<td>MCC</td>
<td>Mission Coordination 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>Maritime Operations Centre (SASEMAR)</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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<td>Port CDM</td>
<td>Collaborative Decision Making within and in relation to Ports</td>
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<td>Personal Protective Equipment</td>
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<td>Rescue Coordination Centre</td>
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<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>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>
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<td>SVM</td>
<td>Strategic Voyage Management</td>
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<td>System Wide Information Management</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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2 General Information

By using modern technology and tailored training programs, the MONALISA 2.0 project has provided tools for identifying, reducing and preventing risk situations, and optimising actions when accidents occur.

“Operational Safety” has been an activity within the project that posed an integrated approach to considering safety as a three pillars concept: in ports, the vessel and at sea, and as a key factor for underlying integral safety management, which does not only cover the landside but also the maritime dimension of the port area and beyond. In this way, MONALISA 2.0 contributed to improved management, coordination and interoperability among safety management on land, on board ship and at sea.

Focusing on different aspects of operational safety in ports and coastal waters, the purpose was to contribute to updating the qualifications of personnel involved in SAR, evacuation operations from the ship (large passenger or cruise vessels) and port contingency plans. Thus, the definition of specific and dedicated training as well as the use of several innovative information systems, tools and test bed exercises, employed to support SAR, evacuation, applied first aids and response in port facilities, and finally, the potential ship recovery during and after an accident, were paramount.

After the planned exercises, Operational Safety activity within the MONALISA 2.0 project contributed to demonstrating the improvements through interoperability among SAR services, passenger ship crews, VTMIS and Mission Control Centres’ staff and other relevant actors during a massive crisis scenario, supported by the use of several technologies integrated for the first time. Technological innovations included the remote recovery of lifeboats, information exchange systems between land, SAR instruments, the port and the vessels, simulations on the recovery of damaged ships, the use of information for the support of decision-making processes based on risk analysis and accident history databases.

The specific training programmes for the various aspects of maritime safety were elaborated and tested, following the existing IMO model courses. The fields covered were: mass rescue operations supported by SAR services, integrated maritime safety on board focused on massive evacuation, leadership, safety management in ports during massive crisis scenarios, information management and firefighting with the emphasis on the provision of fire-fighters for the vessels and LNG spills and fire. The Spanish Maritime Safety Agency, SASEMAR, a coordinated Operational Safety team composed of Chalmers University of Technology, Technical University of Catalonia, Technical University of Madrid, National Technical University of Athens, Valencia Port, Valencia Port Foundation, SSPA, MARSEC XL, FERRI Industries, CIMNE and the Italian Ministry of Transport.
3 Introduction

Sea transport is the most effective mode in moving large quantities of cargo over long distances. In terms of passengers, it is also the mode of transport that can move greater amounts of people per trip. Main waterborne routes are located in oceans, coasts, seas, lakes, rivers and channels; with the northern hemisphere countries the most developed in the maritime transport industry. In shipping, passengers and freight usually share the same vessels and often the same terminals. Since the 1950s, specialisation has occurred, and the two segments are now quite distinct, except for ferries and some roro vessels, making it possible to create new business models based on passengers, cargo, and both. According to the European Commission, “sea transport services are essential for the European economy to compete globally. In 2011, the Commission adopted a White Paper for Transport. It further specified the orientations of the Maritime Transport Strategy until 2018: the ability to provide cost-efficient maritime transport services; the long-term competitiveness of the EU shipping sector; and the creation of seamless transport chains for passengers and cargo across transport modes. In 2011, the Commission proposed new guidelines for Trans-European Networks to broaden the role of the Motorways of the Sea as main European corridors. Through multi-annual calls, the Commission is leading the way in reducing the environmental impact of transport and in increasing transport efficiency” [1].

Since the beginning of the MONALISA 2.0 project, the aim of attaining more sustainable, safer and efficient maritime transport in Europe is possible by means of the intelligent use of information and communication technologies; nevertheless, other external and unexpected factors may cause vulnerabilities in sea transport. Considering this uncertainty, remedial and response actions must be considered part of any holistic view of the maritime transport industry. Operational safety is the answer in minimising the negative impacts caused by such “uncertainties”, primarily human elements and natural phenomena. In this way, the preparedness of and response by the maritime authorities need to include the elements introduced in MONALISA 2.0, Sea Traffic Management and Safer Ships. The articulation of these three pillars is the key in attaining the objectives of the project and the challenges of the shipping industry in the years ahead.

This paper summarises the final results and outcomes in applying important innovations in facing the safety aspects of the maritime transport industry in terms of preparedness and response to casualties, incidents and accidents in the specific area of large passenger ships.

4 Executive summary

On Monday, 15th June, the Spanish Maritime Safety and Rescue Agency (SASEMAR) with the cooperation of the Valencia Port Authority in its role as the MONALISA 2.0 project partners in Spain, together with the participation of the maritime services from the Civil Guard, the Army Emergency Unit, the Air Force, the Navy Maritime Response Unit, the
General Sub-directorate of Operations from the Spanish Customs Administration, the General Directorate for the Merchant Marine, the State Secretariat for Civil Works, the Spanish Red Cross, the Valencia Port Authority, the healthcare and emergencies services from the Valencia Government, the Valencia Government Delegation, and Acciona Transmediterranea Shipping Company carried out a Search and Rescue Exercise proposed under the MONALISA 2.0 project and aimed at demonstrating some improvements to the responses of different bodies when a large passenger ship is declared in distress. The exercise was designed and defined by the Spanish partners involved in the project, and Italian and Greek partner States sent observers to take note of the results for their respective issues within “operational safety“ activity. The Prefecture Maritime from France was also present as an observer providing some appropriate opinions during the debriefing session. The Swedish Maritime Authority was also present as project leader, as well as the DG-Move Officer. CIMNE, FERRI, the Technical Universities of Catalonia and Madrid, the Valencia Port Foundation, and COMPASS, partners in the project implemented some of the innovations developed during the first 18 months of the project, which aims at providing improvements at the technical and operational level in the event of the occurrence of a high-profile maritime accident, in this case a passenger ship.

The purpose of the exercise was to test the contingency plans and procedures at port level and the response at sea by the Maritime Search and Rescue authority. During 2014, some small scale exercises were already completed, all with the shared purpose of practicing cooperation among the participating agencies in specific scenarios, and testing some new tools and support systems to improve specific response operations. The results from the exercise will permit an evaluation of SAR functionalities in the next Sea Traffic Management-related projects.

The complex exercise involved coordination among three different first level actors, namely, the ship, the port and the SAR services, together with the civilian health services, Red Cross, emergency response services and the management of port, maritime and air authorities to ensure swift and safe rescue of those involved in the simulated massive incident. The exercise accomplished most of the planned objectives meeting different actors involved in the issue – vessel, shipping company, crew, SAR facilities and services, port crisis management and land-based crisis management (Red Cross, health and emergency services, local government authorities and communications media). Also, 75% of the innovations developed since the beginning of the project were tested, which included the definition of mass contingency and response plans on board, at sea and in ports, risk management guidelines, simulation of conditions to recover damaged vessels, simulations of the recovery system for on-board rafts after they were dropped, real-time communications with the SAR units through multimedia and customised equipment (NAVSAR system), integration of the various information systems to facilitate decision-making processes by the crisis management staff in charge of the situation, improvements to the integrated operations management system, SAFETRX system, which, by means of a mobile application, permits calls to call nearby recreational craft as opportunity vessels.
to assist a mass evacuation, a web page to provide information to the relatives of victims and the public, and finally, training support for people involved in exercises, firemen preparing to board a vessel to assist and help crew during fire extinguishing, improved ISM and leadership skills for the crew for the management of incidents related to large passenger ships in distress, improvement of the response skills of SAR and ports staff, and the use of “serious game” applications to help passengers find the evacuation routes on the ship and the muster points.

At the end of the experience, the most important conclusion was the need for better cooperation and coordination among the various parties involved, supported by appropriate experts, an intensive and reasonable use of technology and a proper training upgrade for those in charge in maintaining and guaranteeing safety at sea and in ports.

5 Operational and Integrated Maritime Safety – A Challenge for the Future

Maritime transport is one of the safest modes of transport both for cargo and passengers, thanks to the international commitment to safety, strict regulations and vigorous enforcement mechanisms. Nowadays, truly major accidents rarely occur but the consequences in terms of human lives, goods and the environment can be immense should they occur.

Critical human factors and operational aspects of maritime safety related to the challenges facing the industry, bigger vessels, reduced crews and high-density passenger ships can be supported by the use of new technologies, adequate training and legislation. The first two options are a matter of investment and internal shipping company policies; the second option needs more time as it relies on States and international organisations to be analysed, debated, implemented and applied. In the MONALISA 2.0 project, operational safety procedures are treated as a cooperative instrument based on three basic elements: the shore, the ship and the sea (this last pillar indicates the safety instruments deployed at sea by the SAR and Coast Guard Services and is external to the ship), where human, technological, logistics and material means need to be provided by harmonised and coordinated actions. Decision-making processes at different levels are also important and must be developed by comprehensive best practices from the industry, with broad-based implementation among the actors involved: civil agencies, maritime and port authorities, the navy and industry. In the case of passenger ships, “despite the strong passenger safety record of the cruise industry, the modern trend towards ultra-large cruise ships, carrying over 6,000 passengers, poses new challenges, especially in terms of evacuation and rescue in remote environments. The International Maritime Organisation (IMO) has introduced regulations addressing such risks, including proactive risk management with improved fire-safety systems and a focus on the need for such vessels to be their ‘own best lifeboat’ so that, in the event of a casualties, people can stay safely on board as the ship proceeds to port” [2].
“When dealing with passenger evacuation from a vessel, one should keep in mind that the evacuation process itself presents dangers. IMO2 [MSC1049] issued a circular highlighting the dangers of using lifeboats in 2002. This was in turn was partly based on an investigation of a relatively large number of incidents involving lifeboats [LBS]. Also the evacuation to muster stations is not a trivial issue. With a large number of passengers, many of whom may be elderly or otherwise not completely fit, a high level of psychical stress and a certain amount of physical activity, medical problems or even fatalities may occur. This is exemplified, e.g., in the single death associated with the M/S Prinsesse Ragnhild fire in 1999 [PR] where one person died of a heart problem after all passengers were safely evacuated from the ship to shore.

These problems are currently being addressed by on-going work in the IMO, with where very-large passenger ships and new cruise destinations in Arctic and Antarctic areas forming the backdrop. The large number of passengers, the inherent and known problems of evacuating the ship, as well as the inhospitable environment in some of these new destinations create significant problems. Proposed solutions include new types of rescue systems, extended survivability of the ship and better coordination with the SAR services. As quoted from this work: *The MSC has agreed that future large passenger ships should be designed for improved survivability based on the time-honoured principle that “a ship is its own best lifeboat” [3].* This adds emphasis to the role of coordination, cooperation and integration of smart decision-support processes and teams to increase survivability, supported by different technologies and tools, but also assists in deciding when evacuation is really necessary.

5.1 International framework of operational safety

International shipping safety is crucial for the global economy. It is estimated that more than 90% of trade is transported by sea. In Europe it represents almost 90% of the EU’s external freight trade. Short-sea shipping represents 40% of intra-EU exchanges in terms of ton-kilometres. The quality of life on islands and in peripheral maritime regions depends on reliable maritime transport services. Each year, more than 400 million passengers embark and disembark in European ports. Overall, maritime industries are a key source of employment and income for the European economy.

The international and European objective is to protect maritime transport, resulting in very strict safety rules preventing sub-standard shipping, reducing the risk of serious maritime accidents and minimising the environmental impact of maritime transport. The IMO Maritime Safety Committee (MSC) met in June 2013 to discuss a number of recommendations and amendments to safety-related regulations. Stemming from concerns about passenger ship safety in the wake of the Costa Concordia disaster off the coast of Italy in January 2012, the committee adopted amendments to the International Convention for the Safety of Life at Sea (SOLAS) regulation III/19 to require musters of newly embarked passengers prior to or immediately upon departure, instead of “within 24 hours”, as stated in the current regulations. These amendments were expected to enter
into force on January 1, 2015. At the meeting, the committee also discussed other recommendations arising from the Costa Concordia incident, and approved revised “Recommended interim measures for passenger ship companies to enhance the safety of passenger ships” and revised and updated a long-term action plan for passenger ship safety. Also, the MSC discussed amendments to SOLAS regulation III/19 on emergency training to mandate enclosed-space entry and rescue drills, which will require crewmembers with these responsibilities to participate in a drill at least once every two months.

Enclosed and confined spaces can include cargo holds, tanks, pump rooms and any other spaces that may normally be kept closed or sealed. According to the incidents/accidents reports, it has been estimated that more than 50% of workers who die in confined spaces are attempting to rescue other workers who have found themselves in difficulty. Amendments to the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) were also covered, including a new requirement for companies to ensure that ships are appropriately manned. Lifeboats were considered with the approval – for adoption at MSC 93 in May 2014 – of a draft MSC resolution on requirements for periodic servicing and maintenance of lifeboats and rescue boats, as well as associated draft SOLAS amendments to make these requirements mandatory.

Another regulatory adoption by the IMO in 2013 also promises to further improve ship safety in international waters. The IMO Assembly adopted the IMO Instruments Implementation Code (III Code) in December 2013, which provides a global standard to enable states to meet their obligations as flag, port and/or coastal states; the framework and procedures for the IMO Member State Audit Scheme; the 2013 non-exhaustive list of obligations under instruments relevant to the III Code; and a resolution on transitional arrangements from the voluntary to the mandatory scheme. [4]

In 2014, the IMO Maritime Safety Committee (MSC) met for its customary two sessions, during May and November. Extensive cross-industry cooperation on risk mitigation strategies for increased shipping in sensitive polar regions culminated in the adoption of the Introduction and part I-A of the International Code for Ships Operating in Polar Waters (the Polar Code) at the MSC’s 94th session in November. This involved changes to the International Convention for the Safety of Life at Sea (SOLAS) chapter XIV “Safety measures for ships operating in polar waters”, which made the Polar Code mandatory. With reference to the growing movements of liquefied natural gas (LNG) as a cargo – which has raised concerns about the impact of a collision or stranding given the nature of the product – a revised International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC Code) was also adopted by the MSC in 2014. This will come into force on January 1, 2016, with an implementation/application date of July 1. The rising interest in using LNG as a fuel was also covered by the MSC through the approval, in principle, of the draft International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code), as well as draft SOLAS amendments to make the code mandatory. Both are planned to be adopted in 2015.
The IGF Code will provide mandatory provisions for the arrangement, installation, control and monitoring of machinery, equipment and systems using low-flashpoint fuels, focusing initially on LNG, to minimise the risk to the ship, its crew and the environment.

The committee agreed a revised long-term action plan on passenger ship safety, specifically focusing on damage stability and survivability of passenger ships. On the container front, mandatory weighing of containers will soon be a requirement after the MSC adopted amendments to SOLAS Chapter VI.

MSC has also approved an e-navigation Strategy Implementation Plan (SIP), which provides a framework and a road map of tasks that need to be implemented or conducted in the future to improve e-navigation solutions. [5]

At the European level and after the Costa Concordia disaster, the European Commission set out the Commission's priority actions for passenger ship safety. These actions have focused on three themes: operational issues – safety drills, evacuation, communication and training; passenger ship stability; and innovation in maritime safety.

The EC state that shipping is global by nature, so for some of the proposals a twin-track approach could be followed: and, in parallel, proposed EU legislation can be fed into IMO (UN based, International Maritime Organisation). The Commission wanted to see a fully coordinated European response with regard to passenger safety-related submissions to the International Maritime Organisation, and in particular the Maritime Safety Committee (MSC).

- The Commission intended presenting new rules and safety standards for passenger ships by the end of 2012. The Commission planned a revision of Directive 2009/45/EC on domestic passenger ships – the new measures shall offer simplification, and adapt the scope and coverage for smaller passenger ships and ships built in materials other than steel, as well as sailing and historic ships.

- In addition, the Commission envisaged making a proposal to update EU passenger ship stability rules for roll-on roll-off ferries (Directive 2003/25/EC) with a view particularly to improving stability after damage. Meanwhile, the Commission shall provide its research on roro passenger ship stability in a damaged condition to the IMO, with a view to enhancing the IMO international rules.

As a result, the current EU policy can be summarised as follows:

5.1.1 EU ratification

Art. 216 of the Treaty on the Functioning of the European Union (TFEU) reads: The Union may conclude an agreement with one or more third countries or international organisations where the Treaties so provide or where the conclusion of an agreement is necessary in order to achieve, within the framework of the Union’s policies, one of the objectives referred to in the Treaties, or is provided for in a legally binding Union act or is likely to affect common rules or alter their scope.
Agreements concluded by the Union are binding upon the institutions of the Union and its Member States.

5.1.2 European law

Primary law
Art. 91(1) (c) and (d) TFEU states:
For the purpose of implementing Art. 90, and taking into account the distinctive features of transport, the European Parliament and the Council shall, acting in accordance with the ordinary legislative procedure and after consulting the EESC and the CoR, lay down:

(a) common rules applicable to international transport to or from the territory of a Member State or passing across the territory of one or more Member States;
(b) the conditions under which non-resident carriers may operate transport services within a Member State;
(c) measures to improve transport safety;
(d) any other appropriate provisions;
(e) Secondary law

The Commission Implementing the Decision of 19 December 2013 following a notification by the United Kingdom of measures it intends to adopt in accordance with Article 9(2) and (3) of Directive 2009/45/EC of the European Parliament and of the Council on safety rules and standards for passenger ships.


Directive 2010/65: On reporting formalities for ships arriving in or departing from ports of the Member States.

Safety of ro-ro ferries
Directive 1999/35/EC on a system of mandatory surveys for the safe operation of regular ro-ro ferry and high-speed passenger craft services.


**Accident investigation**


**5.2 Drivers and Trends**

With more than 20 million people cruising the seas each year (and increasing), the cruise industry must be made safer than ever. Cruise ships are practically floating cities. Day in, day out in ports all across the world, cruise ships and passengers disembark on what are generally enjoyable, relaxing vacations.

According to the Cruise Lines International Association (CLIA), the industry trends show that:

- Travellers will continue to set sail, as the number of cruise passengers continues to increase;
- The size of cruise ships is becoming less relevant, the focus being more on design and amenities;
- Specialty cruises continue to thrive;
- Also, the Caribbean remains the most popular destination, while the Mediterranean market continues to grow;
- Itineraries will continue to offer new and exciting destinations worldwide;
- Travel agents continue to be the key to cruise travel; and
- Passengers remain at the helm.

New cruise ships are modern, fully equipped and automated, advanced in navigation and communications technologies, and manned by well-trained crews, but unfortunately, accidents are also a reality to be considered by shipping companies, tour operators, insurance companies, and, of course, by the coast guard and SAR services.

