PROJECT DELIVERABLE REPORT

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

D9.5 Exploitation, Sustainability & Business Plans- Life cycle cost& performance assessment (2)

A holistic passenger ship evacuation and rescue ecosystem

MG-2-2-2018

Marine Accident Response

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Abbreviations

6DoF	6-degree-of-freedom
AE	Acoustic Emission
API	Application programming interface
AR	Augmented Reality
CMS	Condition Monitoring System
CPRI	Common Public Radio Interface
COTS	Commercial Off-The-Shelf
DFB	Data Fusion Bus
DoA	Description of Action
DSS	Decision Support System
eCPRI	Evolved Common Public Radio Interface
EMSA	European Maritime Safety Agency
EPC	Evolved Packet Core
FMAGDM	Fuzzy Multi-Attribute Group Decision Making
GA	General Alarm
GCS	Ground Control Station
HMI	Human Machine Interface
ICT	Information Communications Technology
IMO	International Maritime Organization
IMU	Inertial Measurement Units
IOT	Internet of Things
ISM	International Safety Management
ISO	International Organization for Standardization
LCA	Life cycle assessment
LSA	International Life-Saving Appliance Code
MEV	Massive Evacuation Vessel
MOB	Man Overboard
NDT	Non-destructive tests
PaMEAS	Passengers Mustering and Evacuation Process Automation System
PIMM	PALAMEON Incident Management Module
RCC	Rescue Coordination Centres

SB	Smart Bracelet
SHM	Structural Health Monitoring
SME	Small and medium-sized enterprises
SMS	Safety Management System tool
SOLAS	International Convention for the Safety of Life at Sea
SOP	Standard Operating procedure
SRAP	Smart Risk Assessment Platform
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
TOPSIS	Technique of Ordered Preference by Similarity to Ideal Solution
TRL	Technology Readiness Levels
UAS	Unmanned Airborne System
UAV	Unmanned Aerial Vehicle
USAR	Urban Search and Rescue
VDR	Voyage data report
VHF	Very High Frequency
VR	Virtual Reality
VRG	Voyage Report Generator
VTOL	Vertical take-off and landing
VTS	Vessel Traffic Services
Weather Forecast Tool	WFT
WSM	Weather Service map

1 Executive Summary

The current deliverable summarizes the results of the following tasks:

- T9.2 Exploitation Strategy & PALAEMON Business Plan led by ATOS
- T9.3 Assessment of equivalence of PALAEMON solutions with existing standards and potential barriers led by DNV
- T9.4 Project solutions LCA and LCC analysis Led by DANAOS

Below, you can find the tasks descriptions from the DoA

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.

T9.3 Assessment of equivalence of PALAEMON solutions with existing standards and potential barriers (M18 -M42)

This task will be dedicated to the assessment of the PALAEMON solutions' equivalence with the existing statutory and Class requirements. The analysis will be based on an extensive gap analysis of the PALAEMON solutions to identify the gaps towards their validity and applicability from Class/ Statutory perspective. Then, the pathway to cover these gaps will be identified.

T9.4 Project solutions LCA and LCC analysis (M12 -M42)

This task will set the methodology of PALAEMON life cycle assessment. A multi-criteria multi group decision assessor platform will be developed supporting centralized real time evaluation of PALAMEON evacuation eco-system against predefined attributes by a group of evaluators from a diversity of disciplines. Results of analysis will be reported to assess in overall the effectiveness, readiness and feasibility of PALAEMON emergency and evacuation ecosystem application to shipping industry.

The document provides the second and final PALAEMON Exploitation deliverable "Exploitation, Sustainability & Business Plans - Life cycle cost &performance assessment (2)" (Grant Agreement No.: 814962), funded by the European Commission's Directorate-General for Mobility and Transport (DG MOVE), under its Horizon 2020 Research and Innovation Programme (H2020). The deliverable is the outcome of one task developed in Work Package 9 Raising Awareness, Standardisation and Exploitation Roadmap scheduled from M12-M36.

This report seeks to describe the fulfilment of the PALAEMON Exploitation objectives during this period in the aforementioned tasks (T9.2, T9.3, T9.4):

- Provide the assessment of equivalence of PALAEMON solutions
- Complete the life cycle assessment
- Review the external factors affecting PALEMON in the PESTEL analysis.
- Collect the list of Assets and results
- Update the partners' individual exploitation plans
- Identify the Intellectual Property Rights, TRL and standardization activities
- Lays out the Exploitation pathways
- Provide three business cases

PALAEMON provides a wide range of solutions to be offered to customers, since some results can be offered as stand-alone products and other results can be offered combined with others.

Furthermore, the consortium has set the basis to select, define and build a joint exploitation alternative when needed, based on the findings of the business approaches.

2 Introduction

The current document is structured as follows:

Section 1: Executive Summary.

Section 2: Introduction.

Section 3: Assessment of equivalence of PALEMON solutions with existing standards and potential barriers

Section 4: Life Cycle Assessment.

Section 5: PESTEL Analysis.

Section 6: List of assets and results.

Section 7: Individual Exploitation Plans.

Section 8: Intellectual Property Management and Standards contributions.

Section 9: Business model canvas.

Section 10: Exploitation Pathways.

Section 11: Business cases.

Section 12: Conclusions.

Section 13: Annex II Questionnaire.

Section 14: References.

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 PALAEMON 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. Figure 1 shows how 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 they are the central pillars of the rest of WPs.

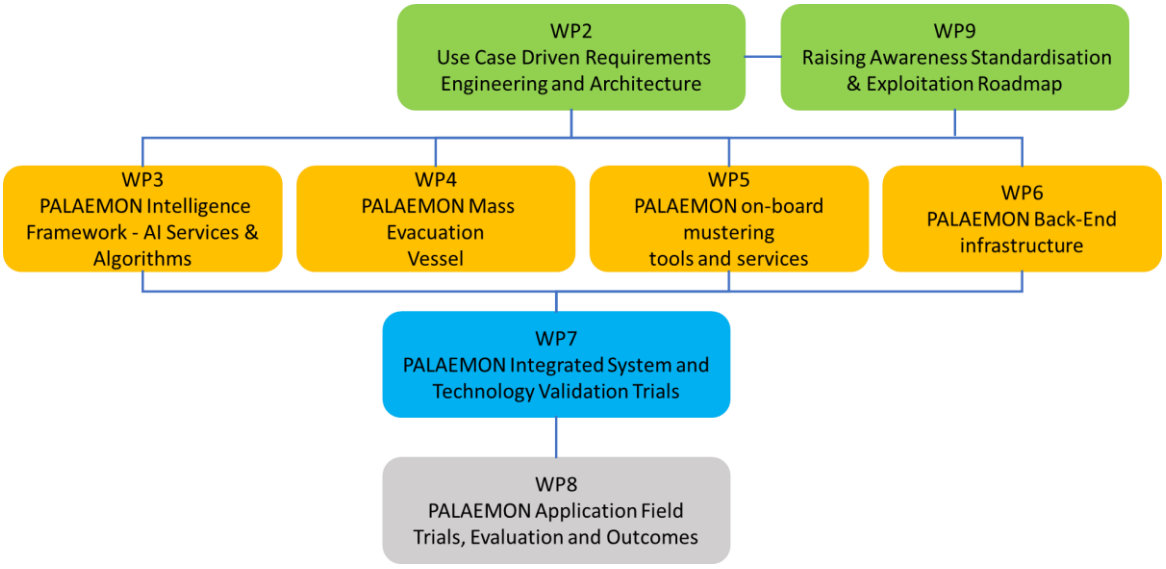


Figure 1.WP2 Dependencies with other WPs

WP9 started with the deliverable D9.1 PALAEMON Dissemination Plan and activities Report on M12 (May 2020) and it was followed by the deliverable D9.4 Exploitation, Sustainability & Business Plans & Exploitation activities [45] and D9.3 Market Analysis[32], which formed the first block of dissemination and exploitation deliverables in which the principles and foundations to achieve the success of the Dissemination and Exploitation tasks were established.

The second block of exploitation and dissemination deliverables is composed by the deliverables:

- D9.2 Dissemination activities report
- D9.5 Exploitation, Sustainability & Business Plans - Life cycle cost & performance assessment. (The current deliverable)

Furthermore, D9.6 Report on PALAEMON training activities and D9.7 Open research data pilot document are part of the WP9 deliverables.

2.2 Partner distribution & effort

Table 1 shows each partners distribution and effort.

Table 1. Partner distribution & effort

Partner	Role	T9.2	T9.3	T9.4
ADS	Aerospace	1		
ATOS	**ICT**	**10**		
KT	ICT	2		
ESI	Maritime	2		
JOAFG	Emergency Response	3		
NTUA	Maritime	1		3

ADSYS	ICT	1		
SIMAVI	ICT	2		
RNA	Maritime	1	1	
EFB	Engineering	1	1	2
AST	Maritime	1		1
DNVGL	Maritime	1	**5**	
ADMES	Engineering	1		
THALIT	Aerospace	1		
WIS	ICT	1		
ANEK	Maritime	1		
OELSR	Maritime	1		
DANAOS	Maritime	3		**8**
DSB	Maritime		1	

3 Assessment of equivalence of PALEMON solutions with existing standards and potential barriers

This chapter is dedicated to the assessment of the PALAEMON solutions' equivalence with the existing Statutory regulations (SOLAS, LSA Code, etc.) and Class rules and standards. The analysis is based on an extensive gap analysis of the PALAEMON MEV I solutions to identify any barriers towards their validity and applicability against Statutory regulations and Class rules. Then, the pathway to cover these gaps is identified.

For PALAEMON the following are identified:

- Further studies
- Modifications required
- Prototype tests

3.1 Innovative technologies developed in PALAEMON

3.1.1 MEV I

The MEV I as specified in D4.1[1] and D4.2[2]. The MEV I is designed to have a capacity of 315 persons and to have a power train capable of obtaining speeds of 5 knots. A reduced scale MEV demo will be manufactured and used as a concept demonstrator for the project.

