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PROJECT DELIVERABLE REPORT

Introducing advanced ICT
and Mass Evacuation Vessel design
to ship evacuation and rescue systems

D9.3 Market Analysis

A holistic passenger ship evacuation and rescue ecosystem

MG-2-2-2018

Marine Accident Response

"This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 814962"

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Responsible Author	Carmen Perea (ATOS)	Email	carmen.perea@atos.net
		Phone	
Reviewer(s):	Vassiliki Apostolopoulou (AdMEs), Philippe Chrobocinski(ADS)		
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Contents

Table of Figures

Table of Tables

Abbreviations

AI	Artificial Intelligence
AR	Augmented Reality
ECSA	European Community Shipowners' Associations
EMSA	European Maritime Safety Agency
EU	European Union
GT	Gross tonnage
IACS	International Association of classifications societies
ICT	Information communication Technologies
IEC	International Electrotechnical Commission
IEEEE	Institute of Electrical and Electronics Engineers
IMO	International Maritime Organization
ISO	International Organization for Standardization
IoT	Internet of Things
LNG	Liquified Natural Gas
LoRa	Short for long range
LPG	Liquefied Petroleum Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
ML	Machine Learning
RO-PAX	Passenger/Car ferries
RO-RO	Roll on-roll off,
SOx	Sulphur Oxides
SSS	Short-sea-shipping
UNCTAD	United Nations Conference on Trade and Development
VR	Virtual reality
WiMAX 2	Worldwide Interoperability for Microwave Access
WiFi6	Wireless Fidelity

1 Executive Summary

Task description from DoA: “This deliverable describes the market analysis for PALAEMON solutions (business cases, business models) to support the future exploitation for the consortium”.
To complement the definition in the Description of Action, this deliverable studies the current market situation, firstly an introduction of the current market trends and the impact of COVID-19 is provided, secondly a PESTLE analysis has been undertaking in order to provide a vision of environmental factors that can influence the project.
Thirdly, the relevant stakeholders involved in the PALAEMON Project are identified and what actions should be undertaken in order to correctly manage them.
In fourth place a SWOT Analysis was conducted in order to identify the Strengths, Weaknesses, Opportunities and Threats of the PALAEMON Project
To finalize a market analysis is provided from two different perspectives, the maritime perspective and the Information Technology perspective.

Disclaimer: This deliverable was scheduled for M36 but the Consortium has decided to advance it because it provides a study of the market and its environment that should serve as a support in the final exploitation deliverable.

T9.2 Exploitation Strategy & PALAEMON Business Plan (M12-M36) ATOS will be in charge for the coordination of the exploitation and commercialization strategy. This will comprise different phases such as product identification, market analysis, preparation of product launch and strategic alliances.

In the process there will be the definition of values proposition, the market and competition analysis and the characterization of the configuration of the value creation (partners, value change, customer relationship, etc.). Based on them, economic analysis will be performed to evaluate the profitability of the revenue model, understand future cash flow and highlight the need for additional funding or external investment to reach the first stage. The whole analysis will be summarized in the business plan report. The details and overall planning specifications will be described in the PDER (Plan for the Dissemination and Exploitation of Results). The Exploitation Manager will develop a programme to investigate the potential impact of the project results on the relevant standards, and will develop measures to comply with or advocate their modification to relevant organizations.

2 Introduction

The purpose of this deliverable is to introduce and describe the external Market factors surrounding and the Palaemon project. The situation has been analysed from different point of views (Environmental, relevant stakeholders, SWOT) and the market status in the Shipping and It domains. These inputs have been and will be taken into account in the development of the initial and final version of the Exploitation deliverable.

The current document is split into 10 Chapters

Chapter 1: Executive Summary.

Chapter 2: Introduction.

Chapter 3: Market Trends.

Chapter 4: Environment Analysis.

Chapter 5: Stakeholders Analysis.

Chapter 6: SWOT.

Chapter 7: Current Shipping Market Analysis.

Chapter 8: IT Market data.

Chapter 9: Conclusions.

Chapter 10: Bibliography.

2.1 WP9 relationship with other WPs

WP9 “Raising Awareness, Standardisation and Exploitation Roadmap” is a horizontal WP that provides support to the rest of Work-Packages,

Together with WP2, WP9 is the core of the PALAEMON Project, this Work Package provides the means for successful dissemination, communication and exploitation of the project. The Figure 1 below, shows how the WP9 is related with the technical WPs (WP3-WP4-WP5-WP6), which in turn are the foundations of WP7, in which the technology is integrated, and WP8, where the results are validated under the different pilots and trials. Also, WP2 (Use Case Driven Requirements Engineering and Architecture) is specifically related to WP9, since both Work Packages are the central pillars of the rest of WPs.

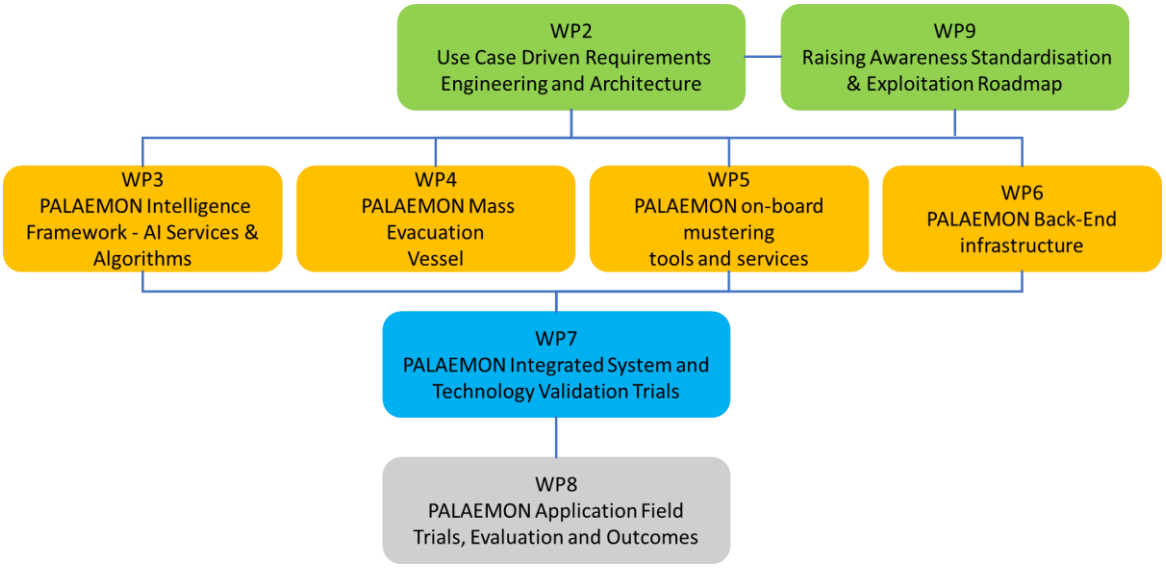


Figure 1. WP2 Dependencies with other WPs

WP9 started with the deliverable D9.1 PALAEMON Dissemination Plan and activities Report on M12 and it is followed by the current deliverable D9.3 Market Analysis and D9.4 Exploitation, Sustainability & Business Plans & Exploitation activities (1) which form the first block of dissemination and exploitation deliverables in which the principles to achieve the success of the Dissemination and Exploitation tasks are established

2.2 Partners distribution & effort in T9.2

Table 1. Partner distribution & effort

Partner	Role	T9.2
ADS	Aerospace	1
ATOS	**ICT**	10
KT	ICT	2
ESI	Maritime	
ITML	ICT	
JOAFG	Emergency Response	3
NTUA	Maritime	1
ADSYS	ICT	1
SIMAVI	ICT	2
DSB	Maritime	
ERI GR	ICT	
RNA	Maritime	1
EFB	Engineering	1
AST	Maritime	1
DNVGL	Maritime	1
ADMES	Engineering	1
THALIT	Aerospace	1
UAH	ICT	
UAEG	Maritime	
WIS	ICT	1
ANEK	Maritime	1
OELSR	Maritime	1
ULJ	Maritime	1
DANAOS	Maritime	1

3 Market Trends

According to Price Waterhouse Coopers report (PWC, 2019) 3 out of 5 main forces transforming the Transport Sector are related to the ICT Results of the PALAEMON Project:

- Digitalization
- Software driven process changes
- Machine driven process change

As it is stated in the report Cruise Market Watch (Watch, 2020) from 1990 to 2020 the growth of the cruise market has been 6.63 CAGR, becoming the mean of transport that has experienced the highest growth. Nevertheless, digital adoption in the maritime sector is slow. Multiple factors have influenced, very expensive communication, resistance to change and the diversity of co-existing systems on a ship that make the integration between systems difficult.

Several factors such as 5G arrival which will facilitate the communications, the adoption of IoT technologies and the sensors reduction of prize, the considerably boost of the Artificial intelligent in the recent years have formed the perfect storm to leverage the Digital Transformation is multiple sectors including the maritime sector.

3.1 Covid-19

COVID-19 has caused a very serious shock for the world economy.

The closing of the borders between countries and the isolation of many countries has affected seriously the cruise market. During 2020 multiple news about cruises and Covid-19 incidents have appeared in the press such as, passengers in quarantine on the cruise without allowing them to disembark in any country (e.g.: the Norwegian Jewel (Doherty, 2020) in Sydney, the Grand Princess in the USA (Dahl) or ships without passengers navigating around the world.

CLIA has evaluated the COVID-crisis economic impact around the world as follows. (Associations, 2020):

- The cruise industry produces around 150 billion USD and it is responsible of 2 million jobs
- A 1% drop in the industry causes the loss of 9,100 jobs
- From the beginning of the COVID crisis to end of September, the impact has been a loss of 50 billion USD, 334000 jobs reduction and the loss of 15 billion USD in salaries.

Nevertheless, according to LA times (Times, 2020) and several polls bookings for 2021 are increasing and the prospects for the industry are flattering.

One thing is clear, when activity resumes the world will have changed and gradually new safety measures will be imposed, and software solutions will support the implementation of these measures.

COVID-19 provides more relevance to Palaemon objectives as the cutting-edge technologies developed in Palaemon will improve the evacuation and the assessment of

Passenger behaviour and health status during and emergency therefore the consortium infers that Palaemon technologies will be requested when full market activity will resume.

4 Environment Analysis

In assessing the external environment PESTLE was chosen as the framework to systematically undertake this task. The name PESTLE is a mnemonic compiled from P as in Political, E as in Economic, S as in Social, T as in Technological, L as in Legal and E as in Environment. The framework aids in identifying forces that affect the ecosystem of the organisation or product/service examined. Classification in the above six categories allows for better aiming on salient factors and also to assess their weight in the outcome of decisions and planned results. Analysis of all these angles maps out the operational environment and puts organisations or in our case product/service offerings in context, enabling assessment of adoptability, potential risk factors and overview of the system integrated in its working environment.

The traditional PESTLE analysis consists of identifying factors in the above six categories, and predictions ranging from short- to long-term. During the pandemic era, the tool still holds its value, even though most mid and long-term predictions and assumptions are highly volatile to change. This is especially true for economic and political factors.

4.1 Political Analysis

In the political sphere of influence all decisions that affect the maritime passenger industry are identified and assessed. Conventionally, tax, fiscal and migration/travelling policies are being investigated. In Covid-19 era, lockdown and ban policies are also considered as restoring/restarting strategies.