According to the Allianze Shipping Review 2015, the maritime industry continued to improve its safety record in 2014 with 75 total losses reported worldwide; the lowest in 10 years. Losses declined by 32% compared with 2013 (110). The 2014 accident year also represents a significant improvement on the 10-year loss average (127). Shipping losses have declined by 50% since 2005, driven in part by a robust regulatory environment.
The last two shipping reviews from Allianze (2014 and 2015) show the following results regarding passenger ship accidents:

- **Setubal Express**: February 7, 2013. Fire on board. No fatalities. 16,925 GT
- **Massimo M**: June 19, 2013. Fire on board. Sent for scrapping. No fatalities. 12,494 GT
- **St. Thomas of Aquinas**: August 16, 2013. Sank following collision with Sulpicio Express. At least 116 fatalities. 11,405 GT
- **Spirit of Fiji Islands**: October 12, 2013. Fire on board. Drifted. Crew abandoned and rescued. No fatalities. 4,421 GT
- **Fajar Samudera**: February 23, 2013. Sank following water ingress. No fatalities. 2,165 GT
- **GP Ferry 2**: June 14, 2013. Sank in heavy seas. 2 fatalities. 2,072 GT
- **Theodoros Maria Z**: July 6, 2013. Capsized and sank. 1 fatality. 479 GT
- **Sewol**: 16 April 2014. Capsized and sank. Only 172 of the 476 passengers rescued. 6,825 GT
- **BJL I**: 14 January 2014. Sank after flooding caused the vessel to list. No reported fatalities. 2,555 GT
- **Maharlika II**: 13 September 2014. Sank in rough waves caused by typhoon. Unconfirmed number of fatalities. 1,865 GT
- **KM Sahabat**: 21 January 2014. Sank. Unconfirmed number of fatalities. 1,805 GT
- **Super Shuttle Ferry 7**: 14 September 2014. Semi-submerged on port side in bad weather. Crew rescued. 730 GT
- **Munawar Ferry**: 3 January 2014. Sank. Unconfirmed number of fatalities 522 GT
- **Q Carrelyn**: 29 November 2014. Capsized. Crew and passengers rescued by passing fishing vessel. 248 GT
These shipping reviews, the continued work of international and European maritime policy makers and compromises by private companies show a clear shipping incident/accident reduction; nevertheless, a clear need for maintaining a global maritime safety strategy continues to be paramount. This industry is a fundamental economic axis and both sea traffic management and operational safety – not only for prevention but also for response
– are a warranty for the next generation of safer, more efficient and environmental friendly maritime transport.

5.3 Efficient Operational Safety Management

Operational safety must be understood as all of the tasks involving prevention, emergency management and response. The benefits for maritime transport, shipping and port industries are competitive advantage in terms of the global transport chain, where the sea leg is subjected to more unpredictable circumstances or undesired situations. With a reduction of lives lost at sea, material damages or losses (ships and goods), environmental impact and insurance claims, the safety culture is an operational structure working in an organic way in attaining these goals. The three aspects of operational safety, preparedness, response and cooperation are directly linked to the safety management principle. Safety management identifies and defines the critical aspects (positive and negative) and risks in maritime transport, port operations, as well as in search and rescue actions when required. These crucial aspects and risks are present in any structure at sea and in ports, and even at the organisational level. The present and future of operational maritime safety management require key investments in systems and tools to support it. The safety culture at sea, on-board and in ports requires multidisciplinary cooperation, information exchange and sharing, decision-making processes based on leadership and human behaviour. These latter issues require considerable investment in continuing training programs, not only for new staff but also for existent crews since technology, methodologies and procedures continuously change and evolve.
The foundations of operational safety management have been established and tested within the MONALISA 2.0 project. Under the sea traffic management concept, information exchange and sharing tools have been defined and tested. The safer ship component has demonstrated the improvements to safety management on board cruise ships, and, finally, operational safety activity could integrate the concepts of some prevention and response tools; effective cooperation among the actors involved (crew, officers, SAR and port safety teams and other relevant shore-based organisations); the basis for the experience exchange, with the implementation of particular safety information systems in a common platform: the application of past successful and failed decisions made in previous registered accidents; and leadership and teamwork improvements, including training, handling of LNG and firefighting, and the establishment of correct and proper crisis management teams.
6 MONALISA 2.0 Project and Operational Safety – Defining the Concept

New technology tools and human efforts supporting safety in ports and coastal areas represent the core of operational safety as a key factor for integral safety management, which does not only cover the portside but also the sea dimension of the port area and coastal waters. MONALISA 2.0 has contributed to improved management, coordination, cooperation and interoperability among the operations and actors involved in the response to incidents, accidents and crisis in ports and at sea.

Focusing on different aspects of operational safety, the purpose of this activity was to contribute in introducing mature innovations, improving efficiency in search and rescue (SAR) operations and crisis management, and at the same time, updating the qualifications of personnel involved in SAR, evacuation procedures on board and in port contingency plans, with the focus on large passenger ships. The definition of specific and dedicated training programmes and exercises, and the deployment of information systems and technologies employed to support SAR, evacuation tasks, first-aid provision and ship recovery proved to be fruitful experiences.

This activity also contributed to improving interoperability among SAR services, passenger ships, VTMS and Mission Control Centres. The technological innovations tested included on-board life raft recovery systems (OLRS), information exchange between shores, SAR instruments, ships and other maritime safety information providers; the dimension of real-time information exchange data was a success factor when the operational safety units were deployed.

Another achievement was the provision of instruments for risk analysis to support tactical decisions by means of intelligent tools and decision-making systems. Such instruments supported the analysis of behaviour, reactions and the chain of responsibility during SAR operations. The introduction of novel safety information systems and the improvement of existing ones, making them interoperable, encompassed the tests and demonstrations. As a complementary and obligatory improvement tool in operational safety, MONALISA 2.0 also developed dedicated training programmes for the various aspects of maritime safety tested with the aim of improving the level of human-resource performance involved in such activities, by using the novel technology implemented and implemented in the project.

Passengers were also trained with a dedicated mobile app, providing evacuation pre-training by means of a serious “game” that can help to identify evacuation routes efficiently. Neighbouring ships like leisure craft and fishing vessels could be included as vessels of opportunity to help in rescuing evacuated passengers.
6.1 Three Pillars – in Ports, on Board and at Sea

When we refer to maritime safety, it must not be viewed as an independent and isolated issue. At sea, the infrastructure is the ship, something different from a port facility, where the infrastructure is fixed; in this way, maritime safety acquires a wider dimension as the ship departs from and arrives to a port; it is a logical conclusion that even at sea, the support and assistance to a distressed vessel will come from land and can be applied at sea or in the port. Thus, the three main pillars regarding operational safety are the port, the ship and the sea. Meanwhile, three components support the three pillars of maritime safety, namely, preparedness, response and cooperation, not only for the prevention of accidents but also in regard to the response to events on board the ship in port or at sea.

Preparedness is based on training and the professional experience acquired by the human resources. Response and cooperation include efficient and improved teamwork capacity, and also leadership skills with the aim of increasing awareness and appropriate decision making. The information and communications technologies serving safety management and response operations sustain and will continue to support the “zero vision” safety approach in maritime transport for safer seas and motorways of the sea.
6.2 Mass Rescue and Evacuation Operations – An Operational Safety Case Study

A mass rescue operation (MRO) is defined by the International Maritime Organization (IMO) as “a civil search and rescue activity characterised by the need for immediate assistance to a large number of persons in distress, such that the capabilities normally available to search and rescue authorities are inadequate”. IMO’s “Guidance for Mass Rescue Operations” (COMSAR/Cir 31) dated 6 February 2003 provides additional valuable MRO background and response information.

MRO’s are low-probability, high-consequence events. Each MRO response will be unique depending on the type of craft or structure involved, number and condition of victims, location, weather, response assets available, capabilities of the crew and ownership, and several other contributing factors. But MROs also share common “operational realities” that must be considered in preparing for and responding to such incidents. Although only briefly described here, each item is worthy of a lengthy discussion, and certainly requires careful consideration in any MRO planning document and incident response. [8]

In the case of ports, mass evacuation may be necessary during an emergency declared within the harbour area. To minimise the impact on people and the port facility community, an evacuation must be well managed, with the community kept informed and supported throughout the process. For these purposes, contingency plans and port safety instruments must be prepared to coordinate actions with the local civil and health authorities.

Evacuations can produce long-term negative effects such as causing psychological trauma, disrupting community cohesion, employment and economic continuity. Therefore, evacuation is only to be undertaken as a last resort and done so in a well-managed and organised manner.

Evacuations may be small and limited in terms of area and number of people to be evacuated; for example, only evacuating those with breathing or medical complications downwind of a potential respiratory threat. Alternatively, evacuations may be large-scale in terms of people and/or geographic area, such as evacuating all people in a given port area, or during an incident involving the evacuation of more than 5,000 people from a large passenger ship.

People generally fare better in crisis situations when they are familiar with their surroundings, so sheltering-in-place is to be considered as the first option to support the safety and welfare of people impacted by an emergency; nonetheless, at sea or in a port, a crisis increases the stress level, producing panic and other complexities when attending the situation.
6.2.1 Mass evacuation and contingency plans in ports

Mass evacuation from a passenger ship in a port, caused by a real event or contingency, has arisen only on rare occasions.

However, given that the likelihood exists, the port receiving passenger ships must unreservedly provide for appropriate actions for potential evacuation cases. Typically, the port emergency plan considers the possibility of response to accidents or other maritime incidents arising on board ships (collisions, fire, etc.) and possible evacuation from them. However, it is not usual for the set of actions involving such evacuation to be treated in individual and specific way if evacuation occurs in a passenger vessel (ferry or cruise).

That set of specific actions in response to mass evacuation may be operable whether the evacuation occurs as a result of an accident related to safety or a need for protection (security) resulting from, for example, a threat of terrorist attack. Note that a mass evacuation on a passenger ship may involve several hundreds and even thousands of people. Also, it can result from a multiple victim accident on board or, in turn, cause an accident of this type if the evacuation is done hastily without being based on sufficient and proper means.

On the other hand, the division of authority for maritime search and rescue operations is clear, but the organisation of on-shore or in-port operations must be agreed separately. There are several organisational methods, involving numerous authorities, other organisations, and also private companies.

6.2.2 Mass evacuation from ships

Evacuation operations involving a passenger ship refer to those actions undertaken by the ship's crew, on deck initially, by the engine operatives and by the service staff, since they are also trained in basic safety procedures. The objective is to empty cabins and guide passengers initially to the assembly point and finally off the vessel. The master of the vessel leads this evacuation procedure. Even if rescue personnel board a vessel to assist with the evacuation, the master of the vessel remains in charge of the evacuation. Once the distressed vessel's passengers are in lifeboats, on other vessels (from several safety agencies and vessels of opportunity if available), or in the water, authority is transferred from the master of the ship to maritime rescue officials. The distressed vessel's lifeboats and crew may take part in rescuing people from the water, for example; but these operations must be carried out under the leadership of the maritime rescue authorities. Preparedness for these types of accidents is currently quite weak, and neither the regional SAR nor Coast Guard services have any real experience of handling such incidents. Authorities face enormous challenges in such situations. [9]
6.2.3 Mass search and rescue operations at sea

Maritime SAR, Coast Guard organisations and the emergency services often engage in operational cooperation in the event of accidents involving ships. The MONALISA 2.0 project included operational safety activity as a challenge to analyse the forms taken by this type of inter-authority cooperation in participating countries by testing the elements involved in the particular Spanish scenario, aiming to extrapolate the most relevant and applicable results to the other ML 2.0 partner States.

A declared uncontrollable ship fire is a typical example of an incident that will involve this type of operational cooperation. There are extremely limited resources available to handle ship fires at sea. Therefore, to effectively get a situation under control, it is vital to have standard operational procedures and seamless cooperation between the teams deployed by national and regional authorities, and neighbouring countries if necessary.

Mass rescue operations at sea also often require cooperation among authorities. People evacuated during MROs are typically transported to different areas within the accident zone, and often to other coastal states. In these circumstances, major demands are placed on general command and coordination. Without commonly agreed procedures, it is unlikely that operations will progress smoothly and with a minimum of victims. [9]

6.3 Six Elements + 1

Operational safety has highlighted a wide variety of aspects of operational safety in ports and coastal waters in order to minimise the number of marine accidents and optimise the response if incidents occur.

It has contributed to improved coordination of multidisciplinary teams in each field of response. In addition, the activity has defined specific and dedicated training topics. This activity was divided into:

- Safety in ports,
- Safety in coastal areas,
- Risk assessment,
- Risk management guidelines,
- Safety information systems, and
- Training

This six main elements developed under a common criteria focused on the implementation of some pilot actions to be used on a final pilot exercise, making it possible to test technology, human decision making and cooperation tools in a coordinated way, as the situation involved different actors at the scene.
Around 700 people were involved in the 6-hour exercise of which around 400 were on board the vessel. The purpose of the exercise was to validate the new information-exchange management systems regarding search, rescue and response, and concepts, as well as to evaluate the efficiency of the available systems and technologies and their efficient deployment and use, the response capacity of various staff trained specially for a mass event at sea, and the relevant decisions based on available on real time information. Other communications with the external agents were evaluated.

The following schedule shows how the 6 activities were designed and driven, before closing with a suitable pilot exercise, where most of the innovations and strategies under the operational safety scope were deployed.

The results obtained during the project’s life are summarised in the following reference documents issued in line with the work plan and the Decision Commission.

6.3.1 Safety in Ports

Reference documents used in this section are: D4.1.1, D4.1.2 D4.1.3. Three epigraphs cover the safety in ports aspects considered under this part of the activity.

6.3.1.1 Contingency planning in ports and its guidelines

A “contingency plan” is a kind of preventive, predictive and response plan. It represents a strategic and operational structure that will help control an emergency situation and minimise its negative consequences.
The contingency plan proposes a series of alternative procedures to the normal functioning of an organisation, when one of their usual functions is impaired by an internal or external contingency.

In this context, this sub-activity proposed the creation of a guide to serve as an index for developing a contingency plan for any port in order to try to ensure the continued operation of the organisation against any eventuality, whether material or personal. A contingency plan includes four basic steps: assessment, planning, testing and implementation feasibility.

In particular, we can establish that all contingency plans must, in turn, be backed by three others, which stipulate the required measures, the threats faced and the time of establishment of those measures.

First, there is the "Self-Protection Plan" that is one which is responsible for determining the prevention measures, i.e. what must be carried out with the clear objective of avoiding what may occur on threat materialisation, and which are contained in the Risk Analysis. Secondly, the contingency project is also integrated into the "Emergency Plan" which, as its name suggests, consists of a set of actions to be activated in conjunction with any threat and after such threat. Thanks to these actions, it is feasible to reduce and eliminate the negative threat effects.

And third is the "Recovery Plan" which emerges after the threat, with the clear objective of returning to the state in which conditions were before that became real.

To establish a common reference contingency plan guide, the Valencia Port Authority analysed certain information in order to standardise the proposed guide. In this respect, the Port Authority of Valencia designed a survey based on multiple criteria for the implementation of contingency plans in European ports. Two types of surveys were aimed at:

- Port Authorities
- Safety national authorities

After a previously validated questionnaire, an inventory of European port authorities and national safety authorities were selected to send the questionnaire and receive feedback from them. In total 65 surveys were sent, of which 42 to 23 Port Authorities and National Authorities were encompassed.

Some of the conclusions from the survey were:

- Existence of different plans.
- Description of a variety of potential accidents in each of the schemes such as:
  - Oil spills
  - Fire in ground installations and ships
  - Nuclear emergency
Earthquakes
- Security risks, etc.

Apart from survey analysis, a number of guides or manuals on maritime safety, emergency preparedness at ports and marine oil pollution were reviewed.

### 6.3.1.2 Pilot exercise on mass evacuation in ports definition

This sub-activity was aimed at defining a practical scenario to demonstrate some improvements in the mass evacuation of a vessel in a port.

The vast majority of merchant ships whose crewmembers are regarded as ranging from 7 to 25 members, handle a high concentration of people on board a ship in the category of highly occupied (cruise, ro-pax and ro-ro) vessels may range from 400 to 6,000 people. These high numbers of people confined in a small and limited space mandate that all port emergency plans available specify procedures to deal with any emergency on board when a vessel of this type is in a port or in its vicinity. Other important aspect to be considered, if the ship is abandoned in the harbour, is that the safety and protection devices must be activated.

This section of the activity 4 of MONALISA 2.0 project has defined the design and selection of all necessary aspects to carry out the exercise that took place in Valencia on 15 June 2015. As regards additional aspects of establishing the parameters for mass evacuation in a port, this chapter has considered to be used as a guide or reference example so that it can be applied in ports in which large passenger ships call or are received.

### 6.3.1.3 Analysis of the results from the pilot exercise on mass evacuation in ports

While it is customary that the emergency plan of a port considers the possibility of responding to maritime accidents or others arising produced on board vessels (collisions, fire, etc.) as well as the possible evacuation of them, it is highly recommended that the set of actions relating to such evacuation be treated individually and specifically whether evacuation occurs on a passenger ship (ferry or cruise).

After the planning and implementation of pilot mass evacuation of the passage on the ro-pax ship "JUAN J. SISTER" held in the Port of Valencia last day June 15, 2015, and which was included in the SAREX 25-15 exercise performed jointly between the Spanish Maritime Safety and Rescue Agency (SASEMAR) and the Port Authority of Valencia, this plan will be included in the next revision of the Emergency Plan of the Port of Valencia (scheduled in December 2015), as response actions in case of a real occurrence of a contingency involving mass evacuation of a passenger ship.
That set of specific actions to respond to a mass evacuation, can serve both if evacuation occurs as a result of an accident involving safety (safety) or if it occurs as a result of a need related to the protection (security): threat of attack, etc. It should be noted that from mass evacuation in a passenger ship may reach a magnitude of several hundred people, or even a few thousand. Finally, the conclusions of the exercise described in the deliverable 4.1.3 include the following aspects:

- Obtaining the passenger and crew lists.
- Enumeration and identification of passengers and crew evacuated.
- Search for possible missing passengers and crew after counting or identification.
- Accommodation of passengers hospitalised, and psychological care as required.
- Information to the media about the event and its consequences.
- Information to relatives of the passengers, and psychological care as required.
- Example list of possible decisions and actions to be taken in the event of a mass evacuation of a passenger ship in a port.