In order to achieve an increased people capacity compared to Conventional Life boats, the design takes into account the test case ship provided by ANEK, which hosts a 150 person life boat and replaces it with the MEV I with capacity of 315 persons, without changing the General Arrangement of the existing ship or the space intended for the Life boat use. The interior is designed to accommodate the elderly, people with disabilities and ease of access to those demographics into the MEV I.

The structure will be manufactured using biocomposites and inflatable devices fitted to the hull. After a stability assessment, it is concluded that MEV I has sufficient stability for all loading conditions of both scenarios that were studied, i.e. with and without the inflatables deployed.

MEV I will be manufactured from composites, while the catamaran hull will be inflatable hull, situated at the bottom of the boat and inflated once the boat reaches the water. The structural drawings of MEV I have been produced in D4.2[2] along with guidelines, use laminate orientations and number, etc.

Biocomposites are chosen, following the circular economy mandates, because they present greater biodegradability and lower emission of greenhouse gases in their manufacturing procedure compared to the traditional synthetic compounds derived from petroleum.

MEV I offers ease of launching, using a two-step hydraulic mechanism described in D4.1[1] and D4.2[2]., it will be fully equipped with watertight doors, inflatable hull attachment points for the davit and power arrangement.

3.1.2 MEV II

MEV II is a conceptual design with structural drawings and naval architectural studies, the concept is tested in terms of simulations. The MEV II is designed and analysed considering CFRP (Carbon Fibre Reinforced Plastic) composite materials. Biocomposites were not considered strong enough for this kind of structure.

MEV II is a novel ship evacuation vehicle with two decks, constructed of composite materials, designed to accommodate 680 passengers and to have a power train capable of obtaining speeds of at least 5 knots as described in D4.4[3] and D4.5[4].

MEV II is also designed in order for the passengers to be immediately boarded in it, from the deck of the ship. This facilitates easy access for all passengers (Figure 2). The launching mechanism is also very straightforward without having to move the MEV II from the initial position. The passengers will embark and then the MEV II will be lowered to the sea only using the ropes from which the MEV II is attached on the ship (Figure 3).

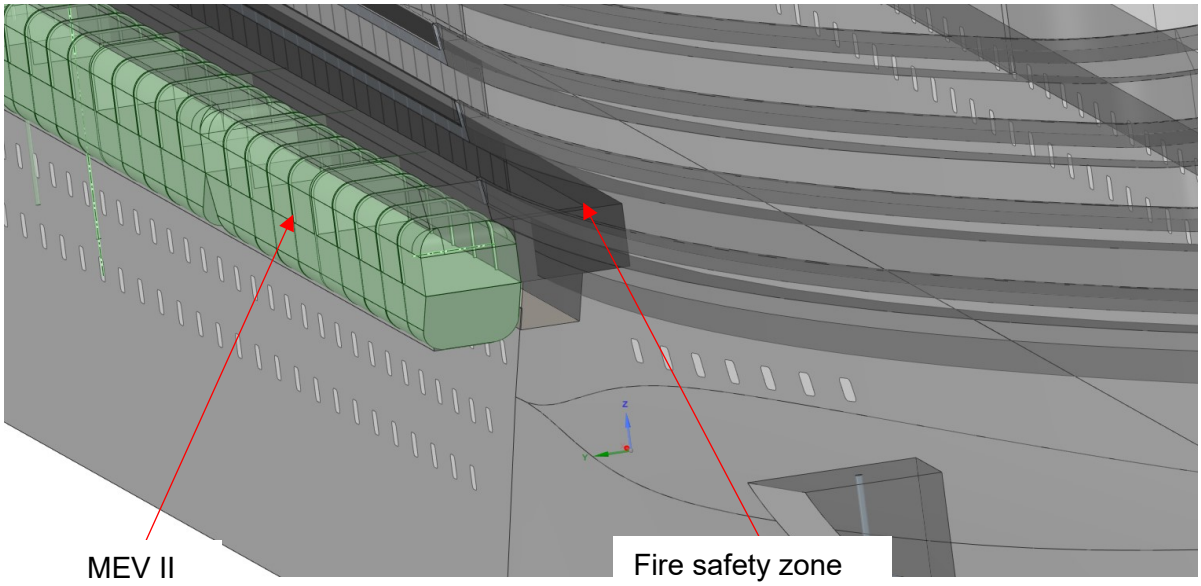


Figure 2 Integration of MEV-II on ship and also buffer zone for fire safety, following SOLAS

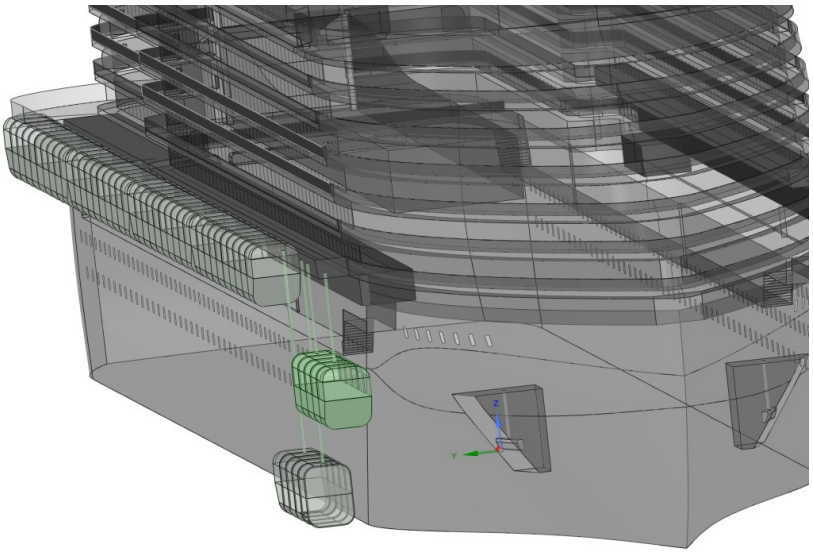


Figure 3 Launching MEVs

3.1.3 ICT ecosystem

Following operation categories for evacuation and monitoring as well as the infrastructure and equipment they utilize, as they have been analysed and described in previous chapters, are shown in Table 2.

These comprise the main structure of the ICT ecosystem, a novel design developed as part of the PALAEMON Concept.

Table 2 PALAEMON ICT Ecosystem

Smart Evacuation	Ship Monitoring	Global (Evacuation & monitoring)	Post-incident Analysis	PALAEMON Academy
Smart Cameras	Ship Health Monitoring (Motion sensors)	Data Fusion Bus (Access + Core)	Safety Management System (Ship & Shore)	eLearning Platform
VDES Transceiver + SW	Ship Health Monitoring (Acoustic sensors)	Ship Stability Toolkit	Voyage Report Generator	VR OnSite Training
PaMEAS	Smart Safety System	AR Glasses		
Evacuation coordinator	Weather Forecast Service			
Weather Forecast Toolkit (DSS)				
Decision Support System (DSS)				
PALAEMON Incident Management Module (PIMM)				
Smart Risk Assessment Platform (SRAP)				

3.2 Gap analysis of PALAEMON systems

3.2.1 The alternative design process

New designs and novel concepts in shipping that are not covered by traditional classification prescriptive rules and international standards, prior to their acceptance and possible implementation are evaluated through dedicated procedures for proof of equivalence against current standards. The alternative design process is such a procedure and is described in a following paragraph.

IMO provides the methodology for the Alternative Design process in the document 'Guidelines for the approval of alternatives and equivalents as provided for in various IMO instruments' [5]. The process for approval of preliminary design is illustrated in Figure 4 and the process for final design in Figure 5.

The LSA Code provides a methodology for alternative design and arrangements for life-saving appliances and arrangements. Life-saving appliances and arrangements may deviate from the requirements, provided that the alternative design and arrangements meet the intent of the requirements concerned and provide an equivalent level of safety. When alternative design or arrangements deviate from the prescriptive requirements, an engineering analysis, evaluation and approval of the design and arrangements shall be carried out in accordance with this regulation (LSA Code, Regulation 38 Alternative design and arrangements). A detailed guide for the evaluation is found in MSC.1/Circ.1212/Rev.1.