The USA political scene influences greatly the industry by being a key player in the global political scene. Also, North American passengers are the biggest segment of the industry according to Cruise Lines International Association (CLIA) global passenger report for years 2016-2018. In this light, USA's current political state in the middle of elections, is not aiding in stabilising the market. Even though USA publicises plans for restart and is trying to allow the industry to recover within the new conditions, major companies in the industry are cancelling trips for the near future and prepare for periods of inactivity. Still, the Centers for Disease Control and Prevention (CDC) have allowed cruises albeit with strict regulations.

The recent USA elections have changed the political scenery and a democratic president is to begin a new presidential term in January 2021. It is naturally expected that a different roadmap towards growth and restarting the economy is to be followed and policies proposed by the White House will reflect this change. A speculation based on traditional historical preferences would dictate that the democratic White House could introduce new regulations and increase government spending and taxation. The negative outlook of these policies would be reflected on companies in the industry. Conforming to new regulations involves cost creating procedures, while increased taxation has a strong impact on net profits. The optimistic outlook of the current situation is that a change in power is often accompanied by a first period of positive economic climate.

Canada as part of the North American group is for now at a standstill, deciding to ban all cruises up to February. This period for Canada though is not considered as high season for the industry and has little impact on the global picture.

The European Union has adopted a new approach to the pandemic measures. It allows cruises in the Mediterranean, with diminished capacity and strict social distancing rules, only

for EU citizens and conditionally accepting travellers from an approved and updated list of countries. Short Sea Shipping for ferries and other vessels are part of each country's mass transportation grid. As such they are regulated by Covid-19 national protective measures but still operational. Another EU specific issue is the Brexit and its impact on UK's citizens ability to freely travel and visit EU shores. The UK will also need to make strategic decisions on fiscal matters that will have a great influence on consumer buying power.

In Asia, the political picture is to a great extend similar. China, the prominent player in the region, communicates the recovery strategies and the long-term growth plans while taking all necessary measures to control the spread of the pandemic. Traveling ban has been lifted and international borders are open again. Another important state in Asia, Singapore has allowed cruises in a very controlled way. The new rules include operating at 50% capacity, only Singapore citizens and the cruise trip not including any port visiting.

On a global scale, political intentions are aligned to restart and recover strategic goals. All major countries have announced their intentions to introduce tax breaks for growth encouragement. Growth can also be supported by national/federal bank policies, such as lowering interest rates, stimulating consumption and investment.

4.2 Economic Analysis

Economic analysis of the global scene is naturally closely tied to political events. Subsequently economical indices have shown great variability lately and are expected to continue this way until we exit the pandemic era. Before the outbreak of Covid-19 the USA had a historically low unemployment rate and the global economy had a 3% projected growth for 2020 and the industry was reflecting this optimistic prediction in trips booked and ship building orders. Currently growth rates are negative and are expected to stay so during 2021 too. Unemployment rate in the USA is projected to reach 20% and the global economic overview is less than optimistic for 2021. Experts predict that the effect of Covid-19 will be mitigated by 2024 if the vaccine is available within 2021.

With economic prospects as described above, shipping companies use equity loans to secure financial resources as their turnover is significantly decreased. This is a temporary fix for the unbalanced cash flows, which however will have important influence in shaping the future of the industry. Shipping companies are also facing another discrepancy between current situation and their strategic plans in effect. Strategic plans plotted before 2020 had positive input from various sources to justify the commission of new ship buildings. Key performance indices in the last years and their projection for the next years were favourable. The market segment for leisure passenger shipping was stable with growing tendencies due to global ageing of the population. Income for this market segment was expected to increase, consequently their traveling budget would also be increased. The above situation though is inversed in many aspects. Projected economical key performance indices are negative and the industry turnover is a fraction of past periods of use. The targeted market segment demographics are still valid, as the ageing of the population is ongoing, their buying power though is notably diminished. A positive effect of the pandemic will be the availability of crew members and their cost as their leveraging is compromised by high unemployment rates.

4.3 Social Analysis

Passenger shipping and especially cruise shipping is characterised by a stable client base. It has one of the highest return purchase rates of all touristic industries. Cruise travelling is part of the lifestyle for most clients. CLIA in their passenger reviews have repeatedly recorded a high traveller age average. The average age varies when associated with origin of the travellers, however the prominent direction is upwards. If we combine this knowledge with the expected global population ageing, the customer base shows positive prospects to be expanded. This is not a major factor for short sea shipping (SSS) in short-term examination, even though it could work in favour of shipping vs. driving.

Customer base establishment in younger age groups is part of the industry's long-term strategic goals. Every company in the industry aspires to inspire young adults to take the first trip, in hope that this will be the initiate of a new generation of loyal returning customers. As educational levels of the global population rise, the strategy to attract new customers is targeted to a positive predisposed audience and grounded as leisure travelling is part of higher income lifestyle.

Social factor analysis would be incomplete without mentioning the social behaviour norms that have been formed by Covid-19 reality. Social distancing and the reluctancy of people to meet and travel in-person is expected to become more intense. Rules governing everyday social interaction and healthcare-related secure practices will initiate a frequent revision cycle of policies for passenger shipping industry. Another important social factor is the compliance with what is expected as safe for the society behaviour. People travelling will be put in the spot-light either by official government policies as in the recent past, dictating quarantine periods and visiting restrictions, or by the members of their social circle as potential disease carriers. This is a negative inversion of the expected social status travellers of cruises are expecting to receive from their peers.

Considering the dire fiscal situation, social security policies are likely to be adapted to the new conditions. Especially pensioning schemes are susceptible to drastic readjustments as they are linked to various economic performance indices and products. The effect on income available to a key potential customer segment is going to greatly affect the passenger shipping industry.

4.4 Technological Analysis

Recent developments in the technological world have caused a major disruption in every aspect of human activity, from industrial machinery to social behaviour. The technological factor has evolved to almost a push-only influence on every applicable field. Furthermore, the versatility and interoperability of the frameworks allowed them to expand and adapt to numerous fields.

In particular Information Communication Technologies (ICT) have made significant advances and offer an extensive array of solutions in various industries. All communications protocols have undergone major revisions to keep up with the growing demand of data transfers. One reason driving the significant increase of data transfer requirements is the development of relatively affordable client devices enabling a greater part of the population to participate in digital society. Data transfer requirements have also increased significantly by the wide adoption of networking enabled machinery. Contemporary equipment is expected to offer

one if not several ways of networking capacity, introducing a populous group of non-human users in any network. This is further intensified by the employment of various Internet of Things (IoT) devices and sensor grids that necessitate additional bandwidth.

Serving this multi-actor system are besides highspeed wired networks, both copper and optical, several wireless communication protocols have been introduced. From low-power wide area network protocol LoRa and Bluetooth Low Energy to WiMAX 2+ and WiFi6 wireless technologies have covered a substantial part of data communication spectrum. In terms of cellular services, the advent of 5G network deployments unlocks new product and service delivery capacity. Integrators have thus a wide array of tools to deploy in any application, covering the solution space with near optimal options. This trend is picked up by passenger shipping builders as the travellers expect the services to be available in their journeys. The deep bond of ICT in daily life and modern technical operation has deemed all these technologies mandatory in any infrastructure planning.

High speed networks and abundance of powerful personal computing devices allow for full utilisation and implementation of Augmented Reality (AR) and Virtual Reality (VR) technologies in mainstream product offerings. Besides the technical showcasing examples, AR and VR are already a considerable section of the gaming industry and expand to other consumer goods rapidly. As part of onboard entertainment options, VR and AR applications are expected to be part of the passenger shipping industry offering.

Artificial Intelligence (AI) and Machine Learning (ML) enhanced the value of operational data considerably. Both are becoming a standard in data processing, empowering data owners by offering comprehensive information. The increase of computational power and the advances in algorithmic processing of data form a new framework of operational management. The enhanced data processing capacity leads to e.g. optimised operations or to in-depth passenger status reporting.

All the above combined introduce a novel level of control over systems including both machinery and humans, preserving the integrity and optimal operation of equipment simultaneously to safeguarding human lives.

4.5 Environmental Analysis

In the 20th century, the environmental performance and impact of human activity has been brought to light and evaluated. Global movements to preserve the environment and protect the planet have gained popularity and influence, leading to voluntary commitment of countries to resolve the situation and founding of organisations promoting these goals.

Shipping industry requires great amounts of energy that currently are delivered by mainly fossil-fuel- based energy sources, ultimately exhibiting low environmental performance. Passenger shipping has specific energy requirements, a significant infrastructure network of electrical equipment for passengers as well as the electricity passengers themselves consume as part of their on-board everyday routines.

The International Maritime Organization (IMO) have introduced and put in force numerous policies regarding maritime pollution through the International Convention for the Prevention of Pollution from Ships (MARPOL). Concerning also engines, MARPOL 73/78 contains IMO's rules on ship pollution. A significant change is the IMO 2020, which sets limits to sulphur emissions. Also, in IMO Tier III strict regulation of NOx emissions is set. To deal with

this situation, conventional fossil-fuel engines are becoming more efficient to decrease their environmental footprint. Combined with dual fuel technologies, introducing Liquified Natural Gas (LNG) as alternative fuel for diesel engines compliance to policies in power is feasible. LNG is attractive in terms of reserves availability, which is reflected on its price also, and is already part of commercial fleets, e.g. Russia that builds ships using LNG. Other approaches to energy efficiency include the use of kites/sails, shore power when docked and slow steaming. Additionally, research in other alternative energy sources is on-going to reach an even higher standard, the Zero-Carbon goal. Electric propulsion for example is promoted especially for short sea shipping.

Other forms of emissions are also under heavy regulation and monitoring by MARPOL. Especially water management and solid waste are in focus. This includes ballast water, bilge water, solid waste management, oil spills, wastewater and any other output of a travelling ship. Local pollution is also in focus, as atmospheric pollution concentration is significant around ports/terminals. This led to suggesting of relocating ports/terminals away from densely populated cities.

It should be noted that shipping is not included in the 1997 Kyoto Protocol nor in the 2015 Paris Agreement as the operational field includes international waters making jurisdiction rights blurry for governments to control and enforce regulations.

In shipping end-of-life vessels are handled by specialised shipyards. Ship demolition is a highly efficient material re-use process, recovering high percentages of used materials. However, environmental dangers exist and potentially harmful substances, e.g. asbestos, oil, heavy metals and other contaminants could be released to the ecosystem if not handled accordingly.

4.6 Legal Analysis

Legal frameworks are proposed and enforced after long and thorough examination of their impact on society in general and on the stakeholder’s interests. In this unprecedented era, legislative bodies are under pressure of rapid adaptation to the quick shifting global conditions. Existing legislative frameworks are revised and extended to cover new conditions incurred by the pandemic on an almost daily basis. The analysis of legal factors in effect initially results to the realisation that we are in a transitional period from a pre- to a post-Covid-19 world. Policies introduced during this period are expected to remain in effect even after the current pandemic as the probability of a world without any health-related threat at global level is not considered high anymore. Legislation regulating healthcare, public health protection and people movement are part of the changes already implemented and to be adapted and put in effect in the short-term time horizon. Directly affecting the passenger shipping industry are the traveling guidelines impairing free people movement. The criteria to initiate a new round of measures introduction are derived from highly volatile public health performance indices. Consequently, travel permissions/restrictions are a constantly changing picture, rendering operational planning a difficult task.

Although regulatory changes are being introduced to deal with the unexpected and unprecedented Covid-19 situation, as stated above, it is expected that these extraordinary measures will be revised and adopted as new norms in the future regulatory frameworks.