### 6.3.2 Safety in Coastal Areas

Reference documents used in this section are: D4.2.1, D4.2.2, D4.2.3, D4.2.4, D4.2.5, D4.2.6. This sub-activity is completed by three main tools and strategies simulated and evaluated as follows:

#### 6.3.2.1 Scenario definition for a pilot exercise involving a mass search and rescue operation at sea

MONALISA 2.0 exercises are conducted in order to evaluate the organisation’s capability to execute one or more portions of its response plans within the project context and beyond. Exercises can be used to provide individual training and improve the emergency management system. Reasons to perform MONALISA 2.0 exercises include:

- Testing and evaluating plans, policies, and procedures.
- Revealing planning weaknesses and resource gaps.
- Improving individual performance and organisational coordination and communications.
- Training personnel and clarifying roles and responsibilities.
- Gaining program recognition.
- Satisfy regulatory requirements.
• Evaluating MONALISA 2.0 support tools – developed under Activity 4, Operational Safety – to improve mass rescue operations (MROs).

This chapter offers the scenario definition in order to perform an exercise based on the response to a MRO and resolve problems identified already and arising during the execution phase. It was aimed to be a guide to understand the main objectives of the pilot MRO Exercise, MONALISA 2.0 SAREX 2515. It was not an audit and cannot establish the best strategy for MRO as it is one challenge that can only be addressed through continuous work and international cooperation within the relevant IMO body.

Several Small Scale Exercises and a Tabletop Exercise have been planned before the full SCALE MRO Pilot Exercise to prepare equipment and staff individually to the full-scale scenario. The tabletop has been designed for the examination of operational plans, problem identification, and in-depth problem solving; it facilitated a group analysis of an emergency situation in an informal, stress-free environment. The most relevant Spanish government agencies involved in a real MRO were invited to assist.

In parallel to the tabletop exercise a functional exercise with the use of simulators has been conducted, this interactive exercise tested the capability of all the organisations involved in maritime emergencies to respond to a simulated event. The tabletop and simulation exercise took place in the Jovellanos training centre in October 2014, focusing on the coordination of multiple functions and organisations. It strived for realism, short of actual deployment of equipment and staff.

Finally in June 2015, a full-scale defined MRO exercise was to be performed. This was expected to be a simulated emergency event, as close to reality as possible. It was designed to involve all emergency response facilities and the full deployment of technical, material and human resources.

During MONALISA 2.0 SAREX, a large-scale exercise – a passenger ship – was defined to be simulated, transporting around 400 people on board, a fire is to break out and after an assessment of the situation, the passengers would have been evacuated and the efforts expected to be provided as required. Several operational areas had to be deployed in the full-scale exercise in order to coordinate information, analysis and action plans at organisational levels. Moreover as the main goal of the project, the Full Scale Exercise had to provide a test-bed, where the activity of 4 MONALISA 2.0 partners shall test the innovative technologies and the training courses developed in advance within the activity. The human resources and relevant training for all who may be involved are key factors in this context.

6.3.2.2 Simulation of the manoeuvring/recovery of a damaged ship

Once the scenario for Maritime Search and Rescue exercise was defined, and after having analysed the simulation of a case study on manoeuvring/recovering of damaged ships, efforts focused on performing different simulations with SeaFEM, for adjusting the
model and evaluating the towing operations under certain conditions. The simulations’ configurations are all based upon the same data used for the case study and the SAREX exercise. It is important to note that available information regarding tugboat operations has been greatly improved after the Activities in Valencia.

The main goal of this sub-activity, which in this case can also be considered an achievement, was to be able to create computer simulation series of towing operations. These simulations eventually could be used in the future for assessing the feasibility of certain transport towing operations.

One of the main achievements was to be able to perform analyses, which included not only multi-bodies (both ships’ hulls), wave distributions and cable dynamics, but could also be also could be performed including a constant current speed to simulate the tugboat’s advancing speed. Another important achievement for this period was to include drift forces in convective analyses (analyses including current speeds). Also, other external forces corresponding to viscous damping forces, were included.

Among other results, these simulations can provide:

- Time evolution graphs of tension and displacements of the towing line.
- Damaged ship and tugboat dynamic response during towing operations.
- Realistic visualisation of the physical process, including towing line, tugboat and damaged ship responses, and free surface evolution.

Therefore, these simulations could eventually help to predict potential risks in rescue operations under different dangerous conditions: sea states, wind, or damage conditions (heeling, trim and sink) of the recovered ship. Also, they could be the basis for a quick, non-destructive testing procedure for towing lines.

![Figure xx. Contour fill of tension and vertical displacement of the towing line at a certain time step during one of the simulations](image-url)
Figure xx. Position of the ships at a certain time step during one of the simulations

Figure xx. Transversal forces evolution on towing line, obtained from SeaFEM simulations

Figure xx. Sway motion time history for Fortuny, obtained from SeaFEM simulations
6.3.2.3 Pilot action for the life rafts’ recovery system

The OLRS is a system capable of recovering life rafts and MOB afloat in the water, and place them safely on board the rescue ship, in a very short time, which is particularly advantageous in bad weather and cold-water conditions, and minimises the risk to people during the recovery operation.

This is in contrast to the usual SOLAS procedures that involve launching a rescue boat, with the added risk to rescuers inherent in launch and recovery operations, and the greater risk of hypothermia to any man overboard.

The OLRS system has the capacity to extend the boom and recovery hook towards castaways or the life-raft, so the rescue vessel in which the equipment is installed does not have to be too close to them, thus avoiding jeopardizing the entire operation. After an in-depth study of the usual methods of rescue, and existing problems during such operations, the specific technical features that the OLRS system must meet have been defined:

- Low load at long outreach
- Low load at long outreach allows the approach of a suspended riding rescuer, or a MOR with two rescuers on board, towards the survivors or the system and also permits a hook hanging from the crane’s boom near the life raft or survivor and away from the rescue ship.
- Thus, it is possible to minimise the risk due to the proximity of survivors to the vessel, and the speed of rescue of the life rafts is maximised, since – instead of recovering persons aboard the life raft from the rescue boat, picking up 4 people at a time – the whole raft is recovered at one once.
- **High load at short outreach**
  - High load at short outreach permits the hoisting of the entire “launchable” life raft (with all people on-board) and place it on the deck of the rescue vessel. Thanks to this, the risk to rescuers is minimised, because they will not have to make the transfer operation from the life raft to the rescue boat, considerably reducing the risk of collisions and rescuers falling overboard due to bad weather and sea conditions.

- **Constant tension and quick response**
  - It will also be necessary for the system to have the capacity to maintain constant tension both while the MOR recovers the survivors, and while the life raft is being towed/pulled from the point of capture towards the rescue ship. A quick response of the system is needed and also a release/retrieval speed of up to 2m/sec, in order to avoid sudden pull stresses on the wire and also to maintain control at all times.
  
  - A pay out device for the wire is needed when there is no load suspended (and no counterweight).
  
  - The system must be able to release the wire without a suspended load, avoiding the use of counterweight, so people aboard life rafts will be able to take the hook and attach it to the life raft. Wire and hook must have a minimum weight and the hook must also be manageable, padded and ergonomic, to avoid dangerous blows and to facilitate the operation in a chaos situation in the life raft amid severe sea conditions.

Once the rescue operations procedures have been analysed and the main requirements that OLRS system should fulfil have been established (for more details on OLRS technical requirements please go to D4.2.4 “Requirement specifications for on-board life raft recovery systems”), various simulations amid different sea state conditions have been developed in order to gain familiarity with OLRS behaviour in real conditions. These simulations have been developed as the first stage of the system validation.
6.3.2.3.1 Simulation assumptions

In order to develop the simulations, the rescue vessel “SAR Mesana” (BS-34) has been taken as a reference. This vessel belongs to the Spanish Maritime Safety and Rescue Agency (SASEMAR), the body responsible in Spain, for maritime search and rescue services, prevention and combat marine pollution and supervise maritime traffic control.

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Once the vessels have been selected to perform the OLRS system simulations, they have been subjected to all the boundary conditions: boom length (up to 12 meters), boom position (two cases to be studied, oriented towards the side of the ship and oriented to the aft of it), three Sea State/Beaufort Conditions (Beaufort 4, Beaufort 6 and Beaufort 8)
Within these boundary conditions and assuming the OLRS system was installed on-board the vessel Sar Mesana, the variables to be measured were established as follows: the vertical component of velocity and maximum acceleration.

In order to develop these simulations, SeaFem software has been used. SeaFem is a suite of tools for the computational analysis of the effect of waves, wind and currents on naval and offshore structures, as well as for manoeuvring studies. This software has been developed in collaboration with the International Center for Numerical Methods in Engineering, and is completely integrated in the comprehensive simulation environment. Tdyn was developed by Compass.

With the simulations of OLRS system, the final objective was to obtain all the necessary pressure and speed inputs in the hydraulic system, winch and spooling of wire device in order to design it. These inputs were, for the two boom positions mentioned, above the values of the vertical components of speed and maximum accelerations.

6.3.2.3.2 Simulation Data and Pilot Tests

As noted above, all necessary simulations have been performed in collaboration with CIMNE (International Center for Numerical Methods in Engineering) and Compass (Compass Ingeniería y Sistemas, SA).

Firstly, all the required data for OLRS and Sar Mesana were introduced. Then, the natural results of an analysis of RAOs (Response Amplitude Operator) by SeaFEM were obtained. That is, the response of the vessel (meaning the movement of its centre of gravity). To get this information, the hypothesis is that of a sea coming forward (Odeg). Then the response of the hull in a defined range of frequencies (periods), for a dimensionless amplitude was analysed. In this case it was analysed for a range of frequencies between 4 seconds and about 14 seconds and it has been obtained a result for the six degrees of freedom of the vessel (Surge, Sway, Heave, Roll, Pitch and Yaw).

Once the simulations were completed, and the inputs to the prototype design defined, the design drawings were developed. Then, all required components were manufactured and the prototype assembled and tested.

Pilot tests have been performed at SASEMAR’s facilities at the Jovellanos Training Centre in Gijon (northern Spain) in June 2015. These pilot tests were developed at Beaufort 4 equivalent conditions in a swimming pool with waves of 1.5m of Hs (Significant Wave Height) and swinging the boom of the crane at the same time.
6.3.2.4 **Analysis of results on the massive SAR operation in coastal area from the exercise performed**

The SAREX MONALISA 25-15 took place between the 14th and the 16th of June 2015. 50 organisations, and around 700 people, participated in the exercise and this chapter is aimed at providing an analysis of the actions that were taken. It also explains the objectives that were achieved, the logistics of the exercise and the lessons learned. In summary, this chapter provides information regarding the timeline of the exercise, the operational areas and resources deployed, the showroom of innovation technologies tested, the exhibition, the event organisation and the final debriefing.

The exercise illustrates how training and preparedness can boost the efficiency with regards to MRO incidents. The exercise demonstrated the interoperability improvements among SAR services, passenger ship crew, VTMIS and Mission Control Centres staff and other relevant actors during a massive crisis scenario, supported by the use of several technologies integrated for the first time.

The main functional mission areas in the first part of the exercise were Offshore Mass Rescue Operations MRO and Cruise Vessel Emergency Towing Operations, ETO. The functional areas of discussion were:

- Notification
- SAR units’ response, organisation and allocation
- Medical coordination
- Port coordination
- Effectiveness of technologies
• Hosting to helicopter
• Damage control
• Firefighting

The main objectives of the achieved exercise achieved were to:

• Demonstrate the capability to initiate public warning procedures at the EOC, including activation of the Emergency Alert System.
• Demonstrate the capability of the local EOC to coordinate the comprehensive response actions.
• Demonstrate the capability of management to conduct and coordinate an evacuation from a passenger ship.
• Demonstrate the capacity of the responsible organisation to identify shelters and mass care facilities for immediate use.
• Demonstrate the collection and dissemination of information to the public during emergency operations.
• Demonstrate the capability to conduct rapid situational assessment.
• Demonstrate the ability to identify immediate supplemental medical assistance to meet the health and medical needs of disaster victims.
• Demonstrate procedures for tracking assets and resources committed to response operations.
• Demonstrate the ability to prioritise and use jurisdictional resources and assets for maximum effectiveness during response operations.
• Determine the procedures for requesting assistance from higher levels of government.

6.3.3 Risk Assessment

Reference documents used in this section are: D4.3.1, D4.3.2, D4.3.3, D4.3.4. This sub-activity is completed by two main tools and strategies simulated and evaluated as follows:

6.3.3.1 Extensive risk assessment in ports and coastal areas

Operational Safety represents a key factor in demonstrating the results of the MONALISA 2.0 Project. This is a key activity as it has merged and properly adapted technologies, skills and knowledge developed throughout the progress of the project progress and will meet the expected objectives. This activity was also crucial because it applied different infrastructures (material, human and technological) through demonstrative actions applying the technical results of tasks related with the possible scenarios, risk
assessment, information technologies, SAR resources, port facilities, risk management and training.

Particularly, sub-activity 4.3 has enabled field-level risk analysis to support risk management decisions at all levels: ship, port and coast. The objective was to provide support and tactical decisions by means of intelligent tools and decision-making systems at the field level by enabling users to consider the full spectrum of potential risks primarily in maritime and port safety.

This chapter comprises an extensive risk assessment evaluation focused on port-logistic scenarios and environments. Ports are considered as strategic and critical infrastructures where huge amount of goods (including dangerous cargoes) are transferred from vessels to the hinterland and vice-versa using intermodal services in a complex, fast and non-stopping logistics chain. European economy and competitiveness strongly depend on the efficiency and safety of European ports. For these reasons, risk management and evaluation become a key area of innovation and improvement due to the fast and continuous transformation of ports and of the whole supply chain in Europe and worldwide.

The risk evaluation study in this chapter has been developed following a specific methodology that quantifies the potential risk impact of a wide taxonomy of undesired events that may result in significant incidents or accidents at ports. In this sense, a classification of three different interfaces (maritime, maritime-land and land interfaces) within the port area has been defined, taking into account the particular nature of the infrastructure, equipment, processes and activities which take place in each of these scenarios. This classification helps to segment and better understand the different risk typologies present in a complex port environment as well as their potential impact and consequences.

The conducted risk assessment has been documented and validated with dedicated interviews involving key expert personnel on safety, environment and security areas of port installations and cargo terminals. These experts have provided the day-by-day vision of a wide variety of port activities, thus contributing to filling the gap between the theoretical study and the real management and control of port-logistics activities. Section 2 of the deliverable 4.3.1 describes the methodology pursued to conduct the extensive risk assessment evaluation, whereas Section 3 provides a detailed taxonomy of risks associated with port activities. Finally, Section 4 provides a detailed risk evaluation based on the case of the Port of Valencia, which can be considered as a reference for risk prevention at the European level.
6.3.3.2 Bridge ICT support based on a dynamic predictor - Collision/conflict candidates and causation factors

IWRAP (IALA Waterway Risk Assessment Program) Mk2 is a statistical method that calculates ship-ship collision frequencies time independently. This means that you cannot study the effect of separating ships from each other in time, only in space. Therefore SSPA has, in the MONALISA 2.0 project, developed a geometric method to classify close situations between vessels, mainly intended for use on routes in the planning stage of a voyage. Since IWRAP is recommended by IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities), it is interesting to relate the method developed by SSPA to IWRAP.

In the previous MONALISA project it was concluded that there was a difference between the IWRAP calculation and the accident statistics. To find out a possible reason for the difference, it was suggested to study the influence of different causation factors on, among others, ship-ship collisions.

The scope of this chapter has been:

- To compare two different ways of defining close situations between vessels: collision candidates according to IWRAP and conflict candidates according to SSPA’s developed method.
- To compare calculations
- To study the effect of using alternative causation factors for IWRAP calculations of ship-ship collision frequencies.

Two different Kattegat cases are investigated; Case I: “All commercial traffic” and Case II: “Commercial transit traffic”. This gives that in all, four calculations are made. The calculations are based on AIS data of the sea traffic during August 2014. Comparing the potential collisions and the conflicts case by case gives that there are about twice as much conflicts as there are potential collisions (2.0 for Case I and 1.8 for Case II). At a first glance this might seem as a large difference but when considering the context for this investigation it might not. The two methods are of different nature and close situations between vessels are defined in two principally different ways. Nevertheless, it is interesting to see if the number of conflicts is of the same order of magnitude as the potential collisions. And the answer is yes, which means that there are possibilities to adjust SSPA’s conflict candidate method towards IWRAP.

6.3.3.2.1 Theory of SSPA’s conflict candidate methods

IWRAP is a statistical method that calculates collision frequencies time independently. This means that you cannot study the effect of separating ships from each other in time, only in space. Since the route optimization software developed in the present MonaLisa 2.0 project includes traffic coordination with separation both in time and space in order to achieve green and safe routes, a risk assessment tool that also copes with the time separation aspect is needed. Causation factors are complicated to choose properly and their effect on the calculated result is significant (see also chapter 5). One way of dealing
with this is to study the collision candidates instead. The hypothesis is that if the number of collision candidates decreases, also the collision frequency will do. A prerequisite for this is that the causation factors are assumed to be constant when the collision candidates vary.

IWRAP calculations of geometric collision candidates are based on the width of the vessels. For crossing, merging, and bend collisions also the length of the vessels is used. SSPA’s method of calculating collision candidates is mainly based on safety ellipses around the vessels. In order to make a distinction between IWRAP’s candidates based on the ships’ dimensions and SSPA’s mainly based on the ships’ safety ellipses, the candidates in SSPA’s method are denoted conflict candidates. Below a short description of SSPA’s conflict candidate method. More information on the method is to be found in the report SSPA Route Optimizer and Conflict Solver by Holm (2015).

SSPA has, in the MonaLisa 2.0 project, developed a geometric method to classify close situations between vessels, mainly intended for use on routes in the planning stage of a voyage. Two vessels that fulfil the definition are called “conflict candidates”. Conflict candidates are defined as two vessels where:

A. Their safety ellipses overlap, both spatially and in time, while each vessel travels on its route leg.

B. Their ellipses, constructed from the length and beam of each vessel, overlap, both spatially and in time, while each vessel travels on the prolonged part of its route leg.

Ship domains around the vessels have been used in marine traffic studies for a long time and the concept has undergone continuous development since the 1970’s, see e.g. Fujii and Tanaka (1971), Goodwin (1975), Coldwell (1983), Jingsong et al (1993), Pietrzykowski and Uriasz (2009), and Hansen et al (2013). Different shapes and sizes of ship domains are discussed based on ship observations in the early days and AIS data nowadays. In this study we use a safety ellipse with the total size 4L in the longitudinal axis and 1.6L in the transverse axis, where L is the ship length according to AIS data. This is similar to the proposed size of the measured comfort zone made by Hansen et al (2013), although the length of each axis is divided by two since we measure ellipse-ellipse interaction whereas Hansen et al measured ellipse-ship interaction.