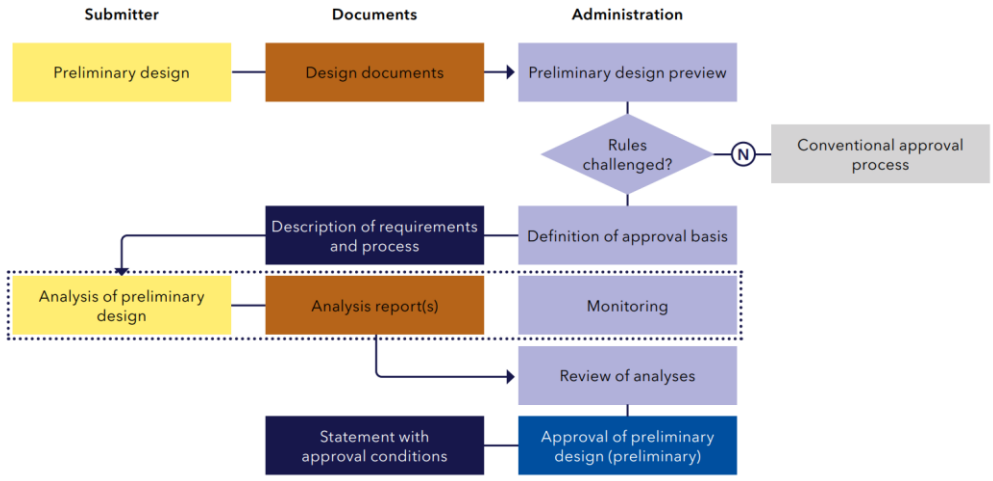


Figure 4 Approval process of preliminary design

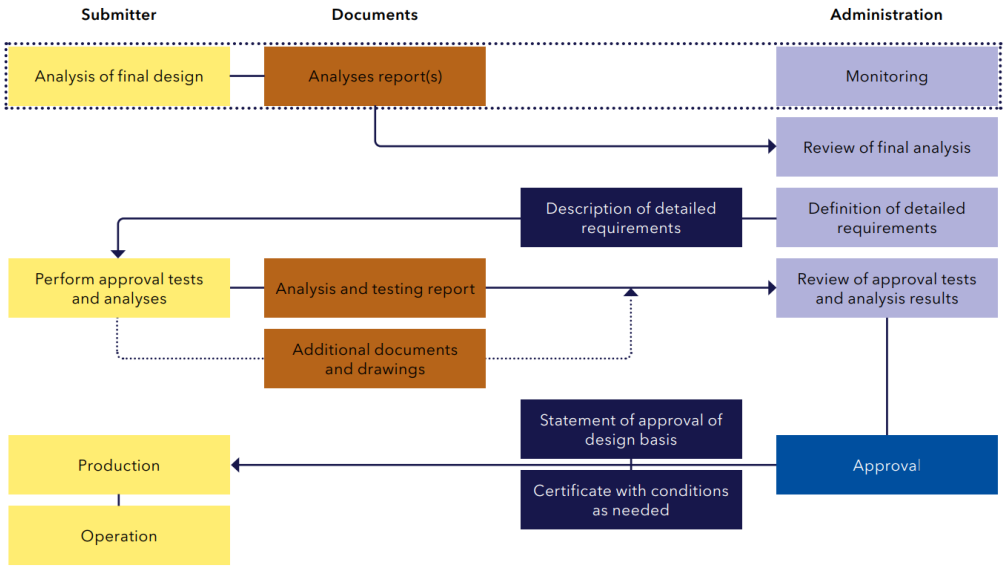


Figure 5 Approval process for final design

Formally, the Alternative Design process is separated into phase 1, preliminary design (milestones 1 and 2); and phase 2, development of final design (milestones 3, 4 and 5). The milestones are:

- Development of a preliminary design;
- Approval of preliminary design;
- Development of final design;
- Final design testing and analyses;

When applying the Alternative Design approval process, several iterations may be needed to build confidence towards the approval body (Flag Administration) and prove equivalent safety.

3.2.2 Gap analysis for MEV I & II

A gap analysis is aimed to assess deviations in compliance of an asset against international and local regulations, as well as project and clients' specifications. It is aimed to provide detailed information regarding the areas of deviation and/or lack thereof, which need to be addressed.

The PALAEMON MEV I & II concepts will be assessed against deviations and gaps in the following categories, as shown in Table 3.

1. Alternative design process
2. Passenger Capacity
3. Principal particulars – Structure
4. Maximum and service speed
5. Power/ Energy Autonomy
6. Trim & stability
7. Configuration of the passengers' space (habitability)
8. Manning, Familiarity & Crew training
9. Passenger embarkation arrangement
10. Propulsion plant
11. Electrical plant
12. Inspection, maintenance, testing and overhaul
13. Launching mechanism
14. Machinery & Equipment

Table 3 Assessment Categories

Category	Rules & Regulations	Gap	Proposed solution
Alternative design process	**SOLAS, Chapter III, Part B Regulation 4 SOLAS, Chapter III, Part C Regulation 38**	Alternative design is permitted as long as it is approved by the Administration (Flag).	Follow alternative design process (out of project scope).
Passengers Capacity	**SOLAS, Chapter III, Regulation 21** **LSA Code, 4.4.2 Carrying capacity of lifeboats** *"No lifeboat shall be approved to accommodate more than 150 persons"*	MEV I has a capacity of passengers (313 passengers and 2 crew members) higher than regulatory limits for lifeboats MEV II has a capacity of passengers (680	A study is proposed to explore the background of the rule for maximum 150 persons onboard a lifeboat, to arrive at a proposal for an equivalent study for the MEV (out of project scope).

Category	Rules & Regulations	Gap	Proposed solution
		passengers) higher than regulatory limits for lifeboats	
Principal particulars - Structure	**SOLAS, Chapter III, Regulation 11** **LSA Code, 4.4.1 Construction of lifeboats** *"All lifeboats shall be properly constructed and shall be of such form and proportions that they have ample stability [...] All lifeboats shall have rigid hulls [...], shall be of sufficient strength [...], hulls and rigid covers shall be fire-retardant or non-combustible."*	The structure of the MEV I is to be constructed from biocomposites. The structure of the MEV II is to be constructed from Carbon Fiber Reinforced Composites (CFRP) for maximum weight to strength ratio of the structure as specified in D4.2 and D4.4	A feasibility study is proposed to confirm compliance with the regulation.
Maximum and service speed	**LSA Code, 4.4.6 Lifeboat propulsion** **LSA Code, 4.4.7.2** *"4.4.6.8 The speed of a lifeboat when proceeding ahead in calm water, when loaded with its full complement of persons and equipment and with all engine powered auxiliary equipment in operation, shall be at least 6 knots and at least 2 knots when towing the largest liferaft carried on the ship loaded with its full complement of persons and equipment or its equivalent…"*	Not specified in this study.	The PALAEMON Concept should be equipped with proper machinery that ensures compliance with the regulation. A hydrodynamic analysis and prototype test is proposed to confirm compliance with the regulation.
Power/ Energy Autonomy	**LSA Code, 4.4.6 Lifeboat propulsion** *"4.4.6.8 […] Sufficient fuel, suitable for use throughout the temperature range expected in the area in which the ship operates, shall be provided to run the fully loaded lifeboat at 6 knots for a period of not less than 24 h."*	Not specified in this study.	A hydrodynamic analysis and a prototype test are proposed to confirm that suitable and sufficient fuel shall be provided to run the fully loaded lifeboat at 6 knots for a period of not less than 24 h.
Trim & Stability	**LSA Code, 4.4.1 Construction of lifeboats** **LSA Code, 4.4.4 Lifeboat buoyancy** **LSA Code, 4.4.5 Lifeboat freeboard and stability**	After a stability assessment in D4.2 it is concluded that the MEV I has sufficient stability for all loading conditions of both scenarios that were studied, i.e. with and without the inflatables deployed.	For the MEV I a prototype test is proposed, while for the MEV II a stability assessment is proposed.
Configuration of the passengers' space (habitability)	**LSA Code, 4.4.1.5 Construction of lifeboats** **LSA Code, 4.4.1.8 Construction of lifeboats** **SOLAS Ch. III, Part B, Reg 11**	Showcased but not finalized in this study.	The interior design or the lifeboat, in order to comply with the regulation should satisfy that seating shall be provided on thwarts, benches or fixed chairs which are constructed so as to be capable of supporting: •a static load equivalent to the number of persons each weighing 100 kg for which spaces provided. •a load of 100 kg in any single seat location when a lifeboat to be launched by falls is dropped into the water from a height of at least 3 m; and •a load of 100 kg in any single seat location when a free-fall lifeboat is launched from a height

Category	Rules & Regulations	Gap	Proposed solution
			of at least 1.3 times its free-fall certification height.
Manning, Familiarity & Crew training	**SOLAS Chapter II, Part B, Regulation 10**	MEV I and MEV II are novel concepts and specific crew training for the innovations developed is required.	Additionally, a suitable approach on training, watch-keeping and emergency preparedness related to the evacuation in the form of learning course notes has been created by DNV, RNA and NTUA and is integrated in the PALAEMON Academy scheme (included in D9.6 [6])
Passenger embarkation arrangement	**SOLAS Ch. III, Part B, Reg 11** **SOLAS Ch. III, Part B, Reg 21** **SOLAS Ch. III, Part B, Reg 23** **LSA Code, 4.4.3 Access into lifeboats**	MEV I "Smart Evacuation" is a novel concept for the evacuation of people with mobility problems, disabilities, injured, children and elderly. As specified, during evacuation of the vessel and embarkation to the MEV I, people may board directly from the deck without the use of special access systems.	Follow alternative design process (out of project scope).
Propulsion plant (Main engine, shafting and propulsor) **& Electrical plant** (Electric generating plant, electric installation, transformers, batteries, switchboards, lighting, cable installation, etc.)	**LSA Code, 4.4.6 Lifeboat propulsion** *"4.4.6.8 The speed of a lifeboat when proceeding ahead in calm water, when loaded with its full complement of persons and equipment and with all engine powered auxiliary equipment in operation, shall be at least 6 knots and at least 2 knots when towing the largest liferaft carried on the ship loaded with its full complement of persons and equipment or its equivalent. Sufficient fuel, suitable for use throughout the temperature range expected in the area in which the ship operates, shall be provided to run the fully loaded lifeboat at 6 knots for a period of not less than 24 h."*	Taken into consideration but not specified in this study.	A hydrodynamic analysis and a prototype test are proposed to confirm compliance with the regulation.
Inspection, maintenance, testing and overhaul	**SOLAS Ch. III, Part B, Regulation 19** *"[…] each lifeboat shall be launched and manoeuvred in the water by its assigned operating crew, at least once every three months during an abandon ship drill."* **SOLAS Ch. III, Part B, Regulation 20** *Specifies processes and directions on Operational readiness, Maintenance, Maintenance of falls, Spares and repair equipment, Weekly inspection, Monthly inspections, Periodic servicing of*	Not specified in this study.	It is advised that the same requirements for passenger vessels are followed for the MEV I and MEV II, as we do not observe any additional features in PALAEMON that could incur any different system in the inspection program.