4.7 PESTEL Summary

Analysis of the external factors in practice shows that passenger shipping is in a transitional period in more than one aspect. Political and Economic uncertainty put the future of the whole sector in danger, although supportive measures are to be expected for such an important revenue generating activity. These two factors have a strong impact in investment plans, directly affecting Palaemon MEV I retrofit potential installations and MEV II new ship building orders. Also, the density of passengers on ships is expected to be significantly less due to limitations by national health authorities, exerting less pressure on mass evacuation procedures. The Social factors have a mainly positive influence on the industry as the market segment addressed has positive prospects in the foreseeable future. Palaemon in particular is to benefit both from the increase of potential passengers in cruises and also from the ageing of the general population by being a holistic system that focuses deeper into user needs. Technological advances present great potential for innovative new builds and upgrading existing ones. The architecture of PALAEMON is fully aligned to these technological advances to an extend that it can be considered a pull innovation when new ship building orders are drafted. Finally, the Environmental dimension is imposing new requirements that need to be met in the near future with the aid of technological and operational advances. Deploying the PALAEMON system can also be part of an environmental performance enhancement strategy. Utilizing a system that was analysed and designed on sustainability assessment criteria, in this case the LCA (Life Cycle Analysis) framework, enhances environmental performance.

5 Stakeholder Analysis

The stakeholder analysis is separated in three sections. In the first section all the stakeholders of the PALAEMON project are identified and some information for each one of them is given. The stakeholders are divided into different categories, depending on their relation with the PALAEMON consortium. In the second section, a methodology to rank the stakeholders depending on their level of power and interest is described and implemented, in order to better understand each stakeholder and how to treat each one depending on their needs, influence, power etc. Finally, in the third section, a stakeholder management approach is described, based on a five-step procedure, which constitutes the management cycle.

5.1 Stakeholder Identification

This section presents the PALAEMON stakeholder identification process that includes the categories of stakeholders which are considered most relevant in the maritime evacuation process. This section is based on Section 5- Stakeholder identification for maritime evacuation, of D2.2 (NTUA, 2020).

A stakeholder can be an individual or an organization having a right, share, claim, or interest in a system or in its possession of characteristics that meet their needs and expectations (ISO/IEC 15288). The stakeholders were identified in relation to their vicinity to the operation of the PALAEMON ecosystem and were situated in the domains presented in Figure 2, which are: the operational work area, the containing business, and the outside world. In addition, the stakeholders were classified in the following classes that share a stake in relation to the PALAEMON ecosystem (NTUA, 2020):

- Maintenance-Service Providers, Developers-manufacturers, and End-users (Operational work area). They directly interact with the system throughout its life cycle, including the design, operation and maintenance phases.
- Training and Verification & Certification Providers (The containing business). They ensure that the system fulfils its business and design goals.
- Maritime Authorities and Industry Standards Bodies (The outside world). They ensure that the operation of the system does not have any adverse impacts to human life, the environment and property.

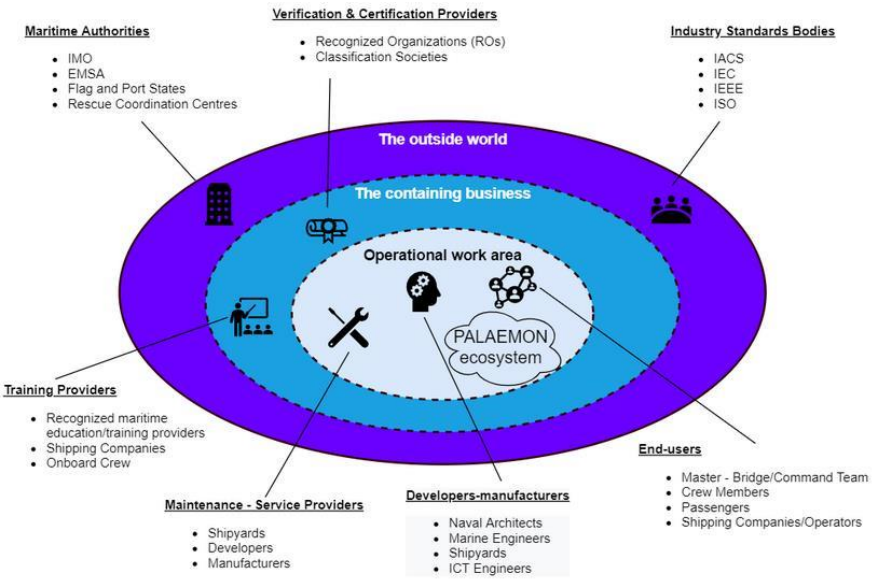


Figure 2: PALAEMON Stakeholder Map (NTUA, 2020).

The contents of the diagram are described below.

Operational work area

Maintenance-Service Providers

- Shipyards
- Developers
- Manufacturers

The prime responsibility of these stakeholders is to keep a system well maintained and functional on a regular basis according to the operational environment once it has been delivered. Apart from maintenance issues, they are responsible for operational environment and performance matters as well.

Developers-Manufacturers

- Naval architects
- Marine engineers
- Shipyards
- ICT engineers

The above-mentioned stakeholders are responsible for the design and construction of the PALAEMON components concerning technical constraints, functionality, performance, maintenance and design ideas. They have to deal with functionality and feasibility issues concerning technical constraints, performance maintenance and design matters.

End-users

- Master-Bridge/Command team

The Master and the Bridge/Command Team ought to perform continuous monitoring and assessments of any emergency (including ship abandonment) and respond accordingly. To do that, they must receive as much and accurate real-time information as possible regarding the incident. Notably, the role of the Master is crucial, as all the decisions are made from him. Thus, in order to be assisted in the decision-making process, he should be provided with not only suitable information but also with guidance and advice.

- Crew members

Their primary role will be to use/operate the PALAEMON components in case of an emergency. They will also keep the system well maintained and available for use. During an emergency, the crew members must implement the emergency procedures, and act deliberately, swiftly and calmly. Some important aspects that affect the crew's performance during an incident are their training, their situation awareness, their adaptability to different emergency situations, the level of information they receive and the quality of the communication with the Master and the Bridge/Command Team and between them.

- Passengers

In case of emergency, the passengers must be guided and assisted in every way to evacuate the ship in an as safe, fast and convenient manner as possible. Their primary role during ship abandonment is to follow the instructions given by the Master/Command Team and the crew members.

- Shipping Companies/Operators

Shipping companies, including cruise ship and passenger ship operators, must maintain safe practices in ship operation and offer a safe environment for passengers and crew members as well. The companies must establish plans and procedures for key shipboard operations concerning the safety of the personnel, the ship and the protection of the environment. They must also identify potential emergency shipboard situations and establish procedures to respond accordingly to each one of them. Shipping companies also include emergency response teams, which comprise technical staff of the company and support the decisions made during emergency situations (e.g. can perform calculations, etc.).

The containing business

<u>Training Providers</u>

- Recognized maritime education/training providers [shipping companies, shipboard crew ("training" to passengers)]
- Shipping companies
- Onboard crew

As stated in D2.2: "Before being assigned to shipboard duties, all crew members must receive appropriate training by recognized maritime education and training providers. Moreover, seafarers and other personnel working on passenger ships must have specific additional safety and emergency training, as required by IMO regulations. Onboard the ship, the seafarers are trained for emergencies through an appropriate training program established by the shipping company. This system of emergency training and education includes procedures and activities developed to familiarize shipboard personnel with the provisions of the onboard safety systems and plans. It also includes a schedule of drills and

exercises to prepare shipboard personnel to deal with potential shipboard emergencies and to simultaneously test the relative safety equipment of the vessel. Passengers are given a ship-specific safety briefing by means of announcement before or immediately after departure. Information cards, posters or video programs displayed on ship's video displays may be used to supplement the passenger safety briefing. Passengers may also participate in onboard drills and exercises under the supervision of the crew".

Verification & Certification Providers

- Recognized organizations (ROs)
- Classification societies

As described in Section 5- Stakeholder Analysis for maritime evacuation of D2.2 (NTUA, 2020): "all shipboard life-saving appliances and arrangements must be verified, approved and certified by the Administration (Flag State) or an approved Recognized Organization (RO). The Administration/RO ensures that the life-saving appliances and arrangements, including ICT components, are evaluated and tested to ensure that they provide safety standards at least equivalent to the requirements of the applicable mandatory rules and regulations. In general, ROs (i.e. classification societies) verify that the construction of a vessel, its machinery as well as its equipment complies with relevant technical and operational standards and carry out surveys to monitor if these standards are maintained. Every vessel is built according to the rules of a classification society. The equipment provided by the yard and installed onboard is usually type approved by the same classification society facilitating this way the systems verification during newbuilding. Apart from the newbuilding phase, the role of classification societies also extends during the lifetime (operation) of the vessel by conducting surveys periodically to ensure compliance with class and international rules and regulations. Additionally, classification societies conduct surveys on behalf of the flag state where the vessel is registered, ensuring compliance with the international maritime laws. Administrations also verify continuing compliance with these standards by performing audits and inspections. In other words, Administration/ROs ensure compliance to international regulations".

The outside world

Maritime Authorities

- IMO
- EMSA
- Flag and Port States
- Rescue coordination centres

International and regional rules and regulations, as well as national laws, determine and influence what a system may or may not do. Relevant authorities are responsible for the implementation and oversight of these rules and regulations. Maritime authorities include rescue co-ordination centres whose purpose is to coordinate and control search and rescue operations.

Industry Standards Bodies

- IACS
- IEC
- IEEE
- ISO

Existing and future standards can affect the goals of a proposed system. The industry has professional bodies that expect certain standards to be maintained by any product built within the industry or for use by the industry.

5.2 Stakeholder Understanding

The understanding of the stakeholders is crucial for every project's success. Success is achieved and ensured by good communication and active support between the project's consortium and the stakeholders. It's very important to be as sure as possible for how the stakeholders (see section 5.1) feel about the PALAEMON project and if their needs and requirements are satisfied.

Some aspects of great importance for the understanding of the stakeholders are the financial interest that they have in the outcome of the project and their motivation to use the project's components. Furthermore, another crucial aspect is the information they need to better understand the concept of the project and the way that this information is presented/provided to them. One more aspect that is very important is the data/information that the project needs from the stakeholders (e.g. user needs, user requirements, etc.) and the way that this information is elicited. Stakeholders are often quite open about their views, and asking for their opinion is often the first step in building a successful relationship with them (Mind tools, 2018).

Low standards of interest on the stakeholder's opinion may cause prevention of the project's success, so it must be known which stakeholders are likely to be supportive and which may block or delay the project's evaluation and development. According to Slater (Understanding your stakeholders, 2012) one way of performing this analysis is the creation of a simple two-by-two matrix of Power (ability to support or undermine) verses Interest, each scored from Low to High. A project sponsor who controls the budget will probably have high power and interest, whereas an individual within an unrelated department is more likely to have low power and low interest.

Understanding and considering the priorities and concerns of different stakeholders informs evaluation planning, communication strategies during and after the evaluation and supports the utilization of evaluation findings. Understanding stakeholders can be separated into two categories. The first one is community scoping, which includes developing an observation of interests of the stakeholders by providing information about their social diversity, history, existing networks, as well as social and economic characteristics overall. The second category is the stakeholder mapping and analysis, which includes identifying different stakeholders' level of interest and influence on the project (Better Evaluation, 2013).

In order to understand stakeholders in a deeper way a power/interest grid may be used as shown in Figure 3. The grid can be used to group stakeholders based on their level of authority and their level of concern for the project's output. The matrix below (Figure 3) can be used to gauge the most influential and most impacted stakeholder groups so that a

focused stakeholder management strategy and plan can be developed and executed. Once the Power/Interest grid is obtained, it can be used accordingly (Ramalingam, Nair, Yuen, & Nadras, 2017).