The prolonged part of the route leg is labelled FTA segment, an abbreviation of “Failure to Take Action”. The FTA segment adds room for error at each waypoint, i.e. the vessel might for any reason continue with the same speed and course on the FTA segment. The length of the FTA segment is set to 600 seconds (10 minutes), but not longer than the leg itself. On the FTA segment, an ellipse constructed from the length and beam of each vessel (approximately the vessel contours) are used.
6.3.3.2.2 Conclusions on the SPPA’s method

Comparing the potential collisions and the conflicts case by case gives that there are about twice as much conflicts as there are potential collisions (2.0 for Case I and 1.8 for Case II). At a first glance this might seem as a large difference but when considering the context for this investigation it might not. The two methods are of different nature and close situations between vessels are defined in two principally different ways. Nevertheless, it is interesting to see if the number of conflicts is of the same order of magnitude as the potential collisions. And the answer is yes, which means that there are possibilities to adjust SSPA’s conflict candidate method towards IWRAP.

On the other hand, maybe that IWRAP should be adjusted towards SSPA’s conflict candidate method instead. Twice as much potential collisions would make the calculated collision frequencies more similar to the accident statistics presented in the previous MONALISA project. This would be a complement to using alternative causation factors for deviating collision frequencies. This is suggested for future studies.

In the present chapter, the effect of using alternative causation factors based on accident statistics showed expected results, i.e. the IWRAP calculation gave approximately the same total collision frequency as the accident statistics. However, the accident statistics are limited and to modify the five causation factors for collisions individually is not possible. To come to terms with this, a more detailed method based on Bayesian networks for estimating causation factors to be used in IWRAP is presented by Ravn (2012).

Returning to the comparison between the potential collisions and the conflicts, one can see that the most exposed route areas are pretty much the same for the calculations made with the two different methods. This is clear when comparing figure 7 and 10 with figure 11 and 12, respectively.

Case I: “All commercial traffic” has a far more complex traffic situation than Case II: “Commercial transit traffic”. The number of potential collisions for Case I is about 5.5 times higher than for Case II. Corresponding figure for the number of conflicts is about 6.0. The increase is illustrated in the figure below. Accordingly, both methods show approximately the same increase, i.e. they behave similar when it comes to relative measurements. Relative difference between alternative scenarios are often studied in risk analysis. The above gives a good basis for using SSPA’s conflict candidate method when constructing safer routes based on traffic coordination with separation both in time and space. For examples of such separations, see Holm (2015). However, some adjustments might be needed with respect to the absolute values.
6.3.3.2.3 Early warning of grounding

Warning systems have a number of difficult and sometimes contradictory aspects to take into consideration, such as how warnings should be presented to the user and when to warn. Too many warnings and there is a risk that users lose confidence in the system, too few and there might not be enough time to react before the warning turns into a critical error.

Confidence in the reliability of an alarm appears to be a function of both people’s experience with it and the presence of other concurrent alarms, which people apparently take as confirming or opposing evidence of its validity.

The problem of irrelevant alarms is a difficult aspect when designing a system. The degree to which a system produces false warnings must be weighed against the likelihood that it will have missed warnings, i.e. situations in which a real problem exists, but for which the system does not produce an alarm. Alarms will not be effective if they can be easily misinterpreted.

6.3.4 Risk Management Guidelines

Reference documents used in this section are: D4.4.1, D4.4.2, D4.4.3, D4.4.4. This sub-activity is completed by four main strategies implemented and evaluated as follows:
6.3.4.1 Maritime accidents typology

The chapter contains a detailed analysis on maritime accidents based on a database carried out within the framework of the MONALISA 2.0 project. It contains a summary of the most remarkable maritime accidents throughout history based on the database elaborated with maritime accidents from 1900 to 2013 (see annex to the deliverable 4.4.1).

It also intends to help database users to gain the best from the tool, as well as making an analysis of some remarkable conclusions received from the database, such as location of accidents by year. A selection of remarkable accidents is carried out, pointing out some of the details of the accident. That selection is divided into three parts:

a. Passenger ship casualties.
b. Boats with immigrants on-board.
c. Non-passenger ship casualties.

The study carried out and the subsequent analysis of the database of marine accidents was conducted in terms of the type of casualty consequences: loss of lives, pollution, serious injuries, total loss of vessel, ship rendered unfit to proceed or ship remains fit to proceed; the causes: less serious, serious or very serious; the type of ship: cargo ship, fishing vessel, passenger ship, service ship, inland waterway vessel, recreational craft, navy ship, submersible, wig, others or unknown. The type of load among these various ships has also been identified in terms of cargo ships, type of fishing vessel and so forth, so that we have all possible information available.

There are also data covering the date of the sinking or accident, coordinates of the location where it happened, elaborate investigation reports and their dates, deadweight at the time of the accident, analysis made, and IMO identification numbers of the vessels.

To elaborate this database, the information has been extracted from the Global Integrated Shipping Information System (GISIS) of the International Maritime Organization (IMO). The main conclusion of this chapter on maritime accidents records is that most accidents could have been prevented, or at least their consequences reduced, if adequate protocols had been observed accordingly.

Analysing past fatal errors is the first step to avoiding them in the future, thereby attaining the objective of minimising maritime accidents and their consequences.

6.3.4.2 Analysis of the procedures for the application of existing reference documents

This task was aimed to facilitate the Member States in identifying the legal provisions such as United Nations and IMO Conventions and Resolutions, and European Guidelines and Standards that could be applied in scenarios where accidents may occur.
A rapid and easy query of these Standards could initially help to guide the course of action of the State Member in demanding the accountability of ship-owners and crew or the loader, as applicable, for the possible loss of lives, the damage the accident could cause to the health of people on board and the coastal population, the damage it may cause to the territorial sea and the exclusive economic zone of the Member State, and the possible pollution of the marine, terrestrial or atmospheric environment.

Based on the previous, this task is orientated to identify the tools that International Standards offer to the State Member, which complement those (to be) included in deliverable 4.4.4. “Procedures after the accident”, to help identify and limit the liability of the casualties.

This document contains general information about the obligations concerning the crew and state of the vessel, occasionally providing illustrative examples of casualties for which these obligations were not fulfilled, resulting in very negatively serious consequences. In addition, lists of the relevant directives, standards, regulations, conventions, etc., have been included regarding different aspects of them, such as inspection and survey, type of vessel, marine equipment, obligations of the parties, pollution and others. Finally, an Annex is attached to this chapter in its deliverable D4.4.2, where the main Conventions and Agreements contained in this compilation are developed in terms of what is noted in these pages.

### 6.3.4.3 Proposal on protocols in case of accidents

This chapter as part of sub-activity 4.4. "Risk Management guidelines", continues in the same line of the previous chapters, “Study of different maritime accidents occurred” and “Application of existing reference documents”, this chapter also includes legislation not only related to emergency and contingency plans but also to other activities derived from these plans, such as tracking, communications, etc.

The related deliverable is divided into two main parts. The first part is “Basis of the draft proposal of protocols in case of accident”, with several sections regarding the actions to be taken in case of accident, such as the accident report, the type of communication to be used in the reporting, the information to be transmitted in such communication and actions taken to maintain a contingency plan and keep the persons involved trained and updated; while the second main part consists of a draft of proposal of protocols in the event of accidents.

To elaborate a guide on the protocols to apply in case of accidents, there is some important information that must be complied about the vessel, the coast likely affected, the people on board and the incident itself. This document collates legislation in reference to reporting, information, communications and contingency plans, in an effort to elaborate an action protocol with legal basis, taking into account the existing protocols and contingency plans.
The first part of this report refers to the notification of the accident, compiling legislation in this regard such as IMO Resolutions, SOLAS Convention and MARPOL Protocol. The articles compiled for this section aim to establish a basis for systems for reporting accidents, the cases in which reporting is necessary and the procedures to follow. Linked directly with the notification of the accident is the communication of such a report. Communications can be classified in terms of ship/shore and vice versa, ship-to-ship or on-board communications, and shall be addressed to the Maritime Rescue Coordination Centre or the Maritime Assistance Service, depending on the circumstances of the incident. The communications shall be clear by using the standardised language shown in section 3.1. Standard Marine Communication Phrases.

These communications shall carry definitive information about what is being reported so that the rescue services to be activated are able to take the relevant actions to resolve the situation. Section 4, the Information, shows a list of the minimum information needed for this purpose. It is important that agents involved in rescue operations are able to collate all the data indicated for the correct drawing up of the protocols.

Once these parameters have been established, a guide for protocols to observe in case of accidents is elaborated. First, the legal basis in which the proposal is supported is exposed, including the Conventions, IMO Resolutions and Directives used for this purpose. Having described the legislation relevant to this objective, the action protocols to take in case of the Alert and Distress Phase are developed.

The alert phase is described taking into account the possible consequences it might cause, defining the role of the Alert Phase Manager and the tasks he should carry out in case an Alert Phase is declared. It is also describes the distress phase, including the figure Distress Phase Manager, and each step that has to be observed in case it is declared. The steps to follow in the Distress Phase are more complex than the steps involved in the alert phase. The situation first requires an identification of the danger causing the distress, carried out through the assessment of the situation, determination of the dangers and identification of liabilities and guarantees. Once this identification has been completed, the steps to follow shall be the requested potential assistance, activation of the relevant contingency plans, the need of an assessment and intervention team, actions required in case of a situation of imminent danger and the announcement to the Advisory Committee.

Having determined and carried out every action noted above, the person responsible shall use the decision-making aid tools in order to make the requisite decision to solve the distress situation. These tools consist of tracking systems to keep the vessel’s situation under surveillance, such as the Long-range Identification and tracking, the Automatic Identification System, the SafeSeaNet, CleanSeaNet and Thetis. Among these tools, there is also an inventory of documents, information and actions to take that can be used to assist decision-making. In addition to these tools, there are criteria that have to be considered in terms of decision-making. These criteria consist of the various choices the
responsible person or agents involved in the rescue operations can take, as well as the priority levels of each of the possible consequences of the accident or of the operations performed. There are also several parameters related to the vessel, meteorological conditions, existence of legislation relating to the incident, etc., that have to be taken into account at the decision-making time.

Once the danger has been identified and the criteria for decision-making established, it is possible to adopt the measures to solve the distress situation. These measures are either to navigate the vessel to a place of refuge or to distance it, continue the journey to its original destination or keep the vessel in the same position as previously to being accepted in a place of refuge, continue the journey or to distance it. Based on legal grounds, this document purports to establish the general protocols to follow in each of these two cases, having also common features such as the communication and implementation of measures, the monitoring of the evolution of the situation, registering the actions taken, establishing an emergency fund, communications with the ship, information to the public and the media, completion and final report, and the implementation and maintenance of the plan.

As final point and as a complement to this chapter, an inventory of the legislation relevant to the emergency plans on board is shown. Using diagrams and charts, this legislation shows the steps to follow when a contingency plan has to be activated and the factors that affect the required actions in each case.

In case of ship spillage, toxic gas emissions, cargo fire, explosions or release of pollutants to the atmosphere, the manager of the accident shall count on consulting the manufacturer of such products so that he can be advised about a superior approach to coping with the conditions that caused the accident and minimise the negative effects on people and the environment.

This sub-activity 4.4 does not include the operational protocols because these are the exclusive competency of each State Member, which has available the specific governmental infrastructure and means for salvage and rescue. The State itself shall have the operational protocols available, based on the organisations or departments with competency regarding maritime issues related to accidents and its resources and also based on the approved Conventions.

It should be pointed out that the European Union has available its own safety/rescue resources for the States.

6.3.4.4 Procedures proposed for post-accident action

The post-accident scenario comes with a new and complex forecast, ranked in different levels in which the State, in one way or another, intervenes along with other actors involved, depending on the type of accident and its resulting consequences.
On the one hand, the population is afraid that their health and way of life may be in danger and upset about the fact that the landscape that has been intact over generations becomes hostile in a short time.

On the other hand, maritime insurance companies take part on the post-accident scenario, as well as insurance companies or P&I Clubs for civil liability on the damage caused by hydrocarbons, dangerous products, fuel and nuclear substances. Complementary Funds as the International Fund for Compensation for Oil Pollution Damage (IOPCF) take action as well.

Safe and rescue private and public companies also intervene, as well as their own compensations for taking part in the accident. It is not strange that shipyards, repairing shops, equipment and installations suppliers and classification societies take part in this scenario too.

In this complex perspective, the State takes usually part in each scenario, although its main role is the human life saving, both the people on board and the coastal population, and protecting the coast and waters from the harmful effects of the accident. Many cases exist in which the parts involved disagree, causing cross-arbitrations and lawsuits.

As an example, the case of the vessel “PRESTIGE” brought cross-claims between the Competent Authority, the Ship-owners Companies, victims, ecological organisations and Spanish politic parties on crimes against natural resources and the environment and reckless damage crimes. In this way, the criminal conviction requested by the parties of the law suit connected with other economic sanctions to which, depending on the case, the civil responsible subsidiary of the Competent Authority, the Captain and two indicted officers should respond.

Furthermore claims were brought by the Spanish State against the Classification Society of the vessel and the Director of the IOPCF was requested to make a claim as well against the Classification Society.

The first function that the internal arrangements and the International Organisations commend to the State in vessel accidents episodes is very clear: Save human lives and try to keep the population safe from the consequences the accident might bring against their health.

The second function involves combatting marine pollution, taking into account the preservation of populations and the conservation of the fragile marine ecosystem and biodiversity.

As explained in the previous chapters, the ability of the States to intervene in maritime accident processes is regulated by International Conventions, as UNCLOS, the
International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties and European Regulations, such as the Directive 2002/59, amended by Directives 2009/17 and 2011/15.

The UNCLOS Convention, in its Article 117 et seq., imposes an obligation on States to adopt measures for the conservation of the living resources in the high seas relating to the population.

International laws system are complemented by internal regulations constituting a tool for the State to meet requirements and complaints about liability for accidents and the defence against accidents that may affect the population, its waters or its coasts. After or during an accident, and depending on the resulting circumstances, the first action to be taken by the State through its department for Civil Protection shall focus on the victims. In the event that, in a political context, social, economic or financial measures are taken, the responsible ministerial departments shall participate in the actions. Simultaneously, the State shall activate the available resources for its own use and on behalf of third parties’ that voluntarily, or in virtue of bilateral or multilateral agreements, offer to preserve the life and health of populations, minimise the environmental effects, achieve its recovery and combat marine pollution.

The second action to be taken is the preparation of an adequate strategy to offer superior support in demanding rights, requiring that the state workers who – directly or supported by specialist legal firms are forwarding claims and arbitration demands – have a good knowledge of maritime legislation and the technical preparation that allows the State, in accordance with appropriate laws, to present any type of claims at court, arbitration assemblies, or to insurance companies and compensation funds, etc., and to defend the State from the various claims that may be presented by other parties affected by State actions during the accident.

Taking into account that each accident is different, the common parameters for almost every accident that the State should analyse in order to compensate the affected population and the costs of the environment, marine ecosystem and coastal recovery are outlined in the following paragraphs.

These parameters refer not only to direct actions involving the population, waters and seabed cleaning, but also to those actions that could result in inconvenience when they are taken in order to demand the liability to which those responsible for damage should respond to in court. In this case, due to the magnitude of the international and local maritime regulations, a list of the Conventions, Resolutions, Directives and Regulations has been collated in order to facilitate the work of those acting on behalf of the State, identifying the specific articles considered for this purpose to this end, although not exhaustive, but which satisfy the rights of the States in case of maritime accidents. Following the results of this this chapter, additional tools for obtaining information, through the IMO or the European Union, on the vessel casualties have been included.
6.3.5 Safety Information Systems

Reference documents used in this section are: D4.5.1, D4.5.2, D4.5.3, D4.5.4. This sub-activity is completed by four main strategies implemented and evaluated as follows:

6.3.5.1 Information systems for safety management in ports

The safety and security of port facilities and their staff and personnel reduce risks to vessels using the port facilities. Physical security of buildings and access points to the port allows threats from persons and materials to be detected and neutralized before reaching sensitive areas. The burden of ship safety and security personnel is reduced by means of an effective threat detection system in the port area.

Port Safety is also a key point of Sea Traffic Management (STM) since if there is some kind of accident or incident in a harbour, it could affect all sea related traffic related and, of course, the safety of all passengers, seafarers and harbour workers. The International Maritime Organization (IMO) has a code of good practice for ports, which provides a framework for the development and implementation a port security strategy, including a Port Security Plan (PSP) and a Port Security Assessment (PSA).

Being able to access information on port safety in real time would improve STM, since it could react to an incident in a port to prevent additional risks and it could, for instance, reduce ship speeds to ensure they arrive later at that harbour or even change ship destinations to a nearby port.

Although the code of good practice is designed to promote a common approach to port security amongst Member States, the fact is that each port has its own security system that meets IMO requirements, but it has its own security information system. Valencia Port, as noted above, has its own Security Information Systems and they are briefly explained in the presentation in this chapter as a possible solution to integrating them into an external and general Safety Information System.

The Safety and Security (Safe Port) information system is a tool aimed at guaranteeing safety in the ports of Valencia, Sagunto and Gandía and its main objective is to offer safety and security solutions to the Port Authority of Valencia in close collaboration with the administrations responsible for police protection, civil protection, fire prevention, rescue operations and anti-pollution measures.

Port operations, services, maintenance and upkeep are all centralised to ensure improved coordination, which enables the Port Authority of Valencia to reduce accident rates to a minimum. The Emergency Control Centre (CCE) is the tool through which the Port Authority of Valencia undertakes this coordination. The CCE monitors port activities 24/7. Decisions that need to be made about safety issues and emergencies can be taken thanks to the information at the disposal of the Centre. In this sense, the main information systems used to prevent and combat risk are the Estrabon and Socaire systems, which
are detailed in the presentation in this section. For more information, refer to D4.5.1 as noted above.

6.3.5.2 Information systems to support SAR operations

This chapter focuses on several key areas related to information systems involved in maritime and port evacuation, and search and rescue operations, and how they may be integrated to optimise operations and decision-making processes during crises 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 in terms of operational safety aspects.

The chapter helps to understand that integrated information systems for safety management assist Administrations greatly in reducing failures or weak decision making, improving efficiency during the response to critical situations involving passengers, goods, vessels and port terminals, they also contribute to reducing safety management and response costs.

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

One of the main objectives of the MONALISA 2.0 project was to define an activity for comprehensive and integral safety management, which would cover the areas of the vessel, port and the emergency response operations at sea. This objective was clearly met with the support of advanced systems in information and communications technologies, facilitating the management processes and the exchange of relevant data to support decision-making and emergency management. Therefore, it raised the definition of an integration platform for information systems used in the management of safety and emergency response, to facilitate the response processes when facing critical situations on large passenger ships, and both at sea and in a port terminal. When a crisis team is called to attend an emergency at sea or a major magnitude accident in a port, the members of the team need considerable and precise information and data. The information displayed and centralised in a common interface will help to improve the work and decision-making processes for those experts.