Category	Rules & Regulations	Gap	Proposed solution
	launching appliances and on-load release gear.		
Launching mechanism	**SOLAS Ch. III, Part B, Reg 11** **SOLAS Ch. III, Part B, Reg 19** **SOLAS Ch. III, Part B, Reg 21** **SOLAS Ch. III, Part B, Reg 24** **LSA Code, 4.4.1 Construction of lifeboats** **LSA Code, 4.4.3 Access into lifeboats**	As specified in D4.2 a novel launching mechanism was selected operating via a two-step hydraulic mechanism. The holding beams are rotating (stopped at 45 degrees angle) on the launching structure with the MEVs to bring them to the launching position and after embarkation, the MEVs are lowered to the sea where the inflatables will be inflated.	A load-strength analysis is proposed to confirm compliance with the regulation.
Machinery & Equipment	**LSA Code** **Marine Equipment Directive 2014/90/EU**	Not specified in this study.	Fittings and equipment used should be in accordance with the Marine Equipment Directive 2014/90/EU. Appropriate control and instrumentation, pumps, piping, insulation, ventilation and air conditioning, navigational equipment, radio and communication equipment, machinery, mooring outfit, hatch covers, manholes, doors, ladders, rails, windows and scuttles, lifesaving appliances, firefighting system, deck covering, stores, etc. are to be selected in order to comply with the regulations.

3.2.3 Gap analysis for ICT integrated system

The PALAEMON Concept operation categories for evacuation and monitoring as well as the infrastructure and equipment they utilize, are displayed in Sec. 3.1.3 Table 2 PALAEMON ICT Ecosystem and consist of:

- Smart Evacuation
- Ship Monitoring
- Global (Evacuation & monitoring)
- Post-incident Analysis
- PALAEMON Academy

From our review within PALAEMON, we have identified and propose that these operation categories, which are innovative concepts, fall into the scope of an approval process based on the Alternative Design process, previously described.

Over and above, the equipment used should be in accordance with the Marine Equipment Directive 2014/90/EU. Marine equipment can only be installed on board ships flying the flag of an EU country, Norway, Iceland and other flag states if it is marked with the MED mark of conformity, also known as the “wheelmark”.

Additionally, a suitable approach on training, watchkeeping and emergency preparedness related to the evacuation should be created. A pilot version for an e-learning course has been drafted by DNV Academy and is integrated in the PALAEMON Academy scheme (included in the D9.6 [6].)

3.3 Conclusions

3.3.1 Main Barriers

The PALAEMON Concept includes novel technologies and infrastructures posing new barriers and obstacles affecting its integration in the maritime standard process.

In this study, a gap analysis was performed based on the conducted research and technologies described in the PALAEMON Concept.

Major showstoppers that have been identified are the passenger capacity exceeding the SOLAS regulatory limits and the novel, two-step hydraulic launching mechanism.

3.3.2 Next steps / further studies

In all cases in which it is applicable, the novel and innovative features of the PALAEMON Concept should follow the Alternative Design Process.

Aiming to overcome the barriers that became apparent in this gap analysis, a series of studies including a feasibility analysis, a hydrodynamic analysis, a load-strength analysis and prototype tests as well as the usage of appropriate marine equipment are proposed.

4 Life Cycle Assessment

4.1 Introduction to Life cycle assessment

Life cycle assessment (LCA), sometimes also referred to as life cycle analysis, is used to measure the impact from many aspects on the environment associated with the life cycle of a product, process, or service [7]. Each phase of a product's, process' or service's life cycle can affect the environment in different ways, i.e. extraction of materials from the environment, the manufacturing of the product, the use phase (i.e. the operational phase) and what happens to the product after it is no longer used (Figure 6). These phases are stated as life cycle stages. LCA is utilized to evaluate the environmental impact from the very first life cycle stage to the last and all the intermediate stages in between. LCA can be used for the improvement of a product development and for issues concerning sustainability, marketing, strategic planning and policymaking [8]

Figure 6: The product life cycle stages [8]

LCA is a standardized methodology, as the International Organization for Standardization (ISO) provides standards for LCA in ISO 14040 [9] and 14044 [10]. These standards describe the four main phases of an LCA, which are also graphically represented in Figure 7:

- Goal and scope definition;
- Inventory analysis;
- Impact assessment; and
- Interpretation.

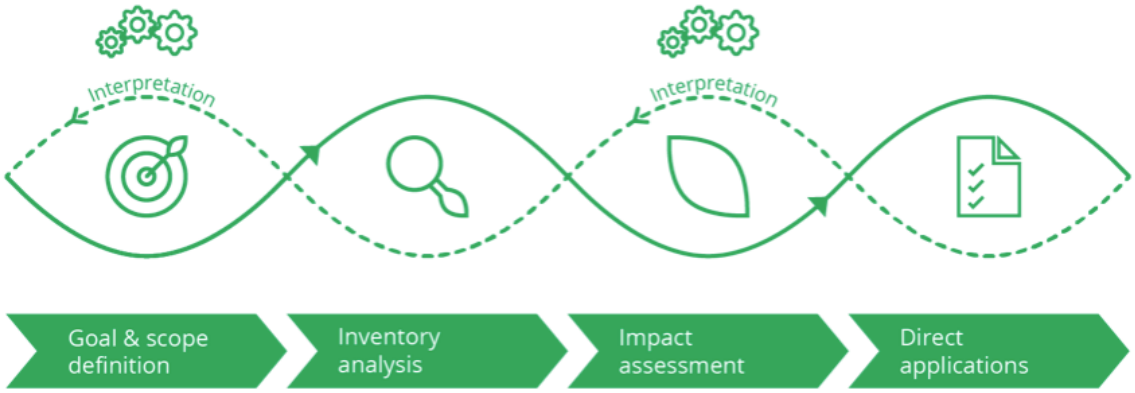


Figure 7: The main phases of an LCA [8]

A simplified version of the aforementioned method of analysis will be utilized for the purpose of this document.

4.2 Application of the simplified methodology

The purpose of the analysis presented in this subsection is to study the life cycle of an incident and to evaluate the impact that PALAEMON can have on it.

The conducted study will be evaluated in three different stages; as stated in the previous section; of analysis:

1. Safety management;
2. Incident assessment and management; and
3. Post-incident analysis.

The safety management stage is referring to all the safety procedures held in order to be prepared in case of an incident, such as maintenance, training, drills, preparation of files for regulatory compliance, etc. The incident assessment and management stage starts after the occurrence of an incident, it contains the assessment of the bridge team whether to sound the General Alarm (GA) or not, the mustering process, the embarkation to the lifesaving appliances and the ship abandonment. The final stage is referring to the analysis of the incident as a whole and its consequences, after it has ended.

Specifically, this means that through a series of evaluation criteria the effect that PALAEMON has on different aspects, regarding the evacuation procedure, is assessed separately for these three stages. The aim is to identify and evaluate how much and in which terms does the PALAEMON ecosystem affects each of the above-mentioned stages in the terms of the below stated aspects. Accurately, the above-mentioned stages where evaluated in terms of:

- Cost;
- Safety level;
- Human factor; and
- Environment.

In order to perform this analysis, a series of interviewees answered multiple questions, from which valuable data were obtained. The interviewees had to answer the questions based on a comparison of the current situation to a situation where the PALAEMON ecosystem will be used. Therefore, the people who answered the questions had to estimate how the

PALAEMON interpretation would affect a company's safety management cost. The safety management cost is referring to different aspects of the evacuation, starting from the prevention (i.e. safety documents management, evacuation drills and training) to the evacuation procedure itself and the maintenance procedures. The cost of the same procedures with the utilisation of the PALAEMON components had to be considered, in order to be compared with the current cost. The feasibility check of PALAEMON emergency and evacuation ecosystem application to shipping industry will be based on the results of this step. Provided that accurate cost estimations are hard to be taken even with a rough order of magnitude a relative estimation will be performed by assessing the marginal cost of the incorporation of the PALAEMON ecosystem in the overall safety management of a shipping company taking also into account the advantages that PALAEMON offers in the avoidance of emergency incidents. This relative comparative estimation will be held through the utilization of questionnaires.

A similar procedure was held in order to specify how much PALAEMON affects, the safety level and the human factor throughout the three pre-set time stages. By default, it is difficult to measure the impact of these soft aspects quantitatively. The questionnaires were disseminated to maritime experts who had to answer to a series of ranking questions. Each answer will have a different weight, depending on the expertise of the person answering on the specific topic.

The questions concerning the safety level asked the experts to estimate the safety level without the use of PALAEMON and then by utilizing its components and the advantages it offers.

Similarly, through the questions regarding the human factor useful information was extracted from the experts, concerning their opinion on how much PALAEMON helps the people using its components and whether it enhances and how it affects their situational awareness.

The effectiveness and readiness check of PALAEMON emergency and evacuation ecosystem application to shipping industry was based in the safety level and human factor study respectively.

Environmentally, the estimation of the impact that PALAEMON has on the evacuation as a whole will be based on the fact that for the construction of the Mass Evacuation Vessels (MEV I) will be mainly based on biomaterials.

The format of the questions allows the interviewees (experts) to grade the efficiency and the impact of PALAEMON ecosystem against the current situation. This is accomplished by a numerical assessment of the effect of PALAEMON from 1 to 5 or otherwise from the lowest (1) to the highest impact (5). More accurately, the 1-2 ranking determines a negative effect, 3 determines a neutral effect and 4-5 a positive effect. The questionnaire is presented in Annex I.

On top of the above approach that is related to the use of questionnaires as a technique to retrieve feedback from subject matter experts (SMEs), a secondary method is followed by processing SME's feedback to a specialized computational tool developed by DANAOS and tailored for the PALAEMON LCA. The tool is dealing with the limitations of the standardized LCA methodology namely:

- Lack of integrity, transparency and depth in inventory analysis which is highly governed by data availability;
- Certain assessment aspects (e.g. environmental and health impact) are difficult to quantify even if quantification could be done via monetization of respective variables;
- Priorities may differ depending on stakeholder groups involved let alone that treatment of uncertainty, if treated at all, is inconsistent.