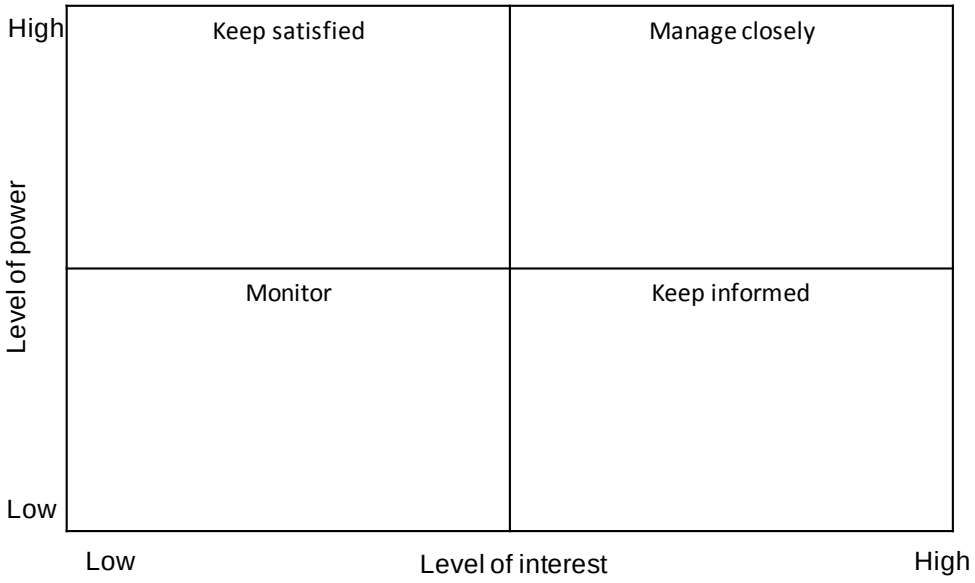


Figure 3: Stakeholder power/interest grid (Riahi, 2017)

The stakeholders with high power and influence are the ones who need more attention. Strong supporters must be kept this way and individuals or groups that have the capability to block or delay the progress of the project form a danger that needs to be dealt with. Close engagement to fully understand each position is critical in order to understand what could be done to minimize their impact. The good understanding of the key stakeholder's positions enables better planning of the project (Slater, 2012).

An application of the above-mentioned methodology is incorporated. All the PALAEMON stakeholders are placed in the grid, as shown in Figure 4, after an evaluation of their power and interest levels, which will actively influence the way they will affect the project but also the way they will be treated by the consortium, as described by the corresponding comments.

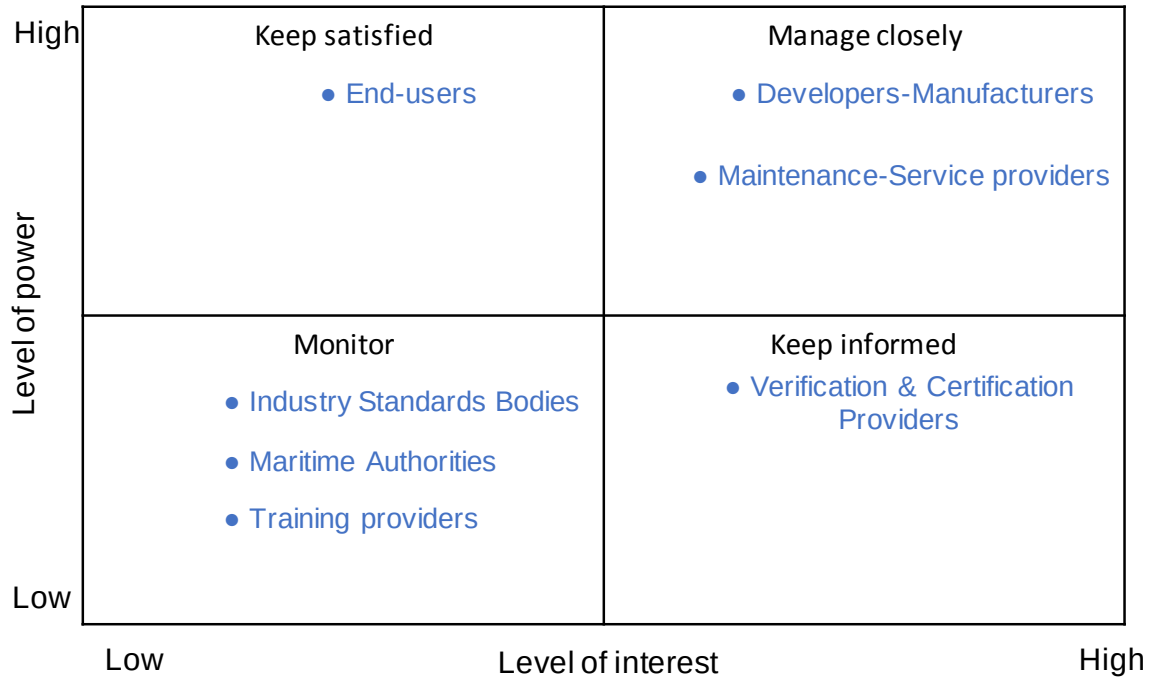


Figure 4: Placement of PALAEMON Stakeholders in the Power-Interest grid

- **Maintenance and Service providers** are placed in a position of high power and interest in the grid diagram, because their role in the proper function of the developed systems is crucial. The main reason they are placed in the "manage closely" field of the grid diagram is that they should always be ready to face every challenge and difficulty that may arise and provide a solution for every malfunction.
- **Developers and manufacturers** are placed in an even higher level in the grid diagram. It's very important to make them feel that the PALAEMON project is based on innovative ideas that can be implemented by them. The important part here is to influence them that the innovation of the components won't be a problem from the feasibility and functionality point of view of their work and won't create issues that may affect the design, technical as well as the performance level.
- The **end users** of the PALAEMON must be treated with extra attention and always keep satisfied, that is why they are placed in the corresponding field of the grid diagram. After all, if the outcome of the whole project is not acceptable from them, the project won't be considered successful, so every move and result of the project should be done and delivered by taking into account their opinion.
- **Training providers** are placed in a lower power and interest position. The PALAEMON consortium shall monitor if appropriate training programs are provided and whether the training procedures for the seafarers and passengers are performed exactly as required by the IMO and defined by the shipping company.
- **Verification and Certification Providers** should be kept informed about all the aspects that may concern them, because any idea as innovative, fresh and

revolutionary as may seem, should always, at first place, meet the standards and requirements defined by the recognized organizations and classification societies. Therefore, the construction of any component must comply with relevant operational and technical standards. Moreover, surveys must be carried out in order to monitor if these standards are maintained. In order for this process to be developed as smoothly as possible, the PALAEMON consortium shall keep informed the verification and certification providers about the technical and operational approvals that will be needed but also be very knowledgeable about their requirements.

- Regarding the **Maritime Authorities**, another important issue in the stakeholder understanding procedure is the monitoring of possible changes in the regulations and requirements that may arise from them and could affect the approval of one of the PALAEMON components.
- The **Industry Standards Bodies** should be treated in the same way. The PALAEMON consortium shall continuously monitor the changes that may arise and always comply with them.

Stakeholder's views change over time, so it is important to regularly check their opinion in order to prevent losing their interest. In summary, to better understand stakeholders it is crucial to know who they are in the first place, to identify if they are inside or outside of the organization, to determine their needs but also what it is expected from them, to engage with them accordingly and to revisit them regularly (Slater, 2012).

PALAEMON consortium consists of most of the identified stakeholders and those that are not part of the consortium are engaged (e.g. Verification and Certification Providers, Industry Standards Bodies) through workshops, interviews and surveys that are been conducted since the start of the project.

5.3 Stakeholder Management

A successful stakeholder management is based on the continuous review and the effective communication of the consortium with each stakeholder. All stakeholders should be involved in the process of creating goals and objectives. Stakeholder’s active participation is not guaranteed, but engaging them at an early stage of the project’s evolution will be helpful to ensure its success. Stakeholders are most likely to be actively engaged by a set of goals and objectives aimed at improving business performance and thereby show great interest in the project.

Riahi (2017) emphasised that the stakeholder management can be divided into five parts, which create the management cycle (Figure 5). The management of the project’s stakeholders includes the processes necessary to identify the groups or organizations likely to affect the project or to be affected by it (Section 5.1), to analyse the expectations of the stakeholders and their impact on the project (Section 5.2), but also to develop a good management strategy to effectively mobilize them by involving them in project decisions and implementation. Stakeholder management also pays particular attention to the communication with the stakeholders in order to understand their needs, expectations and requirements, as their satisfaction is of major importance.

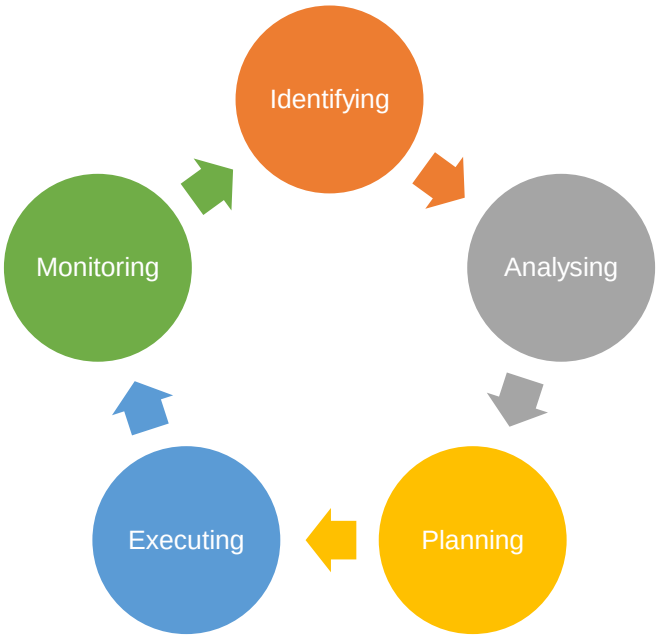


Figure 5: The management cycle (Riahi, 2017)

Figure 5 represents graphically the steps of the management cycle. Its step is described below:

- Stakeholders identification

This process consists the identification of people, groups or organizations that may affect a decision, or be affected by a project's activity, or its results as was analysed in Section 5.1. Some aspects that must be considered are stakeholder's interests, participation, interdependencies, influence and potential impact on the success of the project. One advantage of the PALAEMON project is that some of the major stakeholders are part of the consortium (e.g. shipping companies, ICT designers, naval architects, etc.), so this fact will be proved helpful in the communication and cooperation procedures.

- Stakeholders analysis

This step includes the analysis of stakeholder's responsibilities, contribution and commitment to the project. By specifying the needs and concerns of the various groups involved, the analysis will be proved useful in helping decision-making procedures when different stakeholders have interests and needs in conflict. This aspect is covered in Sections 5.1 and 5.2.

- Stakeholders planning

This process involves developing appropriate management strategies to effectively involve stakeholders as the project progresses, based on an analysis of their needs and interests. Based on the stakeholder register, environmental factors and organizational assets, the PALAEMON consortium will be in a position to develop the stakeholder management plan. This can be achieved by workshops, interviews and questionnaires. A series of interviews has taken place from NTUA, with major stakeholders outside the consortium (Flag state, shipping companies, etc.), in order to hear their opinion and understand their point of view. In addition, a similar procedure has been done by sending questionnaires to stakeholders and receiving back their valuable feedback, as a form of survey. It's important to mention the fact that one workshop has also already taken place, so progress has been made towards the successful execution of this step.