The evaluation of the systems eventually found to be useful and optimal, and were in an adequate level of development, was carried out during MONALISA SAREX 25-15 implemented on 15 June 2015 in the Port of Valencia.
Each of the systems from SASEMAR has been optimised to respond to a massive emergency at sea or in coastal waters, according to the objective of the project, as described in 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. Emergency management can be more flexible by centralising information flows and communications, making it possible to monitor in real life the provision of resources and necessary means, supervising the rescue and care of those affected, managing the possible solutions in towing or manoeuvring the stricken vessel and finally, communicating the results of the operation regularly and efficiently.

The conclusions regarding the effectiveness of these systems and their integration are included in the D4.5.2 report.

**6.3.5.3 Implementation of Maritime/Hydrographical/Meteorological information systems**

Among the most important data required by seafarers is that relating to the weather and hydrography. One the one hand, meteorological observations from ships have been a major pillar supporting this modern science; on the other, hydrography supports safe navigation in coastal waters and in harbour approaches. At sea, automation on board merchant ships suffered for some decades, acting as a kind of obstruction that has
changed only in the initial decade of the 2000s towards a progressive assimilation of the technological advances offered in the market.

Electronic chart systems like ECDIS have improved the integration of hydrographical and navigation information in a single screen, combining fixed data with dynamic data coming from the AIS, information from the ship the ship itself is not also displayed alone but is combined with that of neighbouring vessels as well, improving safety and reducing collision risks in combination with RADAR.

Tools for automatic Route and Voyage planning from Port A to B via C can be integrated as a part of the ECDIS systems available in the market.

Optimising the schedule, with due consideration of the latest weather forecast (weather routing), using integrated environmental databases for tides and currents will allow the vessel to proceed along the route at the safest economic speed and arrive at its final destination on time.

Nevertheless, in SAR operations, the limitations of the units deployed require precise information about conditions at sea. Weather, and navigation combined with hydrography data, require real time access and reduced space to install a standard ECDIS equipment unit. In D.4.5.2, the MiniECDIS customised solution provided by SAINSEL has been developed to be adopted by the Spanish Maritime Safety Agency (SASEMAR) and installed in the small units.

This chapter refers to the results in providing an alternative information system served by the Internet to small vessels when they are sailing/operating in coastal waters. Some previous results in combining hydrographical/navigational/meteorological information have been applied to offer a complementary solution when sophisticated or advanced ECDIS is impossible to have on board, making access to information possible by means of portable devices like tablets, mobile phones or laptops.

From a technical point of view, an important step forward has been made, integrating in a single screen that displays all the specific navigational, geographical and meteorological information required by a user. However the system is far from being an officially approved SOLAS system. One important goal is to achieve approval from relevant organisations, such as the IHO, hydrographical organisations and stakeholders in order to optimise a commercial product useful for different types of end users.

6.3.5.4 Procedures for the integration of information systems

This chapter focuses on several key areas related to different procedures used to integrate the various information systems and their interoperability in maritime safety and how integration will optimise the process of decision support in many fields related to maritime environment, such as route calculation and route selection algorithms, and
critical decisions relating to emergencies on board or in ports. Integration may also lead to a reduction of hazardous operations, incidents and accidents and the best and optimum response to any emergency that may occur. Another related consequence should be a reduction in emissions by applying more reliable information when safety operations are performed so as the units may be optimised from an operational point of view. This chapter, developed during the MONALISA 2.0 project, includes information of previous deliverables in activities 4, D4.5.1, D4.5.2 and D4.5.3 to explain how the integration process has been done.

Maritime systems software architecture should encapsulate domain specific services offered on board and onshore, and also provide a framework that will allow current proprietary networks to be linked to the Maritime Open Reference System Architecture. This will enable a gradual shift towards services such as software components and, considering that a ship's lifetime can be in excess of 20 years, a platform that is future-proof. Maritime open reference systems architecture can serve as a base for the development of standards and, at the same time, support the integration and interoperability of software-dependent devices and systems. The Maritime Open Reference System Architecture should be made available for free to the vendors and/or innovators. Vendors and manufacturers will then be able to derive differentiating, highly innovative instances and implementations of the Reference Architecture, leading to reduced development and acquisition costs, and thereby contributing to higher levels of software component reuse, and consequently leading to a higher quality of maritime electronic systems, amongst other benefits.

With Reference Architecture in hand, various stakeholders will be able to increase the levels of reuse and reduce validation, verification and testing activities. Reference Architecture can be used to avoid re-work, re-validation and re-verification of architectures.

The purpose and main reason for having Reference Architecture in place is to guide the development of architectures for new systems as well as product families. Reference Architecture captures a lot of domain knowledge by analysing past architectures and initiatives and, based on the knowledge accumulated, formulates a reference skeleton architecture from which all future architectures in the domain can be derived.

Open system software Reference Architecture for the maritime industry should serve as a blueprint for the design and implementation of all software systems and their integration on board ships and related onshore maritime operations. The blueprint will tackle the non-functional properties by providing a platform upon which innovation and integration can take place. The open Reference Architecture approach ensures that end-users and other stakeholders are not locked into a proprietary technology or a single-vendor system, making it a future-proof solution. Open Reference Architecture fosters collaboration on low value-added among maritime electronic systems vendors and other stakeholders. Such an approach provides a collaboration platform on a shared domain-specific middleware.
Open Reference Architecture allows suppliers, regulators and other stakeholders to create and operate their own instances of Reference Architecture without giving away their real value-added differentiating portion. It creates an environment where open and proprietary software system solutions co-exist in concert.

Based on publicly available data solutions based on Open Reference Architectures, these deliver up to 80% cost savings compared to proprietary solutions. In the case of Maritime Open Reference System Architecture, similar cost savings can be envisaged for owners and operators in terms of Total Cost of Ownership for equipment manufacturers in development and maintenance costs, and for ship builders, land-based maritime traffic control centres in acquisition, integration and commissioning of maritime digital systems. One of the purposes of Reference Architecture is to steer and control the instant availability of solution architectures. Reference Architecture is a domain and an organisational asset as it:

- Provides a common language which can be understood by all stakeholders involved;
- Provides consistency in terms of the implementation technology used to solve challenges;
- Enables the verification and validation of solutions against the reference architecture;
- Encourages the adherence to common standards, patterns and specifications.

Benefits of Reference Architectures:

- Reference Architecture allows encapsulating an entire domain in a technologically independent manner. Industry members can use the Reference Architecture in order to generate custom architectures for a family of products, with the Reference Architecture used as the template; all specific architectures will be based on the same common core, enabling seamless integration and positive forward progress.
- Reference Architecture improves effectiveness as it:
  - Assists in reducing work duplication;
  - Provides guidance when designing new products;
  - Acts as a mechanism through which the software architect is able to validate and verify the architecture.
  - The particular specific technology of the Reference Architecture can be compared with the Reference Architecture for validity purposes;
  - It enables higher reuse levels;
• Greatly reduces the costs involved in designing and commercializing a software product;
• Reduces time-to-market for the system, as the technology specific architecture for the system can be quickly derived.

Open Reference Architecture allows interaction with COTS (off-the-shelf components), contributing to cost reduction, higher quality and interoperability of systems. Maritime Open Reference System Architecture should provide a set of best practices in domain-specific software engineering for the maritime industry. It should be technology-independent, allowing for both front-end as well as back-end independence, and therefore it should be a candidate to be considered as a European and potentially global standard. One possible implementation on-board is a maritime cloud, a hybrid cloud computing implementation with a private cloud on-board a vessel and a secure connection to the public/community cloud, based on a publish/subscribe model.

Such a platform-as-a-standard (PaaS) cloud implementation could provide a common standard platform for Sea Traffic Management and/or e-navigation service applications, as it does not dictate any specific solutions for each layer of PaaS. Due to the open source approach, it is a future-proof open standard that can benefit from community improvements on a continuous basis. Open solutions for PaaS layers make it also cost effective.

Envisaged benefits of the maritime cloud implementation include:
• Increased software system quality,
• Full interoperability,
• High reliability, redundancy, robustness and scalability,
• Flexibility and support for continuous technology refresh and rapid insertion.

As a hardware- and technology-independent domain-specific shared middleware, the maritime open system reference architecture approach lends itself nicely as an architectural base-layer for implementation of Sea Traffic Management and e-navigation solutions. It provides the platform on which services can be deployed, with applications running on top of it, be they proprietary, open or a mix thereof.

Based on the maritime open system reference architecture, each manufacturer of maritime electronic systems can develop their own proprietary or open source “family” system architecture containing a shared set of assets, and then design and engineer their own specific product or “family” of products to be installed on-board and on-shore, containing a mix of proprietary and open source components. Further in the development cycle, real life “field” feedback from product end-users shall be fed back in order to improve the system by defining constraints and opportunities as well as extracting
essentials to further improve the reference architecture itself. The middleware based on
the open maritime reference architecture can be deployed on each and any computing
platform with high reuse of components that can be easily removed and updated (future-proof).

The main features of the maritime open system reference architecture should include:

• Defined standard data types and interfaces
• Common language
• Verification and validation
• Abstraction from technologies
• Code generation
• UML profile
• View-based model to cater for various stakeholder needs
• Model-driven development
• Component-based
• Modularity
• Robustness.

Finally, the integration of different systems detailed in this chapter has been done
according to the specific systems that are related to this activity of the MONALISA 2.0
project and will need to be updated or modified if is needed to be used with different
information systems, as proposed at the beginning of the action. At the operational level,
integration has been demonstrated as being feasible, and cooperation and future agreements are required to maintain these solutions.

### 6.3.6 Training

Reference documents used in this section are: D4.6.1, D4.6.2, D4.6.3, D4.6.4, D4.6.5, D4.6.6 and the M12 report. This sub-activity is completed by six training strategies implemented and performed as follows:

**Figure xx. Definition of the six training courses within the common framework of operational safety**

#### 6.3.6.1 Training on SAR and Mass Rescue Operations (MRO)

The present subject covers SAR (Search and Rescue) and MRO (Mass Rescue Operations) and includes a training strategy in terms of the specific requirements of those involved in Search and Rescue operations, focusing on mass rescue and crowded passenger ships. The IMO model course and other training standards and requirements from IALA and ILO are considered. The use of e-learning innovations and practical activities in specialised centres like the Integral Maritime Safety Jovellanos Centre, Chalmers University and Valencia Port Foundation are also taken into account.

The training requirements for this subject are based on the IMO and ICAO IAMSAR Manual and on the IMO Model course 3.13, Maritime Search and Rescue Administration, as well as on the IMO Model course 3.15, SAR on Scene Coordinator, adapting the contents to mass evacuation and critical situations management on large passenger
ships. These requirements will define the training material in both components – theoretical and practical – including the evaluation strategy.

6.3.6.2 Training for massive evacuation in ports

This topic covers safety and mass evacuation operations and plans in ports and their passenger facilities, and includes a training strategy in terms of the requirements for those involved in the safety operations in ports that focus on mass and crowded emergencies in passenger terminals or within port waters. The IMO model and other training standards and requirements from IALA and ILO are also taken into account. The use of e-learning innovations and practical activities in specialised centres like the Integral Maritime Safety Jovellanos Centre, Chalmers University and Valencia Port Foundation are considered. The training requirements for this topic have been inspired by the experience acquired by port practice when dealing with emergencies in a port environment. Training requirements will be supported by reference IMO Model courses related to port safety as well as the various port contingency plans that ports should deploy in case of emergency. Mass evacuation in ports is based on a multi-disciplinary approach, as the reasons for mass evacuation can vary greatly and present varying emergency levels. Thus, the training action should focus on the identification of causes and proper management of emergency situations. Risk assessment will be a central part of the training program in the form of strategic methodology to identify critical risks that may require a mass evacuation within the port environment. The training concepts have been adapted to the contents of the mass evacuation and critical situations management in ports, passenger terminals or port waters. These requirements will define the training material in both components – theoretical and practical – including the evaluation strategy.

6.3.6.3 Training for emergency management on passenger ships

This topic covers safety management on board large passenger and cruise vessels, focusing on the human factor aspect, and includes a training strategy in terms of the requirements for the people involved in safety management, which focuses on mass and crowded emergencies on passenger ships. Special attention is paid to the ISM standard and other Human Factor Safety Management and Training regarding large passenger ships. The IMO model and other training standards and requirements from IALA and ILO are taken into account. The use of e-learning innovations and practical activities in specialised centres like the Integral Maritime Safety Jovellanos Centre, Chalmers and Valencia Port Foundation will be included. At the same time, the Universitat Politècnica de Catalunya must consider university knowledge transfer and educational strategies. The training requirements for this topic have been inspired by the IMO Model course 1.29 (Proficiency in crisis management and human behaviour training including passenger safety, cargo safety and hull integrity training), and adapting the contents to crisis management scenarios on passenger ships. These requirements will define the training material in both theoretical and practical components, including the evaluation strategy.
The standards of competence that have to be met by seafarers are defined in Part A of the STCW Code in the Standards of Training, Certification and Watch-keeping for Seafarers Convention as amended in 1995 and 2010. The IMO Model course 1.29 (Proficiency in crisis management and human behaviour training including passenger safety, cargo safety and hull integrity training) covers the competences to achieve those standards set out in Chapter V Section A-V/2 parts 3 and 4.1.4. The course covers the minimum standard of competence for masters, chief mates, chief engineers, second engineer officers and any person having responsibility for the safety of passengers in emergency situations.

6.3.6.4 Training for leadership and the human factor in crisis scenarios

This topic covers the leadership and team working skills required in crisis scenarios, as well as those that would help to avoid critical situations. Developing leadership skills will assist many other tasks in the MONALISA 2.0 project to succeed in real scenarios. The aspects considered are leadership, human factors, motivation, effective communication, conflict management, crisis management, task and workload management, sense-making, decision-making, intellectual stimulation, change adaptation, maritime sociology, multicultural crews, teambuilding, authentic leadership, leadership development and sustainable leadership practices.

The training requirements for this topic have been inspired by the IMO 1.39 Model Course Leadership and Teamworking (GlobalMET Ltd., 2014), The Human Element: a guide to human behaviour in the shipping industry (Gregory & Shanahan, 2010), The Handbook for Teaching Leadership (Snook, Nohria, & Khurana, 2012) and Leadership (Northouse, 2013), adapting the contents to mass evacuation and critical situations management in ports, passenger terminals or port waters. These requirements will define the training material in both components – theoretical and practical – including the evaluation strategy. Currently, the only mandatory non-technical skills requirements in the maritime domain are those provided by the International Maritime Organization at the STCW (Seafarers Training, Certification and Watch-keeping) Code 1978, with the 2010 amendments introduced for the first time, namely, Human Element, Leadership and Management training requirements.

IMO Model Course 1.39 has developed the leadership and team-working skills requirements for the operational level. There is still no IMO Model Course issued for the management level.

Tables A-II/1, A-III/1 and A-III/6 of this code specify the minimum standard of competence for controlling ship operations and care for persons on-board at the operational level. Tables A-II/2 and A-III/2 of this code specify the minimum standard of competence for controlling ship management and care for persons on board at the management level.
6.3.6.5 Training on STM-assisted on-scene SAR administrations

This topic covers the skills required for the people involved in various Maritime Safety Information systems deployed in the different components of Maritime Safety Management (on board ships, VTMIS, SAR and Safety in Ports), with due consideration of risk assessment tools. The IMO model and other training standards and requirements from IALA, ICAO, IAMSAR and ILO must also be taken into account. The use of e-learning innovations and practical activities in specialised centres like the Integral Maritime Safety Jovellanos Centre, the National Technical University of Athens NTUA, Chalmers University of Technology and Valencia Port Foundation will be included. The training requirements for this topic have been inspired on the basis of the IMO and Model courses, adapting the contents to mass evacuation and critical situations management in ports, passenger terminals or port waters. The experience from the aviation industry could serve as the basis for the design of these training requirements. The acquired familiarization of people dealing with critical situations includes a common framework of action and emergency management. The training concepts have been adapted to the contents of IMO and other international training standards along with material relating to risk assessment, enhancing resilience, emergency management and decision-making in crisis scenarios. The primary goal of this training is to adapt the ICAO, IAMSAR and IALA applications within the maritime scheme and specifically in the MONALISA 2.0 concept. The material complies with IMO guidelines but also includes some results from other sub-activities of the project. Both the theoretical and practical components of the course will cover the requirements of this topic. The following courses implemented by IMO and ICAO aim to offer knowledge of administration and management of a search and rescue incident. The courses comply with international standard references and amendments.


6.3.6.6 Training for fire-fighting and LNG handling

This topic covers the required skills for those involved in the Liquefied Natural Gas handling, with due consideration of bunkering, port, on-board storage and transport Target groups, which include industrial fire brigades, fire engineers, LNG Bunkering terminal operators, marine crew, and fire-fighters.

The training requirements for this topic have been inspired by the LNG shipping proposed competency standards (SIGTTO) and the DNV standard for certification No. 3325,
adapting the contents to mass evacuation and critical situations management in ports, passenger terminals or port waters. These requirements will apply the rules and recommendations for training requirements for the handling of LNG fuel in ships, supply facilities and port storage. Special attention to the fire-fighting for LNG spills will be conducted. The Integral Maritime Safety Jovellanos Centre will also provide the strategy to perform practical training at the centre.

Noting that the International Convention for the Safety of Life at Sea (1974) currently does not have any provisions for use of gas as fuel on ships other than gas carriers, the Maritime Safety Committee sees a need for the development of a code for gas-fuelled ships that adopts the Interim Guidelines on safety & training for natural gas-fuelled engine installations in ships (Guidelines on Safety for LNG-fuelled engine installations in ships. MSC. 285 (86) IMO Resolution) and invites governments to apply the Interim Guidelines to gas-fuelled ships other than those covered by the IGC Code.

Regarding the bunkering of LNG, the International Code of Safety for ships using gases or other low flashpoint fuels (IGF Code) will define requirements for the bunkering systems on board the receiving vessel and general operational requirements regarding the preparation, post-processing, responsibilities and communication focusing on the (receiving) gas-fuelled ship. No specific operational guidance – taking into account all types of bunkering modes and requirements for each kind of transfer system for all facilities involved – is considered. The whole operational crew of a LNG-fuelled cargo and LNG bunkered passenger ship should have the necessary training in LNG safety, operation and maintenance prior to the commencement of work on board.

DNV has developed a standard describing the objectives for training, and the technical content that a training course should cover. The “LNG Global Operational Safety Awareness” from the Integral Maritime Safety Jovellanos Centre partly follows those guidelines.