The tool used for the PALAEMON follows a multi-attribute, multi-decision-making analysis and constitutes a dynamic framework of analysis where evaluation is associated with data integrity and adjusted to the readiness of the PALAEMON ecosystem (Coustas John, 2018). PALAEMON approach is treating the inevitable assumptions and limitations of standardized LCA by providing a better understanding of the problem's complexity and the trade-off involved via **prioritization of criteria** applying relative weighting of their importance. The tool used for the PALAEMON LCA deals with uncertainties and quantification of the evaluated criteria **by incorporating fuzzy set theory represented by linguistic values or numbering**. Analysis results are based on multi assessment computation methods (Technique of Ordered Preference by Similarity to Ideal Solution-TOPSIS, Cost Benefit, etc.). The multi-decision-making dimension of the tool is offering the **opportunity for different stakeholder's influence to be systematically investigated in an integrated system of team thinking, transparency and multi decision making.** Reliability of evaluation and consistency in interpretation of conclusions is achieved by **assigning weight factors to each evaluator associating his background knowledge with the nature of the criteria in evaluation (expert judgment monitoring).**

An instance screenshot of the tool is displayed Figure 8. The layout presents a matrix where on the vertical axis assessment criteria are listed and on the horizontal, the alternatives (N>2, x1, x2,…, xN) under comparative evaluation. The expert's knowledge and experience is determined by an administrator with numbers on 1:100 scale. Each expert (N>2, E1, E2,…,EN) grades the alternatives for each attribute (listed assessment criteria) with crisp numbers (e.g. 1-10) or with undefined numbers in 5 degrees scale (VL-Very Low, L-Low, M-Medium, H-High, VH-Very High) or even with absolute numbers (e.g. cost). The criteria are characterized as cost or benefit and the assessment could be Numeric (N), Linguistic (L) and Objective (O) or Subjective (S). Moreover, each expert assigns weight factors (Wij) to the criteria highlighting the importance of the criteria for the analysis, or in other words ranking the criteria according to his preference and also assigns weight factors to level his expertise in association with the nature of each criterion according to his background and knowledge. To illustrate this with an example, if the expert or the evaluator in our case is the safety manager of the company his score against safety aspects is considered higher than the score of the cost controller for the same criteria. The opposite applies to cost criteria.

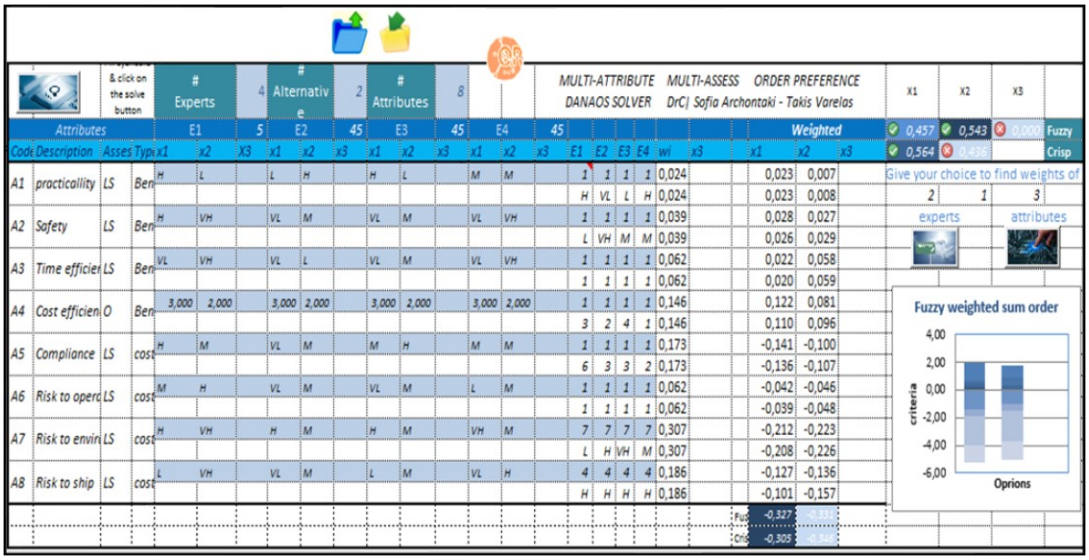


Figure 8: An instance screenshot of the utilised tool

The Method is known as FMAGDM (Fuzzy Multi-Attribute Group Decision Making). Linguist values are converted to fuzzy trapezoid numbers and the weights are normalized linearly or vectorically. Several techniques as TOPSIS can be used provided that alternatives are more than two.

4.2.1 Experts' judgment: Feedback from externals stakeholders

Our multi-stage analysis, as a simplified interpretation of an LCA approach, is based on experts' judgment as a qualified tool and technique for the evaluation of PALAEMON ecosystem against the state of the art. SMEs were selected external to the project in order to secure a degree of objectivity in the overall assessment of the product but most importantly to indirectly assess the reception of PALAEMON ecosystem from users of the industry.

The survey to collect feedback run in two tiers. In the first round of evaluation interviewers from NTUA and DANAOS conducted interviews to external stakeholders with a background related to the topic of PALAEMON (safety managers, evacuation administration). Eight (8) seafarers with extensive experience in the sea, different ranks and with different background, origin and age group but all with service on-board passengers (or cruise) ships, were interviewed, with the use of the developed questionnaire. Before each individual's interview a special dedicated presentation of the PALAEMON project and the components of PALAEMON ecosystem performed by NTUA and DANAOS representatives to inform SMEs on project objectives and capabilities. Interviews were conducted in the last quarter of 2022 and the results of this first tier of analysis are presented in the next section. The sample of the questionnaire is displayed in Annex I as previously stated.

The following charts (Figure 9-Figure 11) present the profile of the eight interviewees.

The chart presented in Figure 9 represents the age of the eight (8) seafarers. The majority (58%) belongs to the target group age of 51-60 (3 participants).

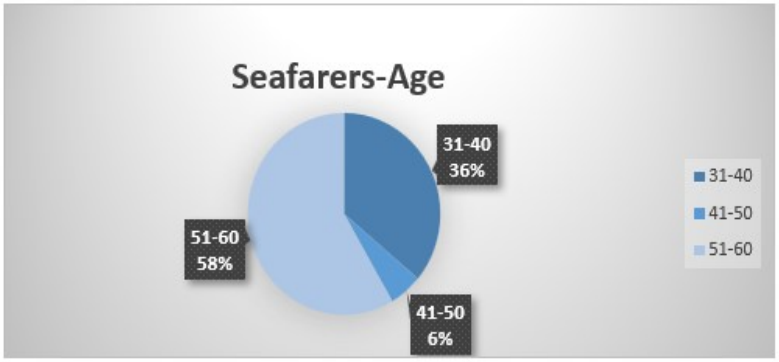


Figure 9: A chart of seafarers age

The chart presented in Figure 10 shows the nationality of the participants in the survey. The majority of the sample comes from Greece (42%), followed by Russia (39%).

Figure 10: A chart of the seafarers nationality

The following chart (Figure 11) presents the seafarers experience on board. Most seafarers have worked on cruise ships (4 participants/ 47%) in the past. The 28% of the total, both on cruise and passenger ships and the 25% only on passenger vessels.

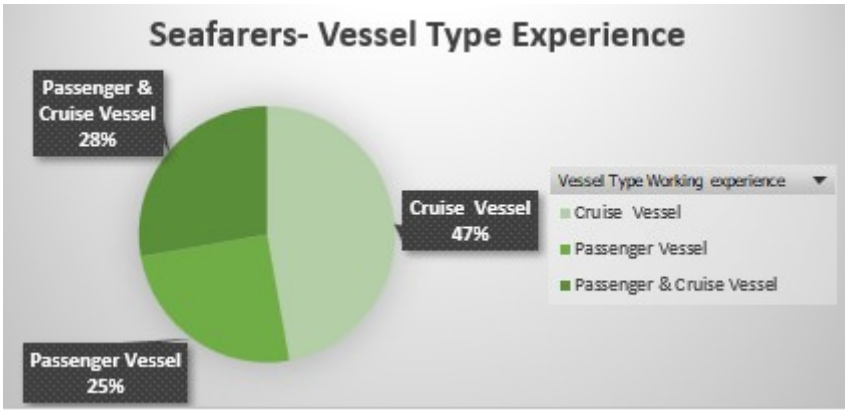


Figure 11: A chart of the Seafarers – Vessel Type Experience

The second tier of analysis was done with the utilization of PALAEMON LCA tool. Four (4) experts were chosen from high-level management of DANAOS shipping. Their working profile matches PALAEMON research topics such as safety and crew management in crisis administration (emergency). DANAOS SMEs are the Deputy Safety Manager, Crew manager,

Accounting Manager and an experienced Captain. The expert's knowledge and experience in relation with PALAEMON assessment objectives were determined by the safety manager of the company with numbers on 1:100 scale. The tool run independently for each incident stage against the same criteria per stage as identified in the questionnaires during the 1st tier of our analysis (interviews). Before interacting with the tool, a focus group with all four experts organized in a format of one-day workshop to familiarize the users with both PALAMEON ecosystem and the tool interface-functionalities. Results of this 2nd tier assessment are also presented in the next session.

It should be acknowledged that all the personal details of the SMEs assisted both rounds of the analysis are encrypted anonymized to handle securely any sensitive information.

4.2.2 Analysis Results

The first tier of analysis includes the questionnaire survey in which eight (8) seafarers participated. The questionnaire included nine (9) questions divided into three (3) sections.

The 1st section '***'Stage 1 – Safety Management''*** contained three (3) questions related to the safety management/awareness and PALAEMON Ecosystem contribution to the environmental footprint and digitalization. The results showed that the majority of the participants believe that the utilization of PALAEMON Ecosystem would slightly increase safety management cost of their company, MEV's advanced construction would slightly decrease the environmental footprint and finally the digitalization of the safety management as offered by PALAEMON would slightly enhance the safety awareness compared to the existing available tools.