The two-day workshop took place on November 25 and 26 of 2019. NTUA coordinated this workshop on evacuation, which was hosted by ANEK onboard their Ro-Pax Ferry “KRITI II” that was moored at the Port of Piraeus (Greece). The purpose of the workshop was to collect information regarding the ship evacuation process, identify potential problems and areas for improvement of the current systems and procedures, elicit the needs and expectations of the stakeholders (consortium partners and guests), and map realistic use cases. The workshop included forty-four (44) representatives of stakeholders both within the PALAEMON project consortium and external guests (NTUA, 2020).

- Stakeholders execution

This process involves communicating and working with stakeholders to meet their needs and expectations, address issues that may arise, and promote appropriate stakeholder involvement in project activities. The PALAEMON consortium can use interpersonal and managerial skills in order to promote the involvement of the stakeholders (communication plan). This is also achieved by workshops, interviews and questionnaires-surveys as described in the previous step.

The WP2 was designed to have a two-stage approach. The first stage was completed at the of July 2020, and the first version of the PALAEMON components was presented along with the PALAEMON architecture. The second stage will start in November 2020. The goal is to conduct more interviews and a workshop to present the first version of the PALAEMON to a larger group of stakeholders and proceed to corrective actions based on their evaluation.

- Stakeholders monitoring

This process consists of an overall observation of the relations with the project's stakeholders and the adaptation of strategies and plans for their involvement. The goal is the maintenance or increase of the effectiveness of stakeholder engagement activities as the project is progressing. This process is supported by the project management plan, the major problems registry, work performance data and project documents (Riahi, 2017). The interviews and surveys mentioned in the previous steps won’t stop until the end of the project and it is in the consortium’s intensions to organize another workshop with the identified stakeholders, which will be conducted either on face to face scheme or via internet, depending on the prevention measures based on COVID-19 pandemic spread conditions.

Finally, PALAEMON Tasks 9.3, 9.4 and 9.6 include actions to maximize the impact of the stakeholders (e.g. engagement of stakeholders in standardization of policies-regulatory aspects). In particular, Task 9.3 will be dedicated to the assessment of the PALAEMON solutions’ equivalence with the existing statutory and Class requirements, through a gap analysis. Task 9.4 will set the methodology of PALAEMON life cycle assessment, through the use of a multi-criteria multi group decision assessor platform and Task 9.6 will focus on the identification of similar to PALAEMON projects and to the organization of workshops and similar events, as mentioned above.

6 SWOT

SWOT is an abbreviation for Strengths, Weaknesses, Opportunities and Threats, a framework that assists in classifying and assessing factors of potential success and failure. SWOT elaborates on PESTLE analysis findings by underlining direct links between factors and the organization/product examined, contributing to the compilations of a strategic plan. The framework also classifies the evaluating criteria as Internal or External examining the origin of cause and effect. Strengths and Weaknesses belong to the Internal class, considering factors that can be controlled by the examined product/business/project. Opportunities and Threats are classified as External, being driven by outside forces/organisations with less control over the effect on the examined subject.

6.1 Strengths

- Partners of the project cover the field from naval to ICT, regulatory bodies to end users in a wide range of dimensions. IoT and edge technologies, computer Science, web apps, VR (Virtual Reality) and AR (Augmented Reality), data management, wireless networks, security, drones, naval engineering, weather monitoring, ship status monitoring, governing bodies etc. PALAEMON has the capacity to analyse and develop systems within the project with high availability of expertise.
- PALAEMON offers a modular and adaptable system that can be tailored to every ship. Scalability is a key feature enabling the system to be deployed modularly from a minimal installation to a full-fledged management system.
- VR and AR are part of the offering, expanding the viewpoint of users and connecting them in real-time and in a safe way enhancing their operative capacities.
- PALAEMON offers a VR academy, augmenting training procedures. Training scenarios can be scripted and cover a wide variety of situations. Furthermore, training can take place with more flexibility in spatial and temporal conditions.
- ICT products require relatively lower capital investment compared to conventional ship renovations.
- PALAEMON can be offered as a retrofit option or as an architecture for a completely new building. This versatility can increase adoptability of the system.
- PALAEMON draws strength from both industrial and academic partners compiling an applicable high value and innovative product.
- Demonstrations showcasing the transition from a dense dataflow to a clear DSS that enhances mass evacuation processes with software and hardware will provide hands-on experiences for potential customers.
- We offer a complete system that is supported in every dimension by an extensive team of experts.
- Modularity enables upgrades in discrete steps, budget friendly options.

6.2 Weaknesses

- High complexity of the system might sacrifice reliability, a critical requirement.
- We should avoid drawing attention to the numerous modules risking to present an obfuscated picture to the users.
- Low utilisation rate of already onboard installed networks.
- The need for new infrastructure on ships.
- Technical limitations of MEV I retrofitting
- Cost justification of MEV II architecture vs conventional.

- Failure to get regulation compliance certification.

6.3 Opportunities

- Ageing of the planet population favours importance of accessibility and safety for travellers. Also, it increases the population significantly.
- Corporate responsibility compliant investment, PALAEMON system is designed to perform highly in all factors of a Life Cycle Analysis (LCA).
- Users are becoming more familiar with informational systems. To some extent they expect some elements of these technologies to be evident and part of the ship.
- Mass evacuation processes will be a hot topic in the future both in a pandemic and in a post-pandemic world. Thus, it is to be expected that regulations will undergo revisions.
- Modern wireless networks integration will increase its presence on ships and will make new PALAEMON installations more attractive as the infrastructure will be in part already available.
- Enhanced MEV II designed to be part of the ship structure can be repurposed in emergency conditions, e.g. isolated spaces for crowd controlling.

6.4 Threats

- Economic performance of the sector is low at the moment, this will be reflected in capital availability for investments in renovations.
- Competitors are developing similar platforms integrating novel technologies.
- Standards are in the spotlight as global health crisis is still a major consideration in every human activity. New regulations and policies introduced might not be favorable to large Mass Evacuation Vessels.
- Changes in the scene of big cruising companies might have a negative effect on investment in retrofitting systems as the upcoming period is considered transitional.
- Failure to get regulation approval will reduce this project to a dry-run case study.

6.5 SWOT Summary

SWOT analysis findings, as described above and summarized in Figure 6**Erreur ! Source du renvoi introuvable.**, allow for an optimistic outlook on the viability of the Palaemon project. Even though the threats and the weaknesses are to be taken into serious consideration, the presence of competition in the field is a clear indicator that potential of additional value in mass evacuation procedures is still existent. Weaknesses stem mainly from the complex and technically challenging problem, thus are manageable by design and implementation choices. The adverse economic environment and volatile regulation and policies frameworks are major inhibitors for a new system to successfully enter a market. However, these are not project specific and are part of the external environment that need to be accounted for in the planning and designing stages of the project. Palaemon project is supported by a competent team of experts and a consistent plan of action. The technological elements that will be part of the core offering are in line with market demands but also with the current special conditions. Furthermore, opportunities for Palaemon system are both economic and technological based, which can be interpreted as high potential for stakeholder interest.

Figure 6 PALAEMON SWOT Analysis

7 Current Shipping Market Analysis

7.1 Passengers Ferry Market

7.1.1 EU Sea Transport of passengers

Seaborne passenger transport refers to the passenger transportation across inland waterways, seas and oceans. It is an integral part of the public transport system for countries with coastal areas, islands or even large canals and rivers, and thus, an important form of passenger transport to and from EU countries. It consists of sea passenger routes between ports situated in the same country and international routes that link different countries' transport networks, e.g. across the English Channel. In EU is mainly carried by national or intra-EU ferry services and is mostly concentrated in three regions: the Baltic, the North Sea and the Mediterranean.

Figure 7: Seaborne passengers embarked and disembarked in all ports, EU-27, 2002-2018 (Source: EUROSTAT) (million)

Figure 7 presents the total sum of seaborne passengers embarked and disembarked in all EU-27 ports for 2002-2018.

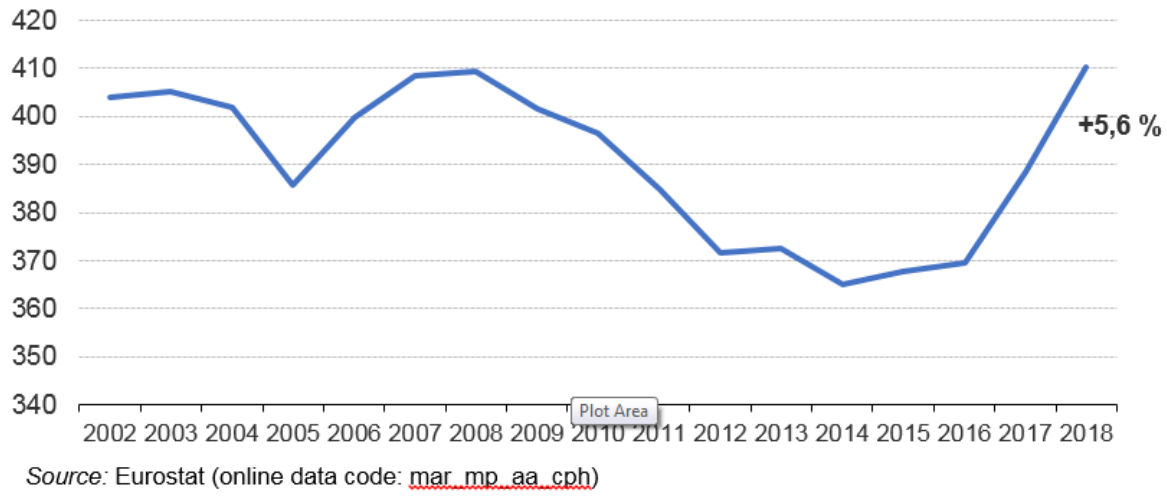


Figure 7: Seaborne passengers embarked and disembarked in all ports, EU-27, 2002-2018 (Source: EUROSTAT) (million)

According to the statistics provided by EUROSTAT, the number of passengers passing through EU ports (counted twice when embark in one EU port and disembark in another EU port) increased by 5.6% between 2017 and 2018, to almost 410 million passengers. It is noted that the total number of passengers embarking and disembarking in EU ports, after falling regularly until 2015, recovered in the last years reaching in 2018 similar levels as those in 2008.

Table 2, extracted from EUROSTAT, presents the seaborne passengers in all ports for 2016-2018 by country. It also shows for 2018, the estimated total number of passengers embarking ("outwards") and disembarking ("inwards"), as well as per cruise and non-cruise passengers, in EU ports by country.