7 Governance Aspects of Operational Safety

7.1 International Convention on Maritime Search and Rescue (SAR) [10]

Adoption: 27 April 1979; Entry into force: 22 June 1985

The 1979 Convention, adopted at a conference in Hamburg, was aimed at developing an international SAR plan, so that no matter where an accident occurs, the rescue of persons in distress at sea will be co-ordinated by a SAR organisation and, when necessary, by co-operation between neighbouring SAR organisations.
Although the duty of ships to go to the assistance of vessels in distress was enshrined both in tradition and in international treaties (such as the International Convention for the Safety of Life at Sea (SOLAS), 1974), there was, until the adoption of the SAR Convention, no international system covering search and rescue operations. In some areas there was a well-established organisation able to provide assistance promptly and efficiently, in others there was nothing at all.

The technical requirements of the SAR Convention are contained in an Annex, divided into five Chapters. Parties to the Convention are required to ensure that arrangements are made for the provision of adequate SAR services in their coastal waters. Parties are encouraged to enter into SAR agreements with neighbouring States involving the establishment of SAR regions, the pooling of facilities, establishment of common procedures, training and liaison visits. The Convention states that parties should take measures to expedite entry into its territorial waters of rescue units from other parties. The Convention then goes on to establish preparatory measures that should be taken, including the establishment of rescue co-ordination centres and sub-centres. It outlines operating procedures to be followed in the event of emergencies or alerts and during SAR operations. This includes the designation of an on-scene commander and his duties.

**IMO search and rescue areas**
Following the adoption of the 1979 SAR Convention, the IMO's Maritime Safety Committee divided the world's oceans into 13 search and rescue areas, in each of which the countries concerned have designated search and rescue regions for which they are responsible. Provisional search and rescue plans for all of these areas were completed when plans for the Indian Ocean were finalised at a conference held in Fremantle, Western Australia in September 1998.

**Revision of SAR Convention**
The 1979 SAR Convention imposed considerable obligations on parties - such as setting up the requisite shore installations – and, as a result, the Convention was not ratified by as many countries as some other treaties. Equally important, many of the world's coastal States did not accept the Convention and the obligations it imposed. It was generally agreed that one reason for the small number of acceptances and the slow implementation pace was due to problems with the SAR Convention itself and that these could best be overcome by amending the Convention.

A revised Annex to the SAR Convention was adopted in May 1998 and came into force in January 2000. The revised technical Annex of the SAR Convention clarifies the responsibilities of governments and places greater emphasis on the regional approach and co-ordination between maritime and aeronautical SAR operations.

**The revised Annex includes five Chapters:**
Chapter 1 - Terms and Definitions
This Chapter updates the original Chapter 1 of the same name.

Chapter 2 - Organisation and Co-ordination
The Chapter clarifies the responsibilities of governments. It requires parties, either individually or in co-operation with other States, to establish basic elements of a search and rescue service, to include:

- legal framework;
- assignment of a responsible authority;
- organisation of available resources;
- communication facilities;
- co-ordination and operational functions; and
- processes to improve the service including planning, domestic and international co-operative relationships and training.

Parties should establish search and rescue regions within each sea area - with the agreement of the parties concerned. Parties then accept responsibility for providing search and rescue services for a specific area.

The chapter also describes how SAR services should be arranged and national capabilities developed. Parties are required to establish rescue co-ordination centres and to operate them on a 24-hour basis with trained staff with a working knowledge of English. Parties are also required to "ensure the closest practicable co-ordination between maritime and aeronautical services".

Chapter 3 - Co-operation among States
This requires parties to co-ordinate search and rescue organisations, and, where necessary, search and rescue operations with those of neighbouring States. The chapter states that unless otherwise agreed among the States concerned, a party should authorize – subject to applicable national laws, rules and regulation – immediate entry into or over its territorial sea or territory for rescue units of other parties solely for the purpose of search and rescue.

Chapter 4 - Operating Procedures
This chapter states that each RCC (Rescue Co-ordination Centre) and RSC (Rescue Sub-Centre) should have up-to-date information on search and rescue facilities and communications in the area and should have detailed plans for the conduct of search and rescue operations. Parties - individually or in co-operation with others - should be capable of receiving distress alerts on a 24-hour basis. The regulations include procedures to be followed during an emergency and state that search and rescue activities should be co-ordinated on scene for the most effective results. The chapter states that "Search and
rescue operations shall continue, when practicable, until all reasonable hope of rescuing survivors has passed”.

Chapter 5 - Ship reporting systems
Includes recommendations on establishing ship reporting systems for search and rescue purposes, noting that existing ship reporting systems could provide adequate information for search and rescue purposes in a given area.

IAMSAR Manual
Concurrently with the revision of the SAR Convention, the IMO and the International Civil Aviation Organization (ICAO) jointly develop and publish the International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual, published in three volumes covering Organization and Management, Mission Co-ordination, and Mobile Facilities.

2004 amendments - persons in distress at sea
Adoption: May 2004
Entry into force: 1 July 2006

The amendments to the Annex to the Convention include:

- addition of a new paragraph in Chapter 2 (Organization and co-ordination) relating to the definition of persons in distress;
- new paragraphs in Chapter 3 (Co-operation between States) relating to assistance to the master in delivering persons rescued at sea to a place of safety; and
- a new paragraph in Chapter 4 (Operating procedures) relating to rescue co-ordination centres initiating the process of identifying the most appropriate places for disembarking persons found in distress at sea.

7.2 European level [11]
As preventive and response actions, some Directives and initiatives have arisen from the European Union:
Europe has 70,000 km of coastline, belonging to twenty-two Member States. The safety and security of the European Union are thus inextricably linked to the sea. Maritime Surveillance is therefore one of the most important policy areas for European institutions, agencies and bodies.

‘Maritime Surveillance is the effective understanding of all activities carried out at sea that could impact the security, safety, economy, or environment of the European Union and its Member States’.

The aim of Maritime Surveillance is to understand, prevent (where applicable) and manage actions and events that may have an impact on Maritime Safety and Security, search and rescue, accident and disaster response, fisheries control, marine pollution, customs, border control, general law enforcement and defence, as well as the economic interests of the EU.

The complexity of the issues at stake is reflected by the panorama of many various initiatives drawn up by EU institutions and bodies. Examples of such initiatives include EUROSUR (European Border Surveillance System), MARSUR (European Defence Agency's Maritime Surveillance project), EMSA’s (European Maritime Safety Agency) CleanSeaNet and SafeSeaNet, and DG MARE’s CISE initiative (Common Information Sharing of the Environment for the surveillance of the EU Maritime Domain).

All these initiatives underline the necessity for harmonisation and integration amongst the diverse legislative, operational approaches and technical capabilities of the coastal EU Member States. Efforts are therefore underway to implement a European Integrated Maritime Surveillance system. The aim of Integrated Maritime Surveillance is to develop ways of sharing data and information among the competent authorities of the EU and EEA (European Economic Area) States, in an efficient and cost-effective manner.

The Integrated Maritime Surveillance is part of a broader policy launched by the European Commission in October 2007: the Integrated Maritime Policy. The aims of this policy are to maximise the sustainable use of oceans and seas, enhance Europe’s knowledge and innovation potential in maritime affairs, ensure development and sustainable growth in coastal regions, strengthen Europe’s maritime leadership and raise the profile of maritime Europe.

8 Information Technology Use

The growing and intensive use of information available is currently crucial for most human activities. Data mining and major data analysis now from the basis for the most relevant actions, not only for ordinary life but also for safety and security reasons at governmental level. Information is power during any accident occurrence as it implies the avoidance of the loss of life, environmental damage and other types of fatal impacts. When a maritime accident occurs, a multidisciplinary team of experts and large amounts of assets are required; virtual accommodation of resources may bring people from around the country, the region, and the world together in a secure video conferencing format, for example. People meet over the Internet, they share their available information, and videos, audio and images, and can take notes – all from their own devices or by large screens sending stream information from the field. These functions – using text pods – are now running and are employed in the field during training, simulations and operations. Some SAR units in particular have recognised the value of these tools, reporting that they work well in a fast-paced marine environment, giving them instant information sharing. Text pods are used for a radio log, a situation update or to log messages from search vessels. Police
and volunteers find it really easy to use, as fundamentally it is texting in a box, and it can be customised to fit the situational needs. The future of information management and exchange is now. MONALISA 2.0 has made the Maritime Cloud real and the SWIM is also capable of including SAR and port safety operations.

Some of the benefits of the technology use in terms of information exchange are:

8.1 Management of internal communications

- Maintain effective information flow to and from the scene and to the responders
- Establish effective communications flow between:
  - Command Posts
  - Initial Responders at port and sea levels
  - Fire/Rescue/Law Enforcement
  - Military/Civil Assets
  - Regional authorities and civil protection bodies
  - Involved parties by (i.e. satellite, cellular, virtual…)

8.2 External communications

Provide first and best source of information for:

- Relatives and families (including next of kin), passengers, and crew
- The media
- Stakeholders

Establish and implement media strategy

- Press releases
- Pre-established website
- Public
- Stakeholders

Establish methodology for unified command to release joint messages to avoid confusion.

9 Training requirements

Six types of training were selected and tested within the MONALISA 2.0 project. They have determined our approach to training, and their need to be reviewed and updated. Training undertaken by organisations that meet the Operational Safety scope was mapped, alongside a plan to fill the gaps that were identified. A training pathway was also
developed – linking training undertaken by individual organisations, and integrating it into cross-sector training. This means future managers will have a more cohesive and structured training path. In a future line of action, a post-graduate degree may be driven by this initial approach and provide suitable staff for safety bodies at the European level.

10 Testing the Operational Safety Concept

After the Costa Concordia¹ and Sewol² disasters, improving passenger ship safety continues to be a priority not only for passenger ships but also for the shipping, maritime and port industries. 2014 marked the 100th loss of a passenger vessel since 2002. Meanwhile, the total loss of two bulk carriers in 2013 – Harita Bauxite and Trans Summer – highlights the importance of proper cargo handling and stowage [6].

To bring accidents in shipping into alignment with land-based industries, owners and managers must embrace a new safety mind-set. While new technologies will play a role in this process, they cannot be viewed as a substitute for a more proactive, holistic approach to safety. By focusing on underlying causes, and how organisations should be structured to support safety systems, the industry will gain a better understanding of how humans interact with each other and technology, and how different forces and stakeholders impact operations and risk management [4]. When safety measures fail and several unfortunate events happen, accidents may occur. This is critical in large vessels and, in the case of new passenger ships with more than 6,000 passengers and 3,000 service and crew personnel, may have severe consequences. The industry and international organisations like IMO and EMSA work to reinforce and apply safety measures but preparedness and response must also be considered. According to the IMO, in major incidents “successful interaction and mutual understanding between those who will have to work closely together during a major emergency are of fundamental importance to its being handled successfully. The human element and relevant training for all who may be involved are key factors in this context.

Fortunately, major incidents are rare. However, they must be planned and prepared for, and this preparation includes an additional element of training. SAR service personnel are generally accustomed to handling relatively small-scale incidents; but the rarity of major incidents means that they cannot gain the same level of direct experience in dealing with emergencies on this scale. The need for specific training therefore increases commensurately” [7].

¹ The Italian cruise ship Costa Concordia capsized and sank after striking an underwater obstruction off Isola del Giglio, Tuscany, on 13 January 2012, with the loss of 32 lives.
² The sinking of the MV Sewol occurred on the morning of 16 April 2014, routing from Incheon to Jeju, Korea.
10.1 Defining a SAREX experience

With the aim of testing the viability and interoperability of the different tools at the technical, human and procedural levels, operational safety activity partners agreed to perform an exercise covering the port, ship and sea dimension in a situation of a large passenger vessel accident, as the more suitable way to demonstrate the concepts previously proposed into this action.

The purpose of the exercise for the MONALISA 2.0 project and in particular the operational safety activity, is to carry out the respective duties in a scenario that puts into effect the search and rescue operations instruments, the emergency plans in the Valencia Port, a mass casualty plan in the Valencia city and the Mediterranean shipping company accountability and safety plan. All these plans and response actions are supported by new instruments and tools provided by the partners involved in this activity.

The exercise also provided the opportunity to test the training program developed within the project, activating and testing mass casualty incident communications, mutual aid requests, on-board response, search and rescue operations, firefighting, the provision and coordination of medical services, and the setting-up of a crisis management and joint information centre at landside.

The MONALISA 2.0 exercise has been planned as the conclusion of a series of small-scale exercises (SSE) conducted with the aim of evaluating the capability of several organisations to execute one or more portions of their response or contingency plans within the project context and beyond. Exercises were used to provide individual training and improve emergency management systems at all levels. The reasons for performing small-scale exercises included:

- Testing and evaluating plans, policies, and procedures.
- Revealing planning weaknesses and resource gaps.
- Improving individual performance and organisational coordination and communications.
- Training personnel and clarifying roles and responsibilities.
- Gaining program recognition.
- Satisfying regulatory requirements. Evaluating new, integrated systems to support SAR operations.
- Evaluating MONALISA 2.0 support tools developed, under Activity 4 – Operational Safety – to improve MROs.

The SSEs were coordinated and supervised exercises to test a single specific operation or functions. They involved the deployment of equipment and the requisite key staff.
SSEs are a very cost effective approach in testing the preparedness of SRUs (search and rescue units) to respond to any MRO scenario without stressing the system excessively. The aim of these SSEs was to obtain concise results in terms of being:

- Simple
- Measurable
- Achievable
- Realistic
- Task Oriented

These SSEs have taken place in line with a chronological plan in order to prepare equipment and tools individually, and staff for the MRO real scale scenario. Moreover, a tabletop exercise was carried out before the exercises plan. This was an undertaking conducted by an expert advisory group, facilitating the analysis of an emergency situation in an informal and stress-free environment. The tabletop exercise was designed for the evaluation and assessment of operational plans, problem identification, and in-depth problem solving. The most relevant Spanish government agencies and organisations involved in a real MRO were invited to assist:

- the Spanish Vice-presidency,
- the State Security Secretariat,
- Maritime Services from the Civil Guard,
- the Army Emergency Unit,
- the Air Force,
- the Navy Maritime Response Unit,
- the General Sub-directorate of Operations from the Spanish Customs Administration,
- the General Directorate for the Merchant Marine,
- the Spanish Maritime Safety and Rescue Agency (SASEMAR),
- the State Secretariat for Civil Works,
- the Spanish Red Cross, the Valencia Port Authority,
- the Healthcare and emergencies service from the Valencia Government,
- the Valencia Government Delegation, and
- Acciona Transmediterranea Shipping Company.

Parallel with the tabletop exercise, a functional exercise using simulators was conducted. This interactive exercise tested the capability of all the organisations involved in maritime emergencies to respond to a simulated event. The tabletop and the simulation exercise
took place in the Integral Maritime Safety Training Jovellanos Centre in October 2014, focusing on the coordination of multiple functions and organisations. It strived for realism, short of actual deployment of equipment and personnel.

10.2 Opportunity to test cooperation, solutions and technology innovations

Imagine a vessel with more than 5,000 people that is on fire or facing really bad weather conditions at sea or an incident in a port terminal. Rescue and evacuation operations must run smoothly or lives will be lost.

The exercise demonstrated the challenges that a mass rescue or evacuation operations face in general, as well as highlighting the specific set of challenges that are faced in a port. It was an opportunity for the Activity 4 team to meet the expectations, test new technologies and innovations and to chisel out other safety management-related processes for the future. It was particularly rewarding to see that the teams from SASEMAR, the Civil Guard, crewmembers, Valencia port safety staff and civilian bodies collaborated in an appropriate manner during the exercise. Technology providers, such as Ferri and CIMNE, could also provide feasible solutions regarding the recovery of damaged vessels and life rafts. Advanced information systems to support SAR, evacuation operations, first aid assistance, and the use of decision support instruments, like risk management guidelines and risk assessment tools, were implemented and tested successfully. Contingency plans for mass evacuation in a port facility were prepared and evaluated, and the potential risks and scenarios in a passenger terminal were defined. In this respect the following innovations and solutions were made possible to meet for the original objectives proposed by the MONALISA 2.0 project.

10.2.1 Solution 1 - Contingency plans for mass evacuation in a port facility:

This issue was reached through:

- The definition of the potential risks and scenarios in a passenger terminal.
- The analysis of decisions and actions during a number of tabletop exercises.
- The analysis of polls that were sent to other Port Authorities in Europe with topics including emergencies arising from accidents to any personnel within the port area, emergencies arising from the accidental fall of vehicles into port waters and emergencies arising from geological hazards such as earthquakes.
- The SAREX exercise was the final test bed for the port tools, services and contingency plans defined to improve response operations and actions in case of an accident of this nature. After the Juan J. sister ship was towed to the Trasmediterránea Terminal in Valencia, the port, health and civil protection plans
also tested and demonstrated the cooperation capabilities among the different agencies involved.

Image xx. Some results from the Valencia SAREX exercise in the port facilities

10.2.2 Solution 2 - Life-raft Recovery System

The OLRS – On-board Life-raft Recovery System – is a system capable of recovering life rafts and shipwrecked people afloat in the water, and place them safely on-board the rescue ship in a very short time (which is particularly advantageous during bad weather and sea conditions), and minimising the risk of people during the whole recovery operation.

The system offers the capability to approach the recovery hook by extending the boom to the castaway or the life raft, so the rescue vessel in which the equipment is installed does not have to be close to them, thus avoiding the jeopardizing of the entire operation. Note that the usual procedures involve launching a rescue boat (in compliance with SOLAS requirements) from the rescue ship to recover shipwrecked people, with the
consequent risk for rescuers, due to launch and recovery operations, and increasing the risk of hypothermia of shipwrecked people due to the extended time required to recover them.

After an in-depth study of the usual rescue methods and existing problems during such operations, the specific technical features that the OLRS system must meet have been defined:

- Low load at large outreach
- High load at low outreach
- Constant tension and quick response
- Pay out the rope device for the wire when there is no load suspended (with no counterweight)
- Capability to calm the pendulum of suspended MOR / life raft

All requirements mentioned above are satisfied by the system implemented by Ferri, as validated at SASEMAR’s facilities at the Jovellanos Training Center in Gijon (northern Spain) last June of 2015.

In conclusion, the OLRS system is proposed as an alternative/complementary method to existing ones in order to minimise the risk and maximise the number of rescues per time unit.

10.2.3 Solution 3 - Towing simulation tool

SeaFEM is a suite of tools for computational analysis of the effect of waves, wind and currents on naval and offshore structures. During this activity new data were collected in order to improve the SeaFEM towing simulation tool.

On site-data from real towing manoeuvring during the SAREX-exercise in Valencia were gathered and we also compiled data from various towing equipment and other associated facilities.
One outcome of considering the data from the towing of the SASEMAR’s “Punta Mayor” vessel was to include the effect of drift in towing simulations, which had not been previously considered. Data from the SASEMAR’s ‘Sar Mesana’ tug in Valencia during the SAR-exercise were collected. The ‘Juan J. Sister’ was also involved in the exercise but was towed by simulation in order to be able to compare the results from the simulator with the real scenario.