Regarding the 2nd section ***''Stage 2 – Incident Assessment and Management''***, the participants had to fill 5 questions about PALAEMON's benefits in terms of safety level, risk exposure and crew members and passengers' performance on board. The results showed that the majority of the participants consider that the safety level would be slightly increased, the performance both of crew members and passengers would be slightly improved and the risk exposure would slightly decrease by the utilization of PALAEMON. Moreover, the time needed for a ship to be evacuated would be decreased a lot through the PALAEMON intervention.

The 3rd section **''Stage 3 – Post incident analysis''** had only one (1) question, where the majority of the seafarers believe that the post incident analysis procedure would not be positively but not strongly affected through PALAEMON reporting system.

Therefore, taking the overall results of the survey shown in Figure 12, the resulting conclusion is that that seafarers assume that PALAEMON tools will definitely benefit the safety management and incident assessment/management on board.

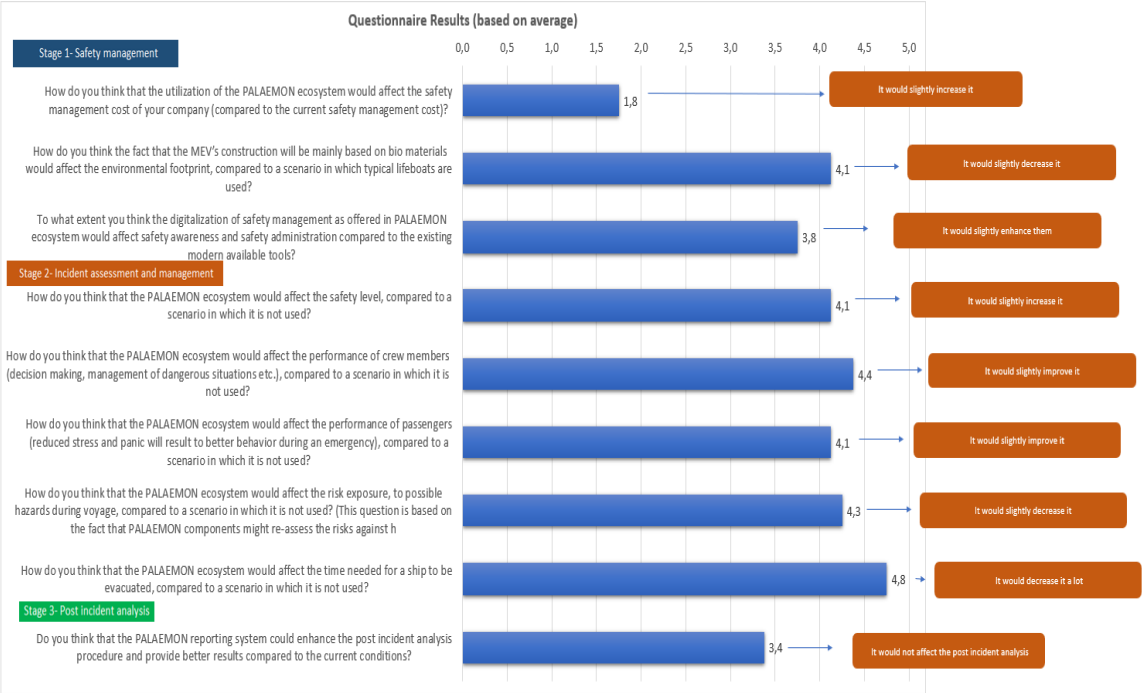


Figure 12: Questionnaire Results (based on average)

For the second Tier of the analysis PALAEMON tool was used by the four DANAOS experts (E1: Deputy Safety Manager, E2: Crew Manager, E3: Accounting Manager, E4: Captain) for each analysis stage. Each expert's knowledge was graded by the Safety Manager in a scale from 1 (lowest) to 100 (Highest). Specifically, E1 scored with 80, E2 with 60, E3 with 30 and E4 with 70 according to their expertise and degree of authority in safety and incident management. For the safety management stage four attributes (criteria) are selected, namely:

- **A1: Safety Management cost**, which is assessed objectively reflecting a rough estimation of safety cost for a vessel with and without the incorporation of PALAEMON framework. The estimation was given by the Safety Manager (administrator)
- **A2: Environmental footprint** which is a benefit to a safety system, scored with linguistic values and represents compared to cost (A1) a subjective assessment of each of the experts.
- **A3: Safety Awareness** which is again a benefit to a safety system, scored with linguistic values and represents a subjective assessment of each of the experts.
- The same applies for **A4: Safety Administration.**

Experts score the two alternatives (X1: current situation, X2: PALAEMON ecosystem) against each of the selected criteria while giving weight factors to the importance of the criteria in the overall assessment and the relevance of their background with the criterion. Alternatives are ordered with fuzzy set theory and TOPSIS method and result is in favour of PALAEMON ecosystem for both multi-criteria assessment techniques. The result is displayed in the following screenshot (Figure 13).

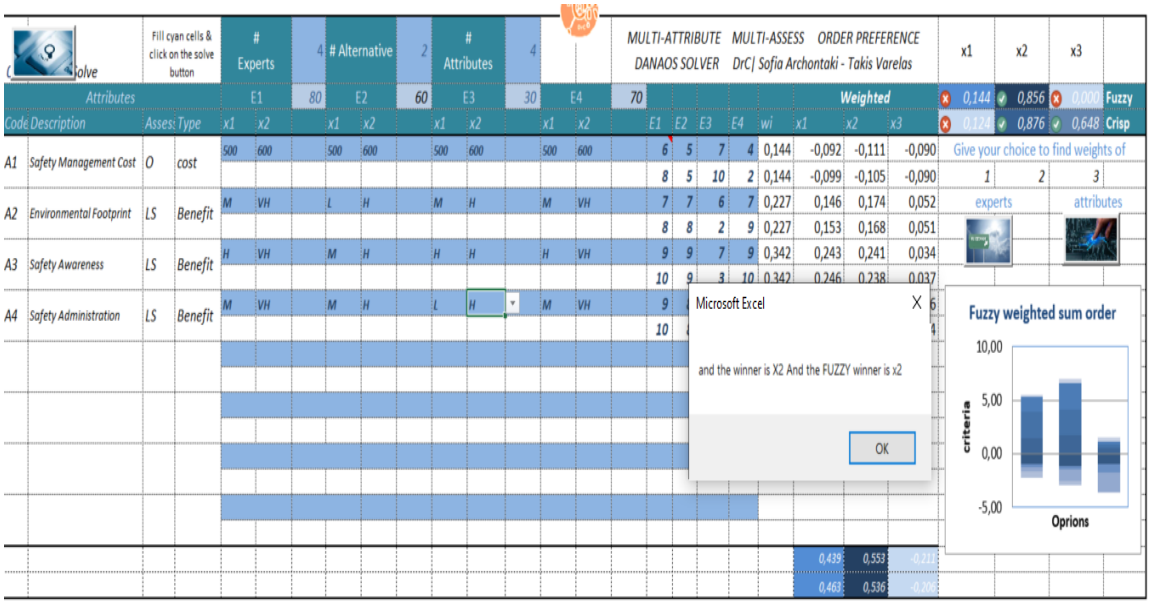


Figure 13: Experts' Multi-Criteria Assessment for Safety Management Stage

The same procedure was followed with the same experts for the next two stages. For the incident management (incident assessment and management) stage, the criteria are five, namely A1: Safety level, A2: Crew performance in terms of decision making and crisis management, A3: Passenger Performance in terms of stress or panic and situation awareness, A4: Risk exposure to an emergency and last but not least A5: necessary time for evacuation. All criteria are characterized as benefits to the procedure of incident management and the assessment reflects a subjective value with linguistic terms for each of the experts. Results are again in favour of PALAEMON ecosystem and displayed below in Figure 14.

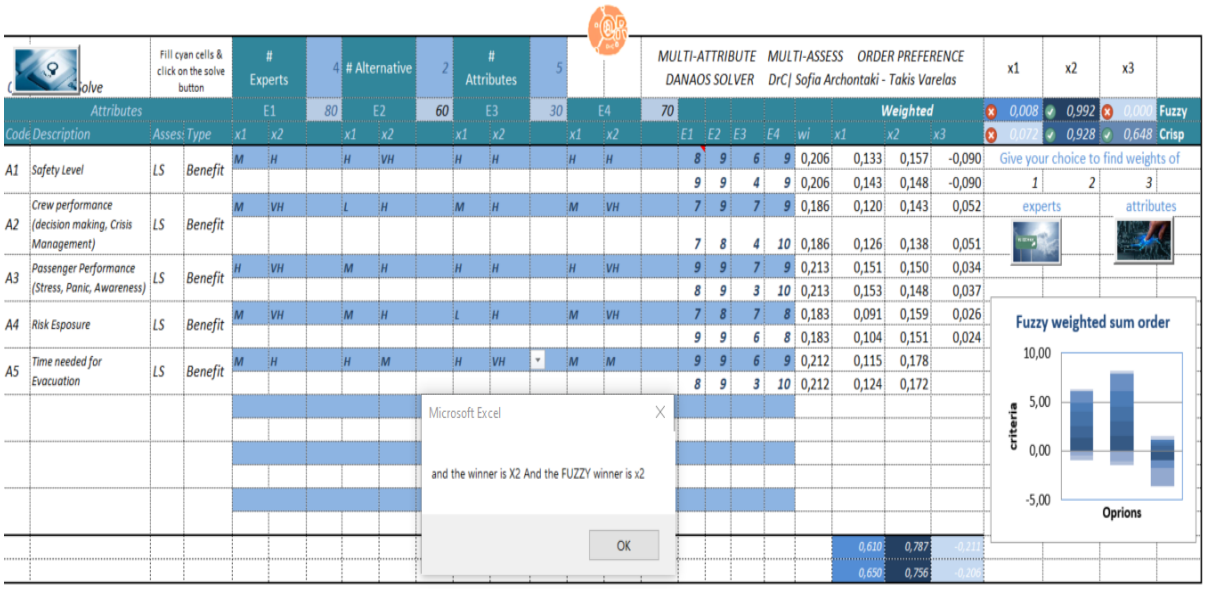


Figure 14: Experts' Multi-Criteria Assessment for Incident Assessment and Management Stage

For the last stage (post-incident analysis) the criteria are three and mostly related to the knowledge management following incident investigation. The criteria are A1: Incident administration as a standardized process of internal incident investigation, A2: Lesson Learnt

Registry as the facilitation of managing a repository and reusing the knowledge and lessons obtained from the incident investigation finally A3: Safety Level in terms of improvement in safety procedures and policies following the lessons learnt as output of the incident investigation. The results of the experts' assessment are presented in Figure 15 .As in all stages, here again the experts' opinion highlights the significant value added in incident investigation from the utilization of PALAEMON ecosystem.