Table 2 Seaborne passengers embarked and disembarked in all ports, 2016-2018 (EUROSTAT) (thousand)

	2016	2017	2018					Change 2018/2017(%)
	Total	Total	Inwards	Outwards	Cruise	Non cruise	Total	
EU-27	**369.636**	**388.463**	**205.802**	**204.374**	**13.709**	**396.467**	**410.176**	**5,6**
Belgium	1.118	1.270	562	565	792	335	**1.127**	**-11,3**
Bulgaria	3	2	0	3	0	3	**3**	**20,9**
Denmark	41.583	42.886	21.946	21.828	410	43.364	**43.774**	**2,1**
Germany	30.849	30.774	15.304	15.383	2.340	28.347	**30.687**	**-0,3**
Estonia	14.333	14.850	7.390	7.447	13	14.824	**14.837**	**-0,1**
Ireland	2.717	2.774	1.386	1.365	41	2.711	**2.751**	**-0,8**
Greece	65.248	70.023	36.277	36.243	476	72.044	**72.520**	**3,6**
Spain (1)	26.323	27.899	16.325	16.233	3.513	29.045	**32.558**	**16,7**
France	24.514	25.093	12.947	12.785	849	24.883	**25.732**	**2,5**
Croatia	29.661	31.327	16.557	16.101	66	32.591	**32.658**	**4,2**
Italy	67.273	73.876	42.773	42.609	4.826	80.556	**85.382**	**15,6**
Cyprus	59	72	14	15	2	26	**28**	**-60,9**
Latvia	723	994	521	542	0	1.063	**1.063**	**6,9**
Lithuania	303	297	154	169	0	323	**323**	**8,6**
Malta	10.690	11.286	5.992	5.986	156	11.822	**11.978**	**6,1**
Netherlands (2)	1.906	1.928	996	984	0	1.980	**1.980**	**2,7**
Poland	2.602	2.585	1.360	1.360	0	2.720	**2.720**	**5,2**
Portugal (3)	679	740	379	378	60	698	**757**	**2,3**
Romania	0	0	0	0	0	0	**0**	**-100,0**
Slovenia	28	31	12	12	0	24	**24**	**-21,1**
Finland	19.222	19.489	9.668	9.551	9	19.210	**19.218**	**-1,4**
Sweden	29.800	30.265	15.236	14.819	157	29.897	**30.055**	**-0,7**
United Kingdom	26.887	26.338	13.240	13.423	2.195	24.467	**26.662**	**1,2**
Iceland (2)	544	917	403	403	0	806	**806**	**-12,1**
Norway (4)	6.266	6.352	3.091	3.257	181	6.167	**6.348**	**-0,1**
Montenegro	110	119	45	54	0	98	**98**	**-16,9**
Turkey	1.250	1.377	688	695	141	1.242	**1.383**	**0,4**

(:) not available

	2016	2017	2018					Change 2018/2017(%)
	Total	Total	Inwards	Outwards	Cruise	Non cruise	Total	
EU-27	**369.636**	**388.463**	**205.802**	**204.374**	**13.709**	**396.467**	**410.176**	**5,6**

(1) Break in time series in 2018 because data coverage has improved.
(2) Data exclude cruise passengers.
(4) Data on international maritime passenger transport only.
Source: Eurostat (online data code: mar_mp_aa_cph and mar_mp_aa_cphd)

From the estimated total number of 410 million passengers embarking and disembarking in EU ports in 2018, ports in Italy and Greece have handled 85.4 million and 72.5 million seaborne passengers respectively, a combined share of 38.5% of the total number of passengers embarking and disembarking. Italy and Greece continued in 2018 to be the main countries in terms of EU seaborne passenger transport, followed by Denmark with 43.8 million, Croatia with 32.7 million and Spain with 32.6 million passengers embarking and disembarking.

High volumes are presented in countries with busy ferry connections to and from well-populated islands, and also in countries with ferry connections to other EU countries. The first category applies to countries such as Italy, Greece, Spain, Croatia and Portugal, while the second to countries such as Belgium, Denmark, Germany, Estonia, Ireland, France, Latvia, Lithuania, the Netherlands, Poland, Finland, Sweden and the UK. In another perspective, high volumes are presented whenever no alternative mean of transportation is available, namely traffic connections from/to islands, (e.g. Mediterranean) or when the land connections represent big detours (e.g. East and West Baltic Sea or certain traffics between mainland Europe and Great Britain). In general, countries with coastlines, islands and island regions (e.g., Greece, Italy, Spain and Croatia) tend to have connections with both a large volume of maritime passenger transport and a high domestic share. However, ferries are facing competition in the form of fixed links and low-cost airline carriers.

The generally small difference between the number of passengers embarking (“outwards”) and disembarking (“inwards”) in EU ports reflects the fact that seaborne passenger transport in Europe is mainly carried by national or intra-EU ferry services.

Table 3 presents the top 20 ports based on passengers embarking and disembarking.

Table 3 Top 20 ports embarking and disembarking passengers, 2018 (EUROSTAT) (thousand)

Rank 2018	Port	Sea	*	2016	2017	2018			Change 2018/2017 (%)
				Total	Total	Inwards	Outwards	Total	
1	Dover (UK)	Atlantic	**+1**	12.097	11.762	5.827	6.030	**11.857**	**0,8**
2	Helsinki (FI)	Baltic	**-1**	11.565	11.769	5.824	5.742	**11.567**	**-1,7**
3	Messina (IT)	Mediter.	**+1**	6.139	9.250	5.318	5.287	**10.604**	**14,6**
4	Tallinn (EE)	Baltic	**-1**	9.676	9.969	4.960	5.007	**9.967**	**-0,0**
5	Reggio Di Calabria (IT)	Mediter.	**+2**	5.569	8.602	4.638	4.697	**9.335**	**8,5**
6	Calais (FR)	Atlantic	**-1**	9.090	8.990	4.664	4.454	**9.118**	**1,4**
7	Piraeus (EL)	Mediter.	**+1**	8.038	8.591	4.410	4.517	**8.927**	**3,9**
8	Stockholm (SE)	Baltic	**-2**	9.980	8.631	4.269	4.266	**8.534**	**-1,1**
9	Palma de Mallorca (ES)	Mediter.	**+4**	6.431	6.862	3.696	3.641	**7.338**	**6,9**
10	Helsingor (Elsinore) (DK)	Baltic	**=**	7.526	7.310	3.611	3.542	**7.152**	**-2,2**
11	Helsingborg (SE)	Baltic	**-2**	7.514	7.319	3.545	3.592	**7.136**	**-2,5**
12	Napoli (IT)	Mediter.	**+2**	5.993	6.159	3.581	3.485	**7.066**	**14,7**
13	Paloukia Salaminas (EL)	Mediter.	**-2**	6.639	6.881	3.427	3.318	**6.746**	**-2,0**
	Perama (EL)	Mediter.	**-2**	6.639	6.881	3.318	3.427	**6.746**	**-2,0**
15	Algeciras (ES)	Mediter.	**+2**	5.599	5.525	3.013	2.940	**5.953**	**7,7**
16	Cirkewwa (MT)	Mediter.	**+2**	5.133	5.384	2.874	2.885	**5.758**	**7,0**
	Mgarr- Gozo (MT)	Mediter.	**+2**	5.133	5.384	2.885	2.874	**5.758**	**7,0**
18	Rodby (Faergehavn) (DK)	Baltic	**-2**	6.016	5.869	2.812	2.812	**5.625**	**-4,2**
19	Puttgarden (DE)	Baltic	**-4**	6.024	5.870	2.734	2.846	**5.580**	**-4,9**
20	Santa Cruz de Tenerife (ES)	Atlantic	**=**	4.521	5.058	2.683	2.684	**5.368**	**6,1**
Total top 20 ports (1)				**145.320**	**152.066**	**78.088**	**78.048**	**156.136**	**2,7**

Note: (*) column indicates number of positions lost or gained compared to 2017.
(1) Total figure for the ports being part of the top 20 ports of the countries reporting data during the reference year concerned.
Source: Eurostat (online data code: mar_mp_aa_pphd)

Among the reporting countries, in 2018 the top 20 passenger ports accounted for 38% of the total number of passengers embarking and disembarking, showing an increase of 2.7% from 2017. The port of Dover in the United Kingdom is the largest European port based on passengers embarking and disembarking, followed by Helsinki in Finland, Messina in Italy, Tallinn in Estonia, and Reggio Di Calabria in Italy.

Table 4 presents without double-counting, as far as possible, of the same passengers being reported as embarking in one port and disembarking in another port, and excluding cruise passengers, the total passengers transport to/from main ports for 2016-2018. EUROSTAT data reveal that total passengers transport to/from main ports for 2018 amounted to 219 million.

Table 4 Passengers (excluding cruise passengers) transport to/from main ports, 2016-2018 (EUROSTAT) (thousand)

	2016	2017	2018	Change 2018/2017 (%)
EU-27	**200.943**	**209.858**	**218.789**	**4,3**
Belgium	330	316	**327**	**3,6**
Bulgaria	-	-	**-**	**-**
Denmark	30.353	30.550	**30.881**	**1,1**
Germany	20.636	19.944	**19.680**	**-1,3**
Estonia	11.953	12.314	**12.255**	**-0,5**
Ireland	2.712	2.769	**2.703**	**-2,4**
Greece	31.806	34.527	**35.739**	**3,5**
Spain (1)	18.852	16.663	**18.170**	**9,0**
France (2)	22.159	21.268	**21.697**	**2,0**
Croatia	14.713	15.583	**16.374**	**5,1**
Italy	35.175	38.888	**45.040**	**15,8**
Cyprus	-	-	**-**	**-**
Latvia	510	953	**1.017**	**6,8**
Lithuania	303	297	**323**	**8,6**
Malta (3)	5.133	5.384	**5.758**	**7,0**
Netherlands	1.934	1.928	**1.980**	**2,7**
Poland	2.123	2.167	**2.230**	**2,9**
Portugal	314	338	**350**	**3,3**
Romania	-	-	**-**	**-**
Slovenia	-	-	**-**	**-**
Finland	18.609	18.831	**18.561**	**-1,4**
Sweden	27.906	29.635	**29.429**	**-0,7**
United Kingdom	22.808	22.354	**22.409**	**0,2**
Iceland	:	:	**:**	**:**
Norway (4)	6.160	6.242	**6.167**	**-1,2**
Montenegro	:	:	20	**:**
Turkey	1.100	1.259	1.242	**-1,4**

(:) not available
(-) not applicable
Note: Main ports are ports handling more than 200 000 passengers annually.

(1) 2017: partially estimated by Eurostat. Break in time series in 2018 because data coverage has improved.
(3) International passenger transport to/from Valletta not included.
(4) Data on international maritime passenger transport only.
Source: Eurostat (online data code: mar_mp_am_cft and mar_mp_am_cftt)

The breakdown of the total passengers transport to/from main ports of amount of 219 million for 2018, between national, international intra-EU and international extra-EU transport for each reporting country (excluding cruise passengers) is shown in Table 5.

Table 5 : Seaborne transport of passengers (excluding cruise passengers) between main ports in the reporting country and their partner ports grouped by main geographical areas, 2018 (EUROSTAT) (thousand)

	2018				
	TOTAL	**National**	**International intra-EU27**	**International extra-EU27**	**Unknown**
EU-27	218 789	136 575	68 467	14 022	29
Malta (1)	5 758	5 758	0	0	0
Portugal	350	348	2	0	0
Croatia	16 374	15 897	477	1	0
Greece	35 739	33 938	1 541	260	0
Italy	45 040	39 633	3 906	1 501	0
Spain	18 170	12 266	492	5 412	0
Germany	19 680	9 050	9 760	869	0
Denmark	30 881	9 256	17 906	3 720	0
France	21 697	4 167	1 956	15 561	14
Estonia	12 255	2 301	9 926	28	0
Poland	2 230	268	1 961	2	0
Sweden	29 428	3 066	24 863	1 499	0
Finland	18 561	618	17 734	209	0
Netherlands	1 980	8	34	1 924	15
Belgium	327	0	1	325	0
Lithuania	323	0	323	0	0
Ireland	2 703	0	381	2 322	0
Latvia	1 017	0	1 017	0	0
United Kingdom	22 409	2 838	19 571	0	0
Norway (2)	6 167	0	6 167	0	0
Montenegro	20	0	20	0	0
Turkey	1 242	9	1 011	36	187

(1) International passenger transport to/from Valletta not included.
(2) Data on international maritime passenger transport only.
Source: Eurostat (online data code: mar_mp_am_cft and mar_mp_am_cftt)

According to EUROSTAT data, seaborne passenger transport in the EU is carried out mostly between ports situated in the same country, a fact that reveals the dominant role of national ferry services in the EU seaborne passenger transport.