10.2.4 Solution 4 - Risk management guidelines

In case of an accident, or other challenging situations at sea, it is very useful to have access to general protocols that are based on legislation and information from prior incidents that have taken place in similar conditions. The protocol should prove to be a useful tool in following the proper steps in case of a maritime accident.

Four tasks to manage risk:
The first task carried out within this sub-activity was to create a database that contains all the accumulated knowledge. It allows you to filter and search and is a useful decision-making tool. It provides the involved parties with access to vast amounts of historical data that they can use, rather than being limited to individual aggregated experience. The information can allow the rescue operation team to anticipate what will happen next and act smarter. There will be less guesswork and you can confidently and swiftly select the best action going forward. If, for example, a vessel is caught in a storm, the information in
the tool will be able to provide case conclusions and advice you on whether or it would be better to move the vessel closer to land compared to other courses of action. The second task consisted of a compilation of relevant legislation related to maritime accidents. This should serve as the basis for the protocols to be observed both during and after a maritime accident.

The third task is a proposal of protocols based on the previously conducted tasks, taking advantage of the knowledge acquired through the analysis of the database and the legislation compiled, based on the general regulation of IMO and European Directives. The fourth task is a proposal of protocols to follow after the maritime accident, which has its main basis in the general regulation of IMO and European Directives.

This database is an alternative to searches or queries forwarded to EMSA, as it includes more search options. For access to the database, please contact Jose Luis Almazan at the Technical University of Madrid, at jl@almazan.eu.

Public data is fed to the database and allows the user to select the fields that are considered important, set criteria and even make calculations. Looking at accidents that have occurred worldwide the database user can:

- Create a query
- Select the data table and the fields in it that should be considered
- Establish search criteria
- Execute the query
10.2.5 Solution 5 - SIGO

SIGO is an information system used for the operational management of maritime emergencies. It includes information concerning maritime traffic, the aerial and maritime units employed by the Spanish Maritime Safety Agency during response operations. It also provides data from the results of the response activities, such as the recovery of people.

10.2.6 Solution 6 – SARMAP

SARMAP is a tool that creates, simulates and sends search patterns to the units when they are executing the task. Weather and sea conditions are simulated to provide the most suitable search path. During the exercise, this tool was integrated within the NAVSAR system to exchange information in real time with the SAR units.

10.2.7 Solution 7 – Integrated Information Viewer

Integrated Information Viewer is a tool that is accessed over the web that makes it possible to show the recommended response actions to the relevant actors in crisis management. Using a geographical information system it also provides the potential to track the movement of units and the progress of the rescue operation.
10.2.8 Solution 8 – SAFETRX

SAFETRX is a mobile app that makes it possible to include opportunity vessels to support mass evacuations when local means are not sufficient. Leisure ships, and other non-SOLAS vessels, are not obliged to carry AIS-systems but with this app they can be detected and their assistance can be requested.

10.2.9 Solution 9 – NAVSAR-12

NAVSAR-12 is a customised navigation, communication and information system available on a mini-ECDIS platform. It is suitable for response units with limited space and reduces their workload, since information is fed automatically.

10.2.10 Solution 10 – Emergency reporting web service

The emergency reporting web service has been created to maintain updated information relevant to the victims’ relatives and other external agencies. Official reports are uploaded and other important links and information referring to the emergency is included – FAQ functions, telephones or contact details to the health and civil agencies attending to the victims.

10.2.11 Solution 11 – Gamified evacuation on the way

SafEscape is a multiplatform game (PC, Smartphone or tablet) that simulates the evacuation of a ship during an emergency.

It contains a "story" mode that teaches how to evacuate the ship with three levels that involve increasing difficulty, and a series of mini-games that are exclusively playful. The player must locate the meeting point as quickly as possible without forgetting to perform actions on the way (press the alarm button, pick up the lifejacket, etc.). At each level the player faces different starting points (cabin, restaurant, indoor) and real situations (passages cut off by smoke, annoying passengers while trying to evacuate, etc.).

The game has been designed to foster a process of discovery learning: the player does not receive instructions, making the initial decisions intuitively, and which are reinforced or corrected as the game advances. Accordingly, during evacuation simulation, some situations are presented in order to be resolved by choice questions. This also comprises the game’s scoring system. On arrival at the meeting point, the time spent and the results of the answers to the questions are displayed. These results are sent to a web server anonymously for statistical monitoring of the learning experience and for the improving on the simulated situations.
To be prepared for the worst:
No two accidents are identical, and most of the time emergencies arise completely unannounced. A high level of operational safety requires crewmembers, SAR officers, port safety teams and fire fighters to have the necessary knowledge and experience to make split-second decisions, under pressure, and in situations that are new to them.

Information about past accidents, lessons learned during those emergencies and related IMO model courses are highly useful for training purposes. By preparing for those scenarios – and the wide variety of challenges that arise – the SAR officers and the port safety personnel are more likely to perform well in situations that are new to them.

In designing future training, updates to training activities are conducted in consultation with key industry actors and representatives from maritime authorities. It adheres to the STCW standards and the primary audience for the training is innovation developers, training providers, trainers and teachers, supply chain partners and key industry stakeholders.

Six main training topics were set as a priority:
1. Training on SAR and Mass Rescue Operations
2. Training on Safety and Mass Evacuation in Ports
3. Training on Emergency Management on-board passenger ships
4. Training on Leadership and the Human Factor in Crisis Scenarios
5. Training on IMO/ICAO/IAMSAR applications
6. Training on Firefighting and LNG (Liquefied Natural Gas)
By adding skills for optimised rescue operations, evacuation and attention of victims, the various actors involved in navigating large vessels – which nowadays may house more than 5000 passengers and crew members – can now be trained for specific tasks focusing on potential risky situations in this kind of vessels. Limited space in the port may make it more difficult to evacuate a large number of people, and sometimes the number of people on a vessel exceeds the population of the host city. Providing them with first aid requires resources. It also requires a large number of people, meaning several external actors, to collaborate effectively.

For a rescue operation to run optimally, the people involved need to have the right skills set. Crew members and SAR services staff need to know what to do in order to react quickly in the face of an emergency, and to make the appropriate decisions that will save lives and minimise environmental impact. Fire fighters, who work in a city where a port is located, also need additional training in order to be able to do their job effectively if faced with a ship fire.

Fire fighters need knowledge and skills such as how to move inside the vessel and quickly reach any space, all the way from the bridge to the engine room. Besides, they also need to be properly trained on how to embark safely, both from a helicopter or from a tug/fast action lifeboat.

Image xx. Training Requirements Report presented as one of the main results of the training sub-activity
11 SAREX 2015 – Preparedness, Response and Cooperation

The MONALISA 2.0 SAREX 2015 exercise was a program developed following a comprehensive series of activities including small-scale exercises and concluded with a large-scale exercise combining the ship’s safety management, the SAR and the port, terminal and Valencia city emergency plans. The program for these activities made it possible to analyse and decide the whole picture of the risk situation during a large passenger vessel accident in terms of the response operations and the actors involved. The final outcome demonstrated the viability to be ready, respond and cooperate in a harmonised way during a situation of this magnitude, enabling it to test several human, material and technical instruments conceived within the MONALISA 2.0 Project.

11.1.1 Planning for comprehensive small-scale exercises

June 2014
Exercise: SRU operational cycle timings and interactions
Purpose: For this drill, it was decided to focus on the time needed for the SRU to complete operational cycles (ex.: winching cycle) and SRU to SRU transfer times.
Rationale: MRO scenarios usually require the quick transfer of rescued people between units. It was decided to establish a self-assessment process in which we could get a clear overview of the real SRU capabilities in transfers among units. Because of the fairly limited scope of this drill, predrill announcements were limited to those necessary for safety and operations, and those needed for the drill control organization.

June 2014
Exercise: Establishment of practical radar sweep widths for use during MROs
Purpose: Radar sweep widths for each combination of sensors, the search object involved in a MRO, and set of environmental conditions. A sweep width can be estimated using tables of values based on exercises and testing like this one.

July 2014
Exercise: SafeTRX validation tests
Purpose: The test SafeTRX tool as a means for filling the gap in the maritime situational awareness picture.
Rationale: When SAR services require vessels of opportunity other than SRUs, they normally rely on merchant and fishing vessels. However in coastal areas, the availability of a sizeable leisure fleet can add important assets when coordinating a MRO. SafeTRX has been designed in close cooperation with SAR professionals.

3 SafeTRX is a vessel-tracking smartphone commercial application that fills a critical gap in the maritime situational awareness picture. http://www.safetrxapp.com/
September 2014
Exercise: 406 MHz electronic search during MROs
Purpose: Review of SASEMAR’s 406 MHz direction-finding requirements and capabilities.
Rationale: SAR services benefit from knowing the capabilities and limitations of each device, providing final homing and locating of a distress device. Testing was conducted by search aircraft at various altitudes on the homing and locating capabilities of the 406 MHz EPIRB alert signal, and the 121.5 MHz homing signal on the 406 MHz EPIRB. Significant quantifiable differences among individual technologies are extremely important in case of a MRO.

September 2014
Exercise: 121.5 MHz electronic search during MROs
Purpose: Review of SASEMAR’s 121.5 MHz direction-finding requirements and capabilities
Rationale: SAR services benefit from knowing the capabilities and limitations of each device providing final homing and locating capabilities of the 406 MHz EPIRB alert signal, and the 121.5 MHz homing signal on the EPIRB. Significant, quantifiable differences among the individual technologies can prove extremely important in case of an MRO.

November 2014 (during the Barcelona mid-term conference)
Exercise: SafeTRX and ACO (Aerial Co-ordinator) exercise
Purpose: Test SafeTRX as a tool designed to provide a better surface picture.
Rationale: In a fatal MRO distress scenario, the main mission of the ACO is to provide organization and control. Air units must exercise evacuation procedures from surface units and communications with ACO and Rescue Centre, in addition to Air Coordination of one or more aircraft and evacuation of multiple persons, both injured and uninjured. Other objectives were to organise the participating units in Sub-On-Scene Coordinators and SRU’s in order to carry out the distress scenario, exercise communications with the OSC and exercise the multiple helicopter hoists from different units.

November 2014 Barcelona (during the Barcelona mid-term conference)
Exercise: Simulation of the damaged ship’s recovery systems
Purpose: To collect data for the Simulation of the Manoeuvring/Recovery of damaged ships
Rationale: This system has been defined as a tool to improve a vessel’s recovering operations after an accident. During the simulation, different parameters were combined from the vessel itself (LOA, weight) with hydro-dynamics and meteorological real data. Data was collected from the Punta Mayor SASEMAR tug vessel, located in Barcelona, in order to feed the designed model. The model was intended to be used and validated during the final MONALISA 2.0 SAREX exercise.

November 2014 (during Barcelona midterm conference)
Exercise: Simulation of requirements for on-board life raft recovery systems
Purpose: Data for specifications for on-board life raft recovery systems
Rationale: On-board Life-raft Recovery System, is a system capable of recovering life rafts and shipwrecked, once they are afloat in the water, and place them safely on board the rescue ship in a very short time (which is particularly advantageous amid bad weather and sea conditions, thus minimising the risk to people during the entire recovery operation). The data were collected in order to build tool simulation. The tool was finally tested in the waves pool of Jovellanos Centre.

**February 2015 Barcelona**
Exercise: NAVSAR conceptual testing
Purpose: NAVSAR-12 equipment and SAR operations
Rationale: NAVSAR-12 is an on-board navigation system customised for SAR operations in small operational units. The main functionality of this system is to provide interoperability and information flow management, including search patterns among SAR units and MRCCs. The system communicates through a control panel, allowing the exchange of the navigation data (from the ECDIS), video, position, search pattern and any other information required to assist the SAR units during an emergency in real time. For the first NAVSAR trial, the CCS Barcelona and Mintaka SASEMAR rescue boat were selected in order to test the communication set up between a MRCC and a SAR unit. For the MRO Pilot Exercise MONALISA 2.0 SAREX, the NAVSAR system were installed in the Valencia MRCC, Barcelona MRCC, the National MRCC, and in the SASEMAR maritime units participating in the exercise. During the MRO exercise, the interoperability among the centres and SAR units for MRO management was tested.

**11.1.2 The MONALISA 2.0 SAREX exercise**
On June 15th, 2015, a full-scale MRO exercise was conducted. It simulated an emergency event, as close to reality as possible. The exercise was planned with the aim of identifying and applying policies, procedures, decisions, administrative and technical requirements, and exercise roles and responsibilities that supported the operational safety objectives achievement of the MONALISA 2.0 project context. Testing the coordination, material means and technologies as well as trainee performance were also possible. The test bed selected for the exercise was the Valencia Port area.

**11.1.3 The events**
At approximately 11:00 LT on the 15 June 2015, a fire broke out in the auxiliary engine room on board the Bahamas-registered cruise/roll-on roll-off passenger ferry MONALISA. The ferry had sailed from Mallorca, Spain, after completing her last port of call. The bed of the fire obstructed the auxiliary engines’ fuel supply module and quickly spread across the compartment. The ship’s crew fire eventually extinguished the fire. There were around 400 people, including passengers on board and crewmembers.

The captain issued the order to abandon ship. After a roll call, three passengers were declared missing.
The fire occurred when a pressure regulating valve’s actuator diaphragm ruptured and fuel oil sprayed onto an exposed high-temperature surface on an adjacent auxiliary engine. The fire caused the vessel to lose electric power, which ultimately required her to be towed into port for repairs.

The cooperation plan between the shipping company and SASEMAR was activated. Maritime and air units from various organisations were deployed. The emergency evacuation procedures on-board ships were activated and the establishment of a Crisis Management Centre was carried out. The Port Authority of Valencia and the Passenger Terminal of the shipping company activated their emergency plans. The harbour master also activated the Valencia Port auto-protection plan. Finally, the exterior emergency plan of Valencia city was activated.

Figure XX. MONALISA 2.0 SAREX Exercise – Events map

11.1.4 Major and detailed events

Major events as noted below, detailed events and expected actions will be included in the exercise control plan:

1. Fire in auxiliary engine room. Crew fire-fighting team extinguishes the fire. Shore-side authorities were not notified.
2. Ship sends a distress alert and reports fire on board. The first fire was detected 3 hours before but the crew fire-fighting team was able to extinguish it.
3. MRCC Valencia receives alert: Via DSC CH70.
5. MRCC Valencia establishes communication with ship.
6. Distress phase declared.
7. Search Mission Coordinator appointed by MRCC Valencia.
8. Helimer, Salvamar and SAR Mesana tasked.
10. Development of rescue plan.
11. Commence fire-fighting support. SAR Mesana, cooling of the ship’s hull
12. Ship reports that the fire has spread to the accommodation areas and main engine room (LNG propulsion) and the captain cannot guarantee that the ship is safe. Captain orders the ship to be abandoned.
13. After mustering, the captain reported three passengers missing. The last time they were sighted was three hours before the first fire broke out. Crew fire-fighting efforts continued. Commence search operation for the three missing passengers.
15. Multi-agency units tasked (Guardia Civil, Cruz Roja, Ejército del Aire, Unidad Militar de Emergencias, Armada, Vigilancia Aduanera)
16. SAR search for the three missing passengers commenced. Most likely jumped overboard when the first fire broke out at 0900 LT.
17. Estimates of passenger injuries/casualties rise between 200 and 220 and at least 20 severe burn victims. 4,000 passenger and crew on board.
18. Several passengers present disabilities involving special mobility needs. Several passengers are injured on deck.
19. MRCC Valencia notifies the competent authorities to consider establishing a forward medical base to enable prioritisation by competent medical staff and whether to send medical personnel to the scene. Procedures are activated for post-traumatic stress syndrome cases.
20. Helicopters used to rescue injured on deck by winching. Winching operation commences.
21. Ship crewmembers start to load, launch and manoeuvre away the lifeboats and life rafts.
22. Surface units commence rescuing survivors at sea from life rafts and lifeboats.
23. Massive COSPAS-SARSAT activation: Up to 25 EPIRBs and PLBs being carried on board. Activated from life rafts.
24. Missing passengers found adrift. Rescue operation.
25. Captain reports that the fire on-board the vessel is extinguished.
26. The captain declares the vessel disabled.
27. The ship is towed to Valencia
11.2 Port instruments

Since no port in the practice manages human and material resources sufficiently and adequately to respond to a notice of a mass evacuation of passengers, it is necessary that the Emergency Plan of the Port is coordinated with other possible Emergency Plans at a higher level (Municipal, Regional or State) that have equipment sufficient and adequate response to meet this contingency. At port level, the passenger terminal facilities were available. The Acciona – from the Transmediterranea shipping company – operates this terminal, and its buildings, gateways and connection fingers were available to help the mass evacuation during the exercise. The platforms for vehicle boarding and disembarking were also employed. The Valencia Port Authority Safety and Security Control Centre, local civil health and protection authorities, Valencia firemen and the Regional and National crisis management bureaus were called to assist the simulated emergency.

11.3 The Vessel

The Acciona – Transmediterranea Juan J. Sister – was the sailing scenario for the MRO and the mass evacuation in the port. Its main characteristics are:
Length: 151.00 m.
Width: 26.00 m.
Draft: 6.00 m.
Propulsion power: 17130.00 C.V.
Speed: 17.00 knots
Capacity: 672 passengers, and 148 vehicles
1,290,00 linear metres.
11.4 Search and Rescue resources

From SASEMAR:

- Crisis Management Centre
- National MRCC
- Valencia MRCC
- Sasemar Helicopter Helimer 200
- Sasemar 101 Aircraft
- Clara Campoamor MultiPurpose Vessel MPV
- SAR Mesana Tug Vessel
- Caliope patrol boat
- Fast Rescue Boats, Es Salvamar Pollux

From Other Organisations:

- Trasmediterranea Ferry JJ Sister: Sarex-Monalisa
- Spanish Air Force: Helicopter SAR
- Spanish Navy: Patrol boat
- Civil Guard: Patrol boat
- Red Cross: 2 Lifeboats
- Monalisa Technology test-bed exhibition.
ASSET FUNCTIONS:
National MRCC-Spanish Maritime Safety Agency-Madrid

- Support of the emergency management at national and international levels.
- Notification and management of maritime and safety information during the emergency.

Valencia MRCC-Spanish Maritime Safety Agency

- The coordination centre responsible for the emergency.
- Makes notifications and establishes communication with the vessel.
- Mobilisation of assets.
- ACO coordinator.

Helicopters: Rescue operations and transfer of the fire-fighting MRO team
Aircraft: Search Operations
Clara Campoamor MPV: On-Scene Command, OSC
SAR Mesana: Lifeboat rescue operations, fire intervention team transfer, fire-fighting and tug.