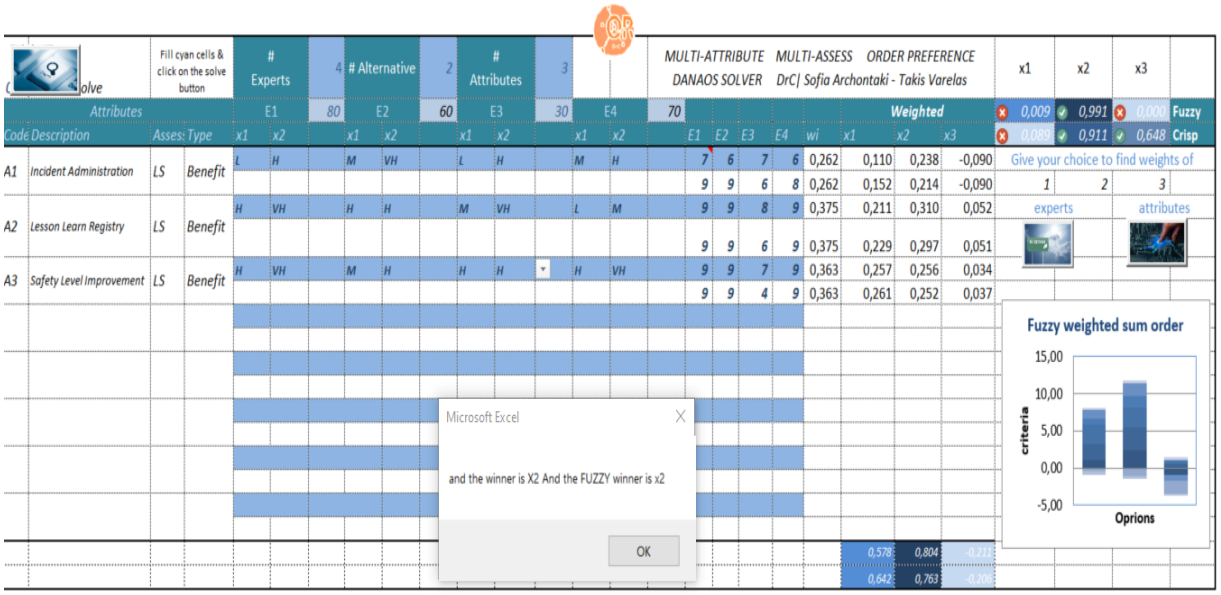


Figure 15: Experts' Multi-Criteria Assessment for Post-Incident Analysis Stage

The overall conclusion of the assessment, including both tiers of the evaluation, concerning the feasibility of the interpretation of PALAEMON in the shipping industry, indicates that PALAEMON ecosystem generates value to the safety system of a maritime company in an end-to-end perspective of the incident management (safety management, incident assessment and management, post incident analysis stages). The industry accepts the digital transformation of safety administration and innovation in the management of evacuation that PALAEMON ecosystem offers. The validity of the system will be further assessed in practice.

5 PESTEL Analysis

As it was recommended in the PALAEMON review report:" in order to have a better overview of the current situation which could potentially influence the exploitation strategy" the consortium has decided to include a review the PESTEL Analysis included in D9.3 [32**Error! Bookmark not defined.**].
As the PESTEL Analysis provides the information about the situation from multiple perspective s (Political, Economic, Social, Technological; Environmental and Legal) we have considered the framework as an appropriate tool to review the market situation.

5.1 Political Analysis

Ukraine War (P1):

In February 2022, Russia invaded Ukraine. The war continues destabilizing the world order. The European Union supports Ukraine and provides militarily supply to them.

Overall, we should highlight the human tragedy, with an increasing number of injured people and even death. The destruction of houses and infrastructure is causing severe economic losses, on the other hand, the number of refugees is growing dramatically.

This delicate situation affects the economy and fosters insecurity.

The war is affecting the tourism, according to the UNWTO [11], in several aspects. Adding risk to the pandemic recovery, decreasing the consumer confident, increasing the inflation, decreasing the travels to Russia and Ukraine, impacting in traditional destinations.

EU Tourism transition pathway (P2):

With the aim of boosting a green and digital industrial transformation the European Commission promotes a new strategy and launched the transition pathways in different industries. The first pathway promoted was devoted to tourism and it was launched in the 2022 spring period.

The transition pathway pursues "to achieve the green and digital transitions and long-term resilience of the tourism sector" "The Transition Pathway for Tourism summarizes 70 actions grouped by key topic areas such as digital transition, green transition, policy and governance, stakeholder, skills and resilience" [12].

Post Pandemic measures (P3):

Pacific's ports are being reopened: Japan, Australia, New Zealand have finally opened their ports to international passengers. This should be a boost to the industry, as Asia is a strong market for the cruise industry. It should be taken into account that according to a CLIA report Asia is 12% of the total market and the Austral-Asia region is 5% of the total market [13].

Pirates Attack- Vandalism (P4):

Nowadays, some areas are considered unsecured for cruising operations, for example:

Mexico drugs cartel: Some cruise companies cancelled cruise to Ensenada due to reported vandalism related to Mexico drug cartel [14]

Aden Gulf: According to UN Office on Drugs and crime, illicit activities are growing in the gulf of Aden, these activities endanger the safety of maritime cruise ships.

5.2 Economic Analysis

Pandemic (E1):

The pandemic's impacts and the Ukraine's war have caused severe damage to the global economy.

As it stated in the report [15] the pandemic affected dramatically the cruise industry from the economic point of view, the number of passengers, the operating margin and the stock prices decreased, also the study highlights that "Stable financial operation is the essential factor for the sustainable development of the cruise tourism industry."
As it can see in Figure 16, below, the revenue of the 3 largest cruise operators decreased around 80% in 2019 and 2020.

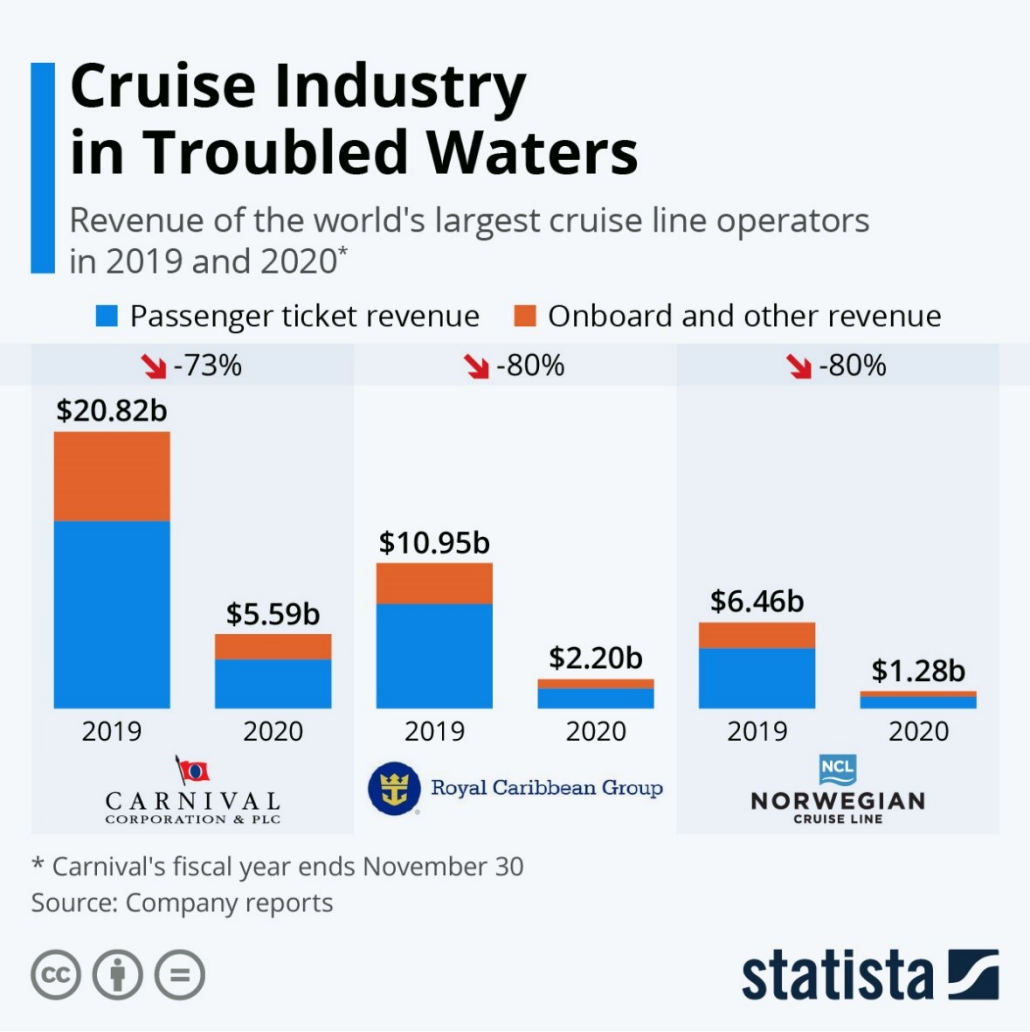


Figure 16 Cruise industry Figures [16]

According to CLIA Report" 2022 State of the Cruise Industry Outlook" [17]. The cruise industry contributed to the total economy in 2019 with 154.5 billion $, the figure decreased to 63.4 billion $ in 2020, this is a reduction of 91.1 billion $ (59%). On the other hand, cruise industry created 1.166 million of jobs in 2019 and the figures were reduced to 576,000 in 2020, with 590,000 (50.6%) losses.
It is forecasted the totally recovery of the cruise business by the end of 2023[18].