7.2 EU RO/PAX fleet

The passenger ferry sector includes the types of vessels of RO-PAX (Passenger/Car ferries) and pure passenger vessels with no Ro-Ro facilities. RO-PAX are defined as vessels which have a passenger capacity in excess of 50 people and where vehicles can be driven on and off a car deck or passenger vessels without RO-RO facilities connecting two places on a regular basis. The vessels must also have a high ratio of passenger capacity to cargo lane length.

The vessels are used for the passenger transportation purpose across inland waterways, seas and oceans. These ships are designed to link transport networks, particularly in sparsely populated areas, providing a vital transport link between otherwise isolated communities, and also are utilised to link different countries' transport network. Referring to the vessels deployed in passenger shipping transport in EU, mainly belong to national or intra-EU ferry services, with national ferry services having the dominant role.

Vessel sizes are typically grouped by gross tonnage, under four headings: small (up to 500GT); medium (500 up to 2,500GT); large (2,500 up to 60,000GT); and very large (more than 60,000GT). It is noted that there are substantial differences in the average size of vessels making port calls in various countries, with some countries, like Germany, Croatia and Italy, having a large number of small passenger vessels calling in their main ports.

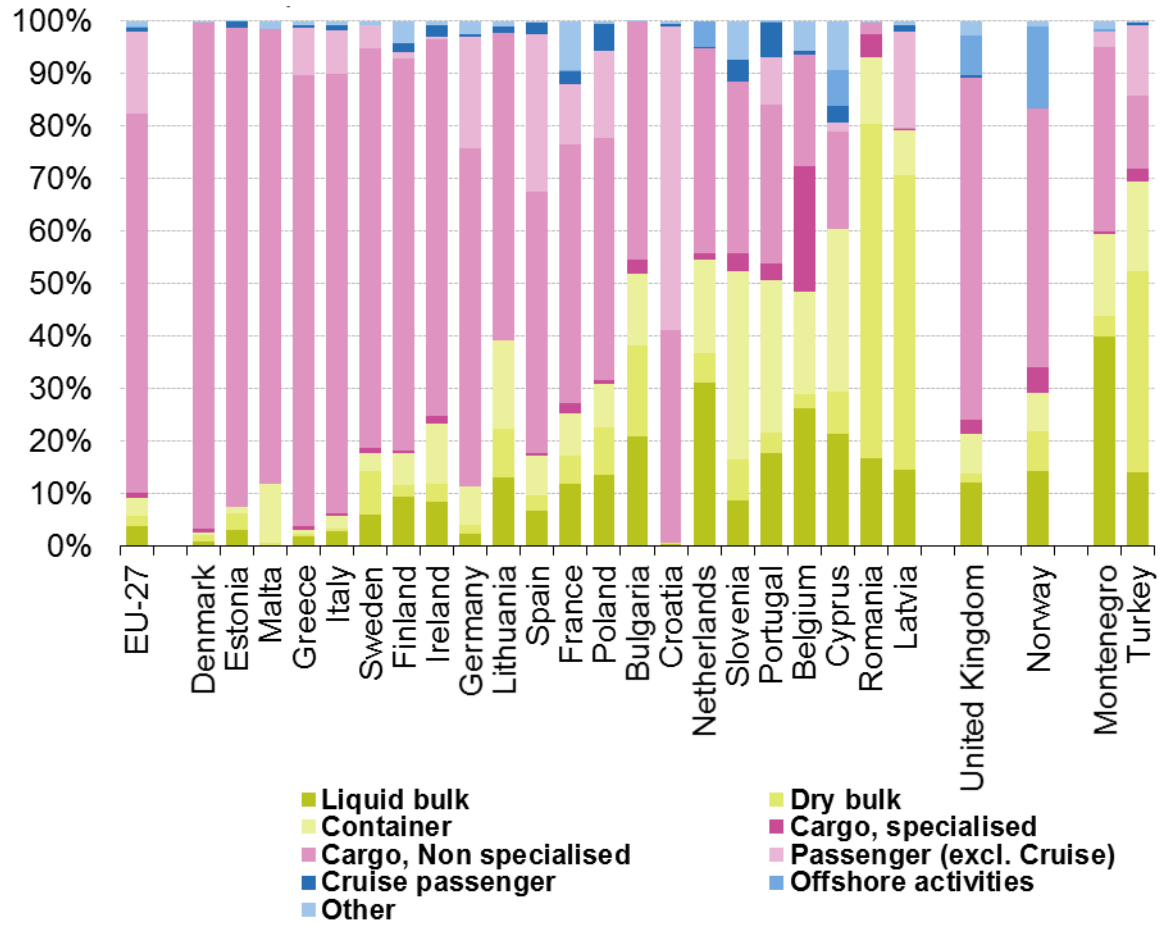
Table 6 and Figure 8 below present the vessels in main ports by type of vessel both as figures and as % share in number, respectively.

Table 6 Vessels in main ports by type of vessel, 2018, EUROSTAT

	Liquid bulk	Dry bulk	Container	Cargo, specialised	Cargo, Non specialised	Passenger (excl. Cruise)	Cruise passenger	Offshore activities	Other
EU-27	**83 903**	**42 510**	**75 639**	**18 832**	**1 583 699**	**340 921**	**19 790**	**2 535**	**22 548**
Denmark	2 478	4 432	1 434	2 635	313 183	0	462	0	651
Estonia	929	947	345	10	27 675	0	359	0	11
Malta	18	143	3 065	28	23 619	0	0	0	435
Greece	8 509	2 088	3 758	3 892	411 165	42 574	2 731	0	3 850
Italy	11 819	2 578	10 382	1 264	358 138	35 458	4 906	24	2 982
Sweden	4 838	6 946	2 794	784	62 656	3 462	0	0	711
Finland	3 009	689	1 940	224	23 928	438	554	0	1 326
Ireland	1 067	425	1 424	193	9 031	69	271	13	94
Germany	2 451	2 059	8 330	21	72 645	23 990	586	17	2 726
Lithuania	644	453	830	4	2 896	0	58	2	45
Spain	13 355	5 627	15 402	956	98 759	60 039	4 435	0	375
France	7 581	3 384	5 240	1 257	31 522	7 377	1 663	103	5 965
Poland	2 513	1 678	1 577	152	8 589	3 095	960	1	113
Bulgaria	647	543	429	83	1 417	0	0	0	2
Croatia	901	541	446	18	113 035	161 863	1 381	347	1 384
Netherlands	11 578	2 104	6 681	400	14 577	0	84	1 852	0
Slovenia	161	149	673	65	614	0	76	0	140
Portugal	2 508	552	4 098	447	4 278	1 258	943	19	13
Belgium	6 769	672	5 007	6 198	5 457	39	162	0	1 454
Cyprus	481	178	698	1	416	39	72	157	208
Romania	676	2 576	516	173	94	0	0	0	9
Latvia	971	3 746	570	27	5	1 220	87	0	54
United Kingdom	13 982	1 856	8 830	3 082	75 738	20	469	8 810	3 158

Norway	8 247	4 496	4 313	2 814	28 854	0	0	9 087	568
Montenegro	232	22	91	2	204	18	0	2	9
Turkey	8 324	22 784	10 185	1 387	8 300	7 984	249	0	233

Note: main ports are ports handling more than 1 million tonnes of goods or 200 000 passengers annually.
Data are based on inward declarations.
Source: Eurostat (online data code: mar_mt_am_csvi)



Note: main ports are ports handling more than 1 million tonnes of goods or 200 000 passengers annually. Data are based on inward declarations.

Source: Eurostat (online data code: mar_mt_am_csvi)

Figure 8 Vessels in main ports by type of vessel, 2018, EUROSTAT (% share in number)

7.3 Future Trends in EU Sea Transport

Since the beginning of the century a gradual consolidation has been undergoing in the ferry industry, as described in “Research for TRAN Committee – The EU Maritime Transport System: Focus on Ferries” (2016) study. Operators, in general, have concentrated their activities in one region only and have optimised their fleet by exploiting vessels’ economies of scale, as the study concludes. This is confirmed as tendency from the contraction of routes operated and overall fleet (i.e. size and capacity). From the latter, it can also be shown that ferry industry is flexible and inclined to adapt its potential to negative or positive variations in transport demand. The shrinking of operations via mergers and other type of collaborations has been among the key strategic decisions, which have taken place during recent years in the sector.

Regarding the traffic progress in the last two decades, the industry achieved the maximum up-to-then traffic volumes in 2008, and then figures were falling regularly until 2015, starting after to recover, reaching in 2018 similar levels than in 2008. However, the spread of the pandemic COVID-19 across EU during the first months of 2020 brought significant negative

impact on the sector. There was a rapid decline in the demand for passenger transport while, in most cases across EU, the implementation of emergency measures caused restriction in transfers and, consequently, large losses in maritime transport services. The priority set was to ensure the safety of passengers and seamen on board, and the companies operated in the sector were obliged to comply fully and immediately with all the measures and instructions required by the competent authorities, during the spread of the pandemic. The sector has tried to offset the losses arising from the significant reduction in traffic, proceeding to restructuring in itineraries through vessels replacing and temporary lay-ups.

The European Community Shipowners' Associations (ECSA) has published the "Sailing ahead: European shipping sets ambitious goals for its next chapter, Strategic priorities for EU shipping policy 2019-2024", where sets 10 priority areas in EU shipping industry: Climate and sustainability, Trade, Competitiveness, Internal market, Innovation and digitalisation, Human resources, Safety, Legal affairs, Taxation, and better regulation. The European shipping industry, with its diverse fleet of container ships, tankers, passenger ships, bulk carriers, offshore service vessels and many other specialised ships, is considered as a success story and a geostrategic asset to the EU in the face of global challenges. The article states that European shipowners operate one of the largest, youngest and most innovative fleets in the world, and moreover, that the fleet also boasts one of the best safety records in the world.

Furthermore, it points out that for the EU the European shipping plays an important geopolitical role, as ferries that transport goods and passengers are an integral component of the interconnected transport network of Europe. Under the scope of a rapidly changing global shipping landscape, considers that the world is changing much faster than before, and is being driven by challenges such as climate change, digitalisation, societal developments, barriers to free trade, and security concerns. It suggests that the EU shipping industry should be committed to placing itself at the forefront of change, and that European shipowners will continue to contribute to this process through pro-active engagement and innovation.

Shipowners will face major changes in the technology used to optimise operations, implement efficiency and security in vessels. Technological developments in the sector concern three main areas: Sulphur Oxides (SOx) limits according to the Emission Control Areas (ECAs), energy efficiency measures and ballast water treatment systems. As the International Maritime Organization's January 2020 cap on sulphur content in marine fuel, passenger shipping operators are obliged to place efforts for energy efficiency and fuel alternatives.

ECAs as well as EU legislation and regulatory pressures are driving to the reduction in SOx emissions from vessels by shifting towards low Sulphur fuel, to exhaust gas cleaning technologies to remove from emissions (wet and dries scrubbing), as well as the use of alternative low sulphur content fuels, LNG fuel, liquefied petroleum gas (LPG), etc. Bioenergy and biofuels are of growing interest at a time of rapidly rising world energy demand and high oil prices.