12 Streaming Experience – A communication strategy
SEDIMAR decided to use streaming as a tool to show the activities at sea and on land, together with the test-bed of activity 4 technologies and the decision-making in the crisis management room.

In order to achieve these objectives several scenarios were defined:

12.1 Valencia Port foundation facilities
In this building most of the attendants, partners and press were located during the exercise. The visitors were able to go through all the rooms depending on their particular interest:

- Conference room: a video wall of 2 x 6m² was installed to display and track all the activities and the storyline of the situation. José Manuel Diaz, Training Manager of SASEMAR’s Training Centre and leader of Activity 4 in MONALISA 2.0 Project, conducted the events narration throughout the various actions of the exercise. He also explained the technologies and the activities involved and developed during the project. A fixed camera was also installed in the conference room to record the intervention of the speakers and the different program situations during the day.
• Crisis room: the main organisation involved in the exercise was located in this room. A 46’ screen was installed and connected to the one in the conference room but without sound. Moreover, a camera was recording the meetings and main interventions.

• Exhibition room: the technologies were displayed in this room to show all attendants their functionalities, performance and innovative details. The same camera as the one in the crisis room was used to record the events as they happened.

12.2 Trasmediterranea Maritime Station:

Passenger disembarkation was carried out there. Next to the quay, the emergency units, fire fighters, civil protection, 112, national policemen as well as other agents were deployed to receive the passengers. The images were collated by camera and used for post-video production, because some technical problems didn’t allow the connection for live streaming as during the SAR experience.

12.3 Maritime area (3 miles from shore):

This was the main point of the exercise. The cameras were installed in:

• Juan J Sister passenger vessel: Juan J Sister passenger vessel: a camera was on board to broadcast life the events as they occurred. One of the two passengers evacuated by helicopter took a Go-Pro camera to record the evacuation. Additionally, a fire fighter, who was embarked to assess the situation, carried a Go-Pro camera.

• Clara Campoamor: a camera was on board. This vessel saw less active participation so it was possible to place it in strategic positions.

• R/S Sar Mesana: the tugboat was provided with a camera to record the towing operations.

• Caliope: also with a camera on board. One of the survivors had a Go-Pro camera to record the life raft recovery operations.

• HS Helimer 204: the rescuer was provided with a Go-pro camera to record the exercise from the air as well as their intervention in evacuating passengers.

• AS SASEMAR 101: the launch of the buoy to simulate the drift of a passenger was recorded with a camera on board the aircraft.

Communication among units was a difficult task. With more than a distance of 7 kilometres, plus containers, cranes, buildings and even a big wheel being in the vision line between the maritime area and the Valencia Port foundation, it was necessary to install an
antenna half way. Testing was carried out on the 4 June. The rest of the antennas were installed on board the units the day before the exercise.
During the exercise, the images were recorded according to plan, and the webpage of SASEMAR reproduced the exercise for those who could not attend it. The attendees gave a very positive valuation of this new format for receiving notifications and news from such an event.
The following link shows a summary of the activities carried out during the exercise: http://www.salvamentomaritimo.es/sm/multimedia/MONALISA-SAREX-2515/?id=14780

12.4 Debriefing

After the exercise, a debriefing session was conducted. The main outcomes and conclusions from the SAREX experience were discussed.
The debriefing was chaired by:

- Felipe Cano- Harbour Master (Director of the Emergency)
- Víctor Jiménez- Deputy Director of Safety, Inspection and Marine Pollution. Deputy Director of the General Merchant. (Representing the Technical Advisory Committee)
- Joaquín Maceiras- SASEMAR Operations Director- (Directors Operations)
- Antonio Padial- Valencia MRCC Chief (Operations Coordinator)
- José Manuel Díaz- SASEMAR Training Manager (MONALISA 2.0 Activity 4 Leader and the host for the live-stream exercise)
- Alejandro Busto- Chief of the National MRCC (Organiser of the SAREX-MONALISA Exercise and Facilitator of the Debriefing)

The debriefing was moderated by Alejandro Busto, Chief of the National MRCC, and in charge of the organisation of the SAREX MONALISA EXERCISE.
13 Conclusions and recommendations

MONALISA 2.0 provided a significant opportunity to create a common framework through which maritime and port authorities, technology providers and other relevant stakeholders can move towards the future for maritime transport. Operational safety represents a specific field that provides response and action when unexpected events occur and safety measures, technology and the human element fail.

When a mass operation at sea is required, many organisations are involved with the aim of making the best decisions efficiently and in time in order to reduce or minimise the loss of lives and damage to the ship and the environment. The roles and responsibilities must be well identified for this kind of incident management. A mass rescue operation (MRO) at sea is complex and requires the cooperation of a large number of agencies. This sub-activity was concluded with the successful SAREX 25-15 exercise: The great efforts after the table-top and small-scale exercises made it possible to demonstrate the capacity to respond and attend to victims, vessels and other stakeholders.

The SAREX 25-15 exercise demonstrated the usefulness and need for modern and up-to-date information and communication systems. SASEMAR has tested some of its own technologies to improve the effectiveness and efficiency of operations and procedures. Information exchange among the MRCCs (local and national), the units and the crisis...
management rooms was achieved in real time. In this case all the agencies and bodies involved in the simulated accident could access the same view and work in line with the information of what the situation required. Inputs from the other technologies provided by the partners of the MONALISA 2.0 project also demonstrated that many tools make it possible to understand, plan and respond to emergencies properly.

The communication processes, with the external community and victims, were also demonstrated. A real-time web-based information service was successfully tested. This website reduced the workload of the crisis attention channels and emergency call centres. At an international level, official news and communications permitted the follow up of the progress of the incident. In the future, this channel could be improved and maintained and be activated in case of a real accident.

The SAREX-MONALISA Exercise was a challenge from the communications and media viewpoints and an opportunity to simulate the role of the press department during a MRO situation.

Through this exercise we could test different actions, for example, the use of various communication channels, such us social media, to provide real time information and audio-visual material, cooperation and coordination with the different organisations’ press departments involved in the response to the emergency, and the experience of live broadcasting of an event.

Cooperation and coordination with the Port Authority of Valencia, the shipping company and the other maritime safety organisations, like SASEMAR and the General Directorate for the Merchant Marine were crucial as parts of efforts to involve other agencies like the Spanish Navy, the Civil Guard and the regional Health and Emergency attention bodies. The human and material resources that were deployed demonstrated the reaction and response capacity when a mass crisis at sea occurs. These kinds of projects and experiences provide valuable results in improving and enhancing the internal and external procedures according to the new requirements of the sector, namely, bigger ships moving vast amounts of passengers or cargo, higher sea traffic, unexpected weather and changes in sea conditions, etc.

Final conclusions, considerations and recommendations were collated after the SAREX exercise and are presented below.

13.1 Development of national legislation regarding families and victims in a passenger vessel emergency.

The General Merchant Directorate and SASEMAR proposed the development of similar legislation as in the aviation and railway sector regarding assistance to families and victims in an emergency.
Víctor Jiménez (Deputy Director of the General Merchant) explained that it was a complex project and that its scope had to be defined.

13.2 Identification of victims during the exercise

Although the information flow between the shipping line and SASEMAR was smooth, Javier García, Chief of Castellon MRCC and Liaison Officer, who was on board the passenger vessel, claimed that the disembarkation in port presented several difficulties in terms of counting and identifying the passengers. One alternative suggested by Joaquín Maceiras, SASEMAR Operations Director, was to use aviation-like information systems. Víctor Jiménez (Deputy Director of the General Merchant) commented that, according to legislation (Real Decreto 665/1999, de 22 de abril), shipping lines are obliged to have a passenger list but not in an informatics system.

13.3 Cooperation plans between SAR services and regular shipping services

The role of the company in mass rescue operations is of great importance, in addition to its relationship with the rescue services. This is addressed in the Cooperation Plans between SAR services and shipping companies, although they are currently insufficient and need to be extended. They should be updated, detailing, among other things, the exchange of information at the beginning of the emergency.

13.4 SAR plans for mass rescue operations

A unified command that integrates all the organisations with means and interests in the emergency is needed for emergency management. It clarifies that this command does not have a head, since it is under the Director of the Maritime Emergency. Felipe Cano, Valencia Harbour Master and Director of the Emergency suggested the need to formalise the command structure on a SAR plan for operations management. In Spain, such a plan exists for pollution incidents but not for this type of incident. Therefore, it would not have been necessary to clarify that the Unified Commander covers all the stakeholders in an emergency and that it is under the scope of the Director of the Emergency as it unfolds. On this occasion, under Unified Commander, the Regional Government from Valencia was missing. Therefore, there was an emphasis on the need to formalise in detail the organisational structure for large-scale operations. Moreover, an incompatibility between the coastal and port emergency plans was noted. The maritime emergency director was expected to be present at the CECOPAL and at the maritime crisis room at the same time. Therefore, the solution was to delegate his responsibilities to another person.

Víctor Jiménez (Deputy Director of the General Merchant) considered that a good initiative would be to take account of what had been established in pollution emergency plans and return to search and rescue operations with a special focus on passenger ships.
Another input from the exercise was the clarification by Fernando Gimeno, Valencia Port Safety Manager, that the port emergency plan can be activated when the vessel is sailing towards the port with the intention of disembarking passengers. Moreover, every port has a clear view and procedures for handling these types of emergencies. Alejandro Busto, National MRCC Chief, remarked on the need for improvement in the coordination of land and sea applications for mass rescue operations.

13.5 Evacuation and Intervention Team

José Manuel Díaz, SASEMAR Training Manager at Jovellanos Centre, revised the MONALISA 2.0 training courses such as that dealing with fire-fighting, SAR actions from helicopters and maritime units that staff, such as the Valencia and Sagunto fire-fighters, went through before the exercise.

Tomás Asensio, fire-fighters manager, praised the training courses and the exercise as a fantastic way to implement the courses, but also to visualise improvements in operations, such as communication between the maritime SAR centres and the regional government emergency centre. It was also noted that the response time was longer than usual, since the helicopter had to wait for the fire fighters.

Alejandro Busto, National MRCC Chief, stressed that there is a lack of qualified fire fighters in SAR operations. Therefore, José Manuel Díaz, introduced the possibility to continue this type of training, following the model of the Maritime Incident Response Group (MIRG).

Oliver Rodríguez, INAER helicopter manager, noted that the external staff embarking in an air unit must have licenses according to the RD 750/2014. José Manuel Díaz, Jovellanos’ training manager, took this point into account during the development of the MONALISA 2.0 training courses.

13.6 Healthcare at sea

Javier Valencia, Barcelona Harbour Master, suggested the provision of healthcare before the evacuation in the form of a doctor and two extra staff on board. Veronique Magnin, Maritime Prefecture of the Mediterranean, commented that, through the CECIS program, it is possible to request three doctors to attend the casualty as it is anticipated in the international SAR plan.

Alejandro Busto, National MRCC Chief, explained that although the possibility to activate the plan was considered, it was finally was not necessary. Nevertheless he considers healthcare on board to be crucial.
13.7 Streaming

Ulf Siwe, MONALISA 2.0 communications officer, stressed the potential for the cameras on board air and sea units to be opened to the observer in order to follow the exercise. The possibility to observe the exercise, via live streaming, with the explanations of the evolution of operations and the application of various technologies, was very much appreciated by visitors and online observers. Mr Siwe highlighted this fact and stated that all those who had witnessed the exercise learned lessons.

13.8 Technologies

13.8.1 Safescape technology

José Manuel Díaz, SASEMAR training manager at Jovellanos Centre and MONALISA 2.0 Activity 4 Leader, elaborated on the Safescape tool, an intelligent game for passengers to learn emergency actions. A SQR code orientates passengers on the vessel. Part of the exercise involved measuring the difference in time of evacuation from those who used Safescape as opposed to those who did not. A last-minute problem in the organization diminished the scope for testing. Susana Pascual from Oviedo University commented that, unfortunately, the number of volunteers is not sufficient to write a scientific article or make concise conclusions.

13.8.2 SAFETRX technology

Antonio Padial, Valencia MRCC Chief and SAREX-MONALISA Operations Coordinator, explained the success of this tool during the exercise. A Red Cross unit registered its voyage as a leisure vessel in the SAFETRX application. At the time of the incident, Valencia MRCC was able to mobilise her immediately thanks to its proximity to the incident. John Murphy, manager of SAFETRX Company, explained that SASEMAR is assigning inputs from users. This tool has been used in the Netherlands for a real rescue operation.

13.8.3 SARMAP technology

According to Antonio Padial, two operators used the SARMAP technology in the crisis centre to calculate the drift of life rafts, objects and persons. Antonio Morlá, one of the SARMAP MRCC operators, commented that the difference between the simulated drift and the one from the buoy, which was previously thrown from the airplane, was minimal. Clearly, the use of SARMAP, having introduced high quality wind and currents data, is a key factor in large-scale rescue operations.
13.8.4 NAVSAR

During the exercise, the NAVSAR 12 navigation and communication system was tested in the SAR Mesana, Clara Campoamor, Salvamar Pollux and Guardamar Calliope maritime units. The system permits the dynamic management of mobilised units. By this means, maritime units directly received the search patterns from the land centre. The Valencia MRCC Chief, Antonio Padial, remarked that it is an extremely helpful tool that has to be tested a bit more to adapt it to Coast Guard requirements.

13.8.5 WEB VIEWER technology

Web Viewer technology was viewed as being very positive as a tool in integrating information in a geo-referenced manner for SAR units. 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.

13.8.6 Life raft recovery system

Francisco J. Ruppen, from Industrias FERRI, mentioned that, although the lifeboat recovery system could not be tested during the exercise, it was tested in the Jovellanos centre where sea conditions were satisfactorily simulated.

13.8.7 Recovery damaged vessel system

Daniel Sá López, COMPASS Ingeniería y Sistemas S.A, explained the recovery damaged vessel system makes it possible to simulate the best options to tug a vessel safely. It is necessary to introduce the real meteorological and hydrographical conditions, together with the data from both vessels. The system was tested the day after the exercise due to technical problems during the exercise. Alejandro Busto, National MRCC Chief, remarked that there is a huge interest in this tool, since tug operations are very complex and are fully dependent on the accumulated know-how of the operator due to the lack of tools to calculate the operations.

13.8.8 Webpage facility

This webpage was created to allocate in a single site all the information from the various organisations that participate in emergencies. Within just one hour, the tool was able to share all the necessary information on the emergency, especially the facility for telephone calls to the families involved, according to Mónica Mulero from SASEMAR. This tool was created by SASEMAR in order to make information public when an emergency happens.

13.8.9 MONALISA 2.0 MRO Training Courses

Jose Manuel Diaz, SASEMAR Training Manager at Jovellanos, noted that in the framework of activity 4.6 of the MONALISA 2.0 Project, six courses were
developed, five of which have been presented so far. Regarding the MRO course, Carlos Fernández Salinas, trainer at the Jovellanos Centre, said that the content was a practical approach and included a website to meet the demand for information.

13.9 Operations

13.9.1 Operations at Valencia MRCC and the National MRCC

Valencia MRCC verified the distress information and sent the first notifications, SAR tasks were completed and the centre activated the specific procedures. It was confirmed that the Valencia MRCC established a communication system with the shipping line and the unified commander.

Antonio Padial, Chief of Valencia MRCC and Operations Coordinator for maritime operations during the exercise, reflected that the managers should have an emergency phone line in order to guarantee the transmission of instructions and commands. Also, he continued, it was necessary to strengthen the centre with extra staff that can attend to calls, help in search and rescue operations, and register all the information that can be user later in claims.

Julián Camus, Chief of Santander MRCC who participated in the Crisis Centre, requested that confirmation of communication with the SafeSeanet system be conducted. Alejandro Busto, National MRCC Chief, confirmed that notification was made from the National MRCC, since it was supporting the Valencia MRCC during the operations.

It was confirmed that the Valencia MRCC had the SAR agreement with the passenger vessel. Nevertheless, the emergency contact with the JJ Sister was not updated and the information was not received in the first place.

In general, it was verified that all the operational objectives had been accomplished.

13.9.2 Operations Coordinated by the Director of Operations

The communication among all the organisations involved in the exercise worked perfectly. Antonio Morlá, SARMAP operator, mentioned that some of the organisations were not aware of the conventional system that SASEMAR used as SITREP or search patterns. Alejandro Busto, National MRCC Chief, mentioned that at national level, there is coordination with Civil Guard, the Army, and the Red Cross, among others, to establish a common workflow.

It was verified that communication with the private shipping line was successful.

The need to establish a safety officer to identify the operational risks of the response units was confirmed. His/her roll is essential especially during specific risk operations; such when fire fighters get on board a vessel.

Mónica Mulero, from the SASEMAR Technical Secretariat, pointed out the importance of sharing documentation during operations. She proposed to identify new joint systems among the organisations involved.
It was observed that the response times of some units were not as expected. This was due to the fact of the “artificial nature” of the exercise, in the sense of bringing together different operations in a short period of time. Some units started the operation before being activated.

In general, it was verified that all the coordination objectives of the OSC and the Operations Centre were accomplished.

13.9.3 Operations on shore

It was confirmed that the shipping company counted the passengers but they were not identified. The Ministry of Home Affairs should conduct this action. A lesson learned from previous accidents is that this information arrives late. The Port Safety commander of the national police explained that the first step is to attend to the victims with psychologists and then subsequently to process identification. The national police gather together the passengers and then later place them in a reception centre.

The State Security Forces are in charge of investigating any criminal evidence regarding the vessel.

Rosa Mencía, manager of the Valencia regional emergency and healthcare service, remembered that the sorting and prioritising of the rescued is the first thing done on land. This classification is essential before identification.

13.9.4 Press

Eugenia Sillero, SASEMAR Technical Secretary and MONALISA 2.0 Activity 4 Leader, explained that press resources should match the dimension of the incident. In future exercises, we should make sure tasks are completely separated. There should be enough staff in order to participate in the exercise, thereby simulating the press officers who are dealing with fake calls from media, while others would only be attending the real journalists who are covering the exercise itself.

13.9.5 Logistics, administration and finance

In general, it was verified that all the targets set in connection with logistics, administration and finance required for the management of emergencies and by the responsible bodies were met.
## 14 Contributors

The activity 4 team and contributors to this final report are:

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### Sub-activity 4.2 – Safety in Coastal Areas

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### Sub-activity 4.3 – Safety in Coastal Areas

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### Sub-activity 4.4 – Risk Management Guidelines

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### Sub-activity 4.5 – Safety Information Systems

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Sub-activity 4.6 – Training

Final report on training on SAR and MRO
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Special Milestone 12 Report – Training Requirements
José Manuel Díaz Pérez, Juan Carlos Fernández Salinas – Jovellanos Centre; Natalia Mazas and Sergio Velásquez external consultants

15 References


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