Inflation (E2):

According to Eurostat “Euro area annual inflation was 10.6 % in October 2022, up from 9.9 % in September 2022.”

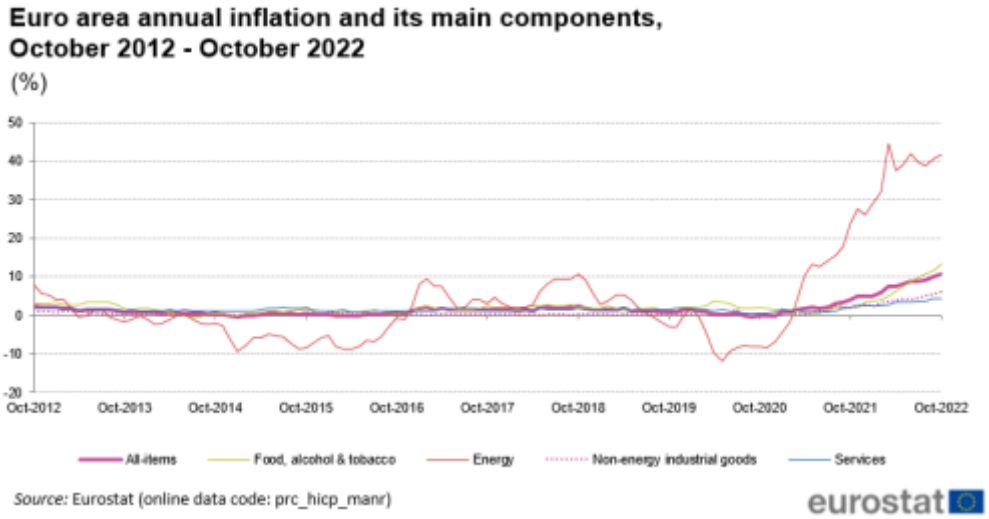


Figure 17 Euro Area inflation and its main components Source: Eurostat

It can be seen in the figure above those prices of Energy and Food are influencing this inflation rise, these factors affect directly the cruise business, and the business depends on energy and Food to provide their services.

Favourable growth forecasts (E3):

Recent cruise industry reports show favourable economic forecasts [19] It is foreseen to reach the figure of US$ 17.4 Billion in 2031, from US$ 5.3 Billion in 2022, with a CAGR of 11.97% during the period 2022-2032.The institute of shipping economics and Logistic (ISL) highlights in its web page: “The global cruise industry. Hope for 2023” [20].

Low consumer confidence (E4):

As it shown in the figure below, the consumer confidence has decreased, due to the economic uncertainty, the inflation rate, the politic uncertainty. On the other hand, as the dollar is obtaining a stronger position, American travellers have increased [21].

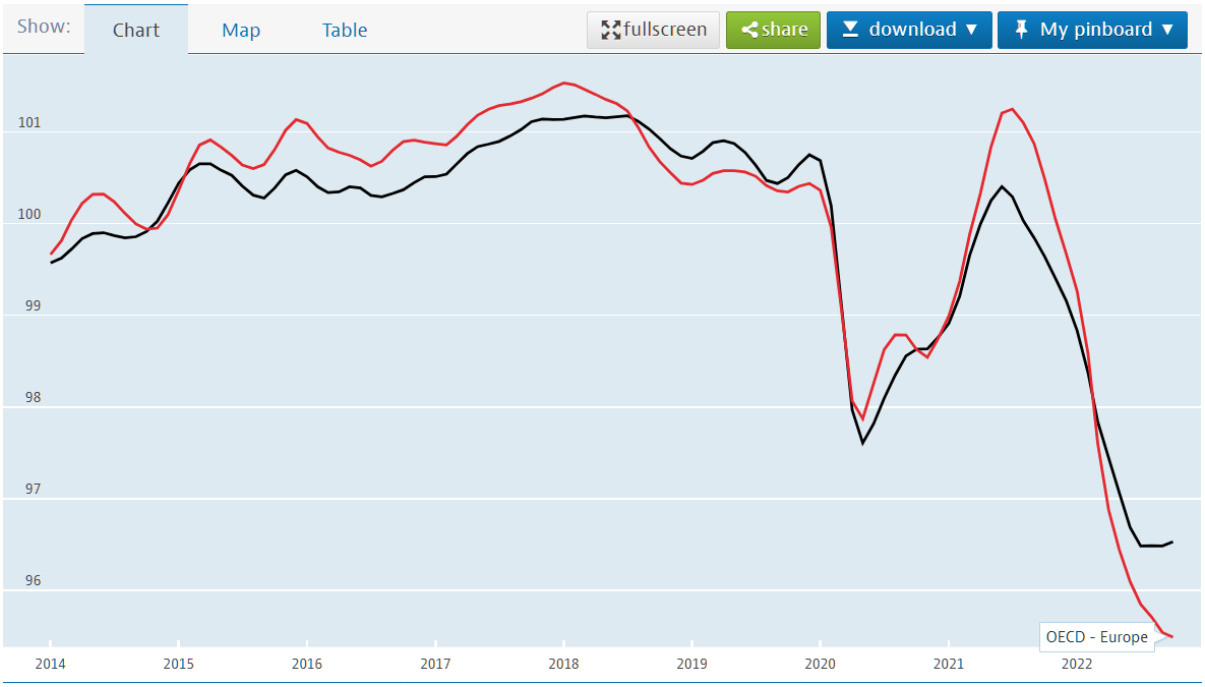


Figure 18 Consumer confidence index Source: OECD

Debt Increase (E5):

According to the study [22], the economic situation of cruise companies has worsened after the pandemic, as incomes and profits have decreased, and the debt ratio has increased. Stock figures have not recovered the pre-pandemic levels, as shown in the picture below.

Figure 19 Carnival Corp., Norwegian Cruise Line and Royal Caribbean Cruise Stock evolution during 5 Years. Source Google Finance.[23]

5.3 Social Analysis

New Generations (S1):

New generations are engaged with cruises, according to CLIA study 85% of millennials passengers are willing to repeat the cruise see Figure 20.

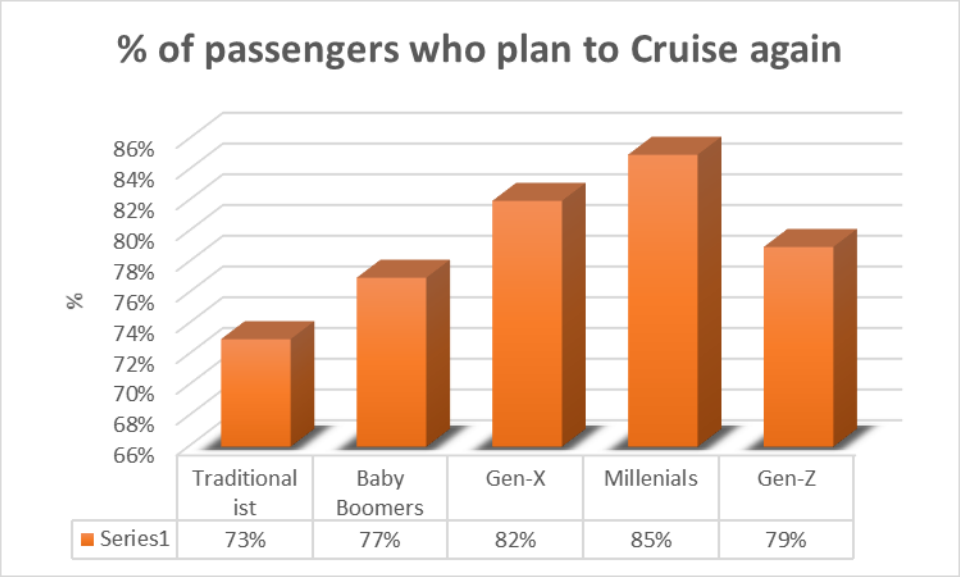


Figure 20 % of passengers who plan to cruise again. Source: CLIA Global Market Report 2020

Crew conditions (S2):

Cruise workers do not have good salaries and conditions, long hours, tiny rooms and low salaries. This can lead to a decrease in the cruise quality of the cruises as well-trained workers could refuse participate in the cruise. In addition, a growing mentality of social awareness in the new generations will demand better conditions for workers or will choose other options.

Sustainable conditions (S3):

Travellers have expressed their preferences with regard to sustainability travels. According to the survey of the company Booking "81% of travellers confirm that sustainable travel is important to them" [24], the same study shows that people main concerns are the use of plastic, dangerous of the local wildlife, massive tourism and carbon footprint.

Protest against the cruise industry (S4):

Several cities and their citizens have complained and fought again the massive number of tourists, water contamination, and air pollution associated with cruises.

Some examples are "Asamblea de Barris pel Decreixement Turistic" (Assembly of Neighbourhoods for Tourism Degrowth) trying to protect Barcelona (Spain) from massive cruises. Protest in Venice ("No grandi Navi") to avoid the transit and cruise berthing of big cruises. Mexico's protest in The Bay of Paz and Cozumel against the construction of new terminals and piers. In Lisbon (Portugal), the organization Zero complained about the great consumption of energy and air pollution provoked by cruises