In the UNCTAD: United Nations Conference on Trade and Development publication of "Review of Maritime Transport", 2018 is stated that to address greenhouse gas emissions, complementing international efforts have been made. The efforts include the Paris Agreement under the United Nations Framework Convention on Climate Change and the 2030 Agenda for Sustainable Development, specifically Sustainable Development Goal 13 to

take urgent action to combat climate change and its impacts. According to UNCTAD, an important achievement was made at the International Maritime Organization (IMO) related to the determination of international shipping's fair share of greenhouse gas emissions reduction. In April 2018, an initial strategy on the reduction of such emissions from ships was adopted, according to which total annual greenhouse gas emissions would be reduced by at least 50 per cent by 2050, compared with 2008.

References in this chapter: (Eurostats, 2020) (POLICIES, 2016) (Association, 2019) (UNCTAD, 2018)

8 IT Market data

According to Kongsberg Digital in the report Maritime Software Landscape (Kongsberg, 2020), maritime companies are ready to digitalization. The report pointed out the following challenges slowing the adoption:

- Market insecurity
- Difficult access to quality data
- Many solutions to be evaluated, the emergence of new start-ups in the market.

On the other hand, the main advantages enumerated in the report are:

- Reduction of costs
- Safer operations
- Increase sustainability
- New business models

The report identified around 400 solutions in Figure 9.

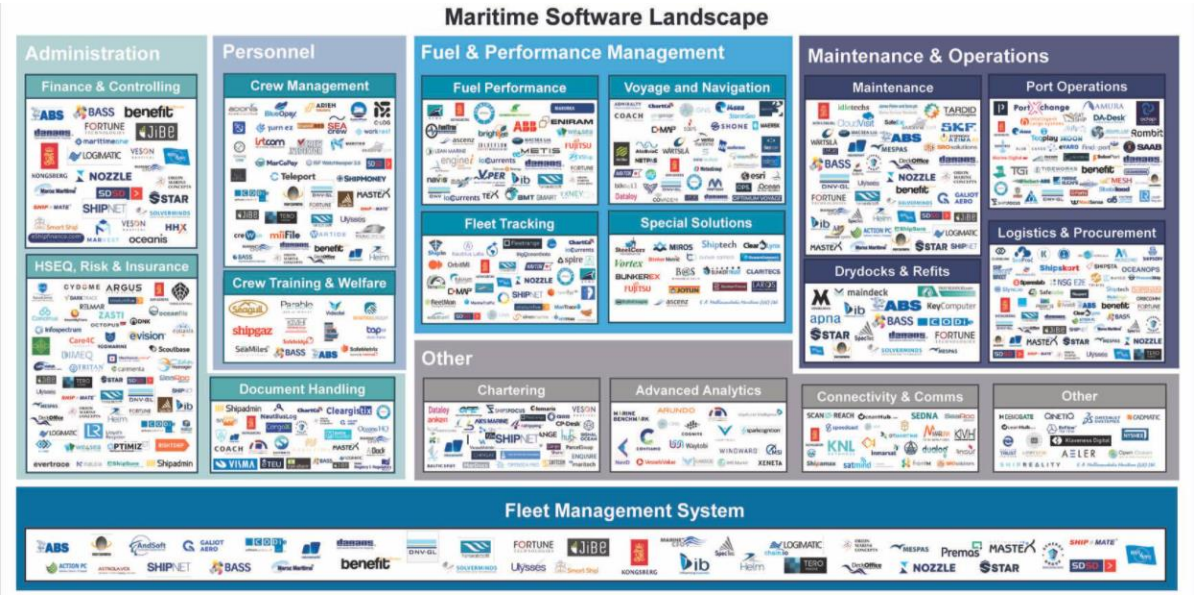


Figure 9 Maritime Software Landscape. Source: Kongsberg Digital (Kongsberg, 2020)

8.1 Key IT players

8.1.1 Related research projects

Project	Description
Lynceus2Market *(Sources: Cordis* (CORDIS, European Commission. Cordis, n.d.) *and Lynceus2Market* (lynceus, n.d.) *web site)*	"An innovative people localization system for safe evacuation of large passenger ships" The project Lynceus2Market was a H2020 project with Grant agreement ID: 636286. The project ended in November 2018 and it was coordinated by RTD TALOS LIMITED. Lynceus2Market presented several technology products with the goal of achieving: "safe and timely evacuation of large passenger ships". The main results can be summarized under the following subjects: A: On-board passenger and crew localization/tracking during emergency evacuation from a ship. B: Passenger and crew localization after abandoning the ship, for search and rescue.
SAFEGUARD (*Source:* (CORDIS, CORDIS European Commission, n.d.))	The project SAFEGUARD was a FP7 project with Grant agreement ID: 218493 "The 'Ship evacuation data and scenarios' project was established to provide full-scale data for calibration and validation of ship-based evacuation models. It also worked to propose and investigate additional benchmark scenarios to be used for certification analysis. They performed five full-scale passenger trials on three different vessels (two Ropax (passenger and cargo) ferries and one cruise ship). The project results, which succeeded in achieving all set objectives, were presented to the IMO in three information papers. They included recommendations for future revisions of regulations on evacuation analysis: five response-time data sets and two validation data sets. SAFEGUARD developed a validation protocol, together with acceptance criteria for evaluating maritime evacuation simulation tools. Finally, the project also evolved a set of enhanced certification scenarios."

8.1.2 Simulation tools

This section covers software evacuation analysis tools as the IMO requires an evaluation analysis conducted in new passengers' ships.

Tool	Description

Evi (*Source: BrookesBell* (Brookesbell, n.d.)) Developed by Safety at Sea (Brookes Bell)	"EVI is a computer based pedestrian and crowd simulation tool that can represent many individuals and assesses their behaviour and interaction with the surrounding environment, such as on a ship or in a building. EVI can be used throughout the design process to optimise designs at an early stage to ensure safe and efficient evacuation, thereby avoiding costly redesign."
PathFinder **Source:** *Thunderhead Engineering* (Engineering, 2020)	"Pathfinder is an emergency egress simulator that includes an integrated user interface and animated 3D results. Pathfinder allows you to evaluate evacuation models more quickly and produce more realistic graphics than with other simulators." Although PathFinder was initially devoted to buildings it can be used to simulate ship evacuation.
MarimiteExodus Source: Fire Safety Engineering Group (FSEG) University of Greenwich ((FSEG), 2020) Developed by FSEG University of Greenwich	"maritimeEXODUS is more than simply an evacuation model, it is a computer based laboratory for evaluating the emergency and nonemergency movement and behaviour of passengers and crew. maritimeEXODUS simulates people-people, people-fire and people-structure interactions. The model tracks the path of each passenger as they gather at their assigned assembly point and await the order to abandon the vessel. If the passengers are subjected to the effects of fire hazards, maritimeEXODUS takes this into account and predicts whether passengers are likely to survive the effects of fire hazards such as heat, smoke and toxic gases. maritimeEXODUS also takes into account the impact of heel and trim on travel speeds and can simulate the abandonment phase. maritimeEXODUS can be applied to: Accident reconstruction, Tourist vessels, Ro-Ro Ferries, Cruise Ships, Naval Vessels, Off-Shore Facilities, HSC, FPSOs."

Flame GPU Source: (FLAME, n.d.) 	As stated in (FLAME, n.d.): ”FLAME GPU is a high-performance Graphics Processing Unit (GPU) extension to the FLAME framework. It provides a mapping between a formal agent specification with C based scripting and optimized CUDA code. This includes a number of key ABM building blocks such as multiple agent types, agent communication and birth and death allocation. The advantages of our contribution are three-fold. Firstly, Agent Based (AB) modelers are able to focus on specifying agent behavior and run simulations without explicit understanding of CUDA programming or GPU optimization strategies. Secondly simulation performance is significantly increased in comparison with desktop CPU alternatives. This allows simulation of far larger model sizes with high performance at a fraction of the cost of grid-based alternatives. Finally, massive agent populations can be visualized in real time as agent data is already located on the GPU hardware”.

8.1.3 Commercial solutions related to PALAEMON.

The current section enumerates the main software tools that cover some areas of PALAEMON features.

Tool	Description
Hanseaticsoft (*Source: Hanseaticsoftl* (Hanseaticsoft, 2020)*)* 	“Cloud Fleet Manager is the web-based all-in-one software solution for shipping companies.” Cloud Ship Manager is devoted to manage the ship. The tool Cloud Ship Manager has the following modules: Schedule, towage jobs, Disturbance, Bunker, Garbage disposal, Circulars, Event Reporting, MRV & IMO, Vessels Certificates, Crew, Incidents, Inspections & audits, Maintenance, procedures, Blog, Offhire, Purchase, Office contacts, Risk Assessment.

	 *Figure 10 Cloud Ship Manager (Register, 2020)* This tool is focused in ship management, although some features are similar to those in PALAEMON such as, Events reporting, MRV & IMO, Incidents, Procedures, the tool doesn't provide real-time evacuation management.
Sertica HSQE Source: Sertica (SERTICA, 2020)	SERTICA HSQE allows the follow-up of documents. The product has the following standard modules: Analytics, activity Management, Data synchronization, document management, Fleet supervision and Dynamic Dashboard. Also, add-on modules can complete the SERTICA HSQE tool. Between the Add-on modules, the Event reporting module and the risk assessment provide some functionalities similar to PALAEMON.
BASS SAFIR (BASS, 2020)	BASnetTM SAFIR is a solution designed in order to analyze and report events arising from accidents and hazardous occurrences on board ships. SAFIR provides the following features: Hazard assessment, simplify risk assessment process, Alerts in high risk situations, Risk assessment progress, handle risk assessment.
AMOS from SpecTec Source: (SpecTec, 2020)	AMOS Quality and Safety covers the QHSE processes, managing all aspects of operations to support vessels in moving safely. Features: • ISM-ISO-ISPS Documents Management • Audit and NC-NM-INC Management • Risk Management

Unisea Emergency Source: (unisea, 2020)	Unisea Emergency improve the collaboration and provide situational awareness “UniSea Emergency helps control information and maximize team efficiency during a crisis or an emergency. It is built around the Emergency log and aids the organization to manage emergency incidents and drills by working smarter together in an easy to use workspace with a live data feed.”

9 Conclusions

Maritime market is gradually adopting Digital transformation thanks to the advantages that this is providing such as reduction of costs, reduction of communication costs, 5G arrival, although the maritime market has been reluctant, and the pace of adoption has been slow.

COVID-19 has seriously paralysed the sector and the losses has been significant (around 50 billion USD from the beginning of 2020 to September 2020) .although the prospects are promising, also it foreseen the new safety measurements should be implemented and these should be supported by technologies.

Analysis of the external factors in play shows that passenger shipping is in a transitional period in more than one aspect. Political and Economic uncertainty put the future of the whole sector in danger, although supportive measures are to be expected for such an important revenue generating activity. The Social factors are a mainly positive influence on the industry as the market segment addressed has positive prospects in the foreseeable future. Technological advances present great potential for innovative new builds and upgrading existing ones. Finally, the Environmental dimensions imposing new requirements that need to be met in the near future with the aid of technological and operational advances.

The PALAEMON stakeholders were identified in relation to their vicinity to the operation of the PALAEMON ecosystem and were situated in the following domains the operational work area, the containing business, and the outside world.

The PALAEMON stakeholders have been placed in the Power Interest grid to analyse how they influence the project success.

The stakeholder's management plan is presented in order to define the action to be implemented in order to achieve a successful involvement.

A comprehensive market analysis from two perspectives shipping and technological is provided analysing the current situation, the perspectives and the key IT players.

To conclude this report, the uncertainty is considerable, and the end of the current pandemic is not clear yet, although the prospects of a vaccine are encouraging the market and the end of the situation is drawing near. As the solutions provided by PALAEOMON will support the safety of the passengers it is foreseen that shipping companies will invest in improving safety where PALAEMON Technologies will be strategic.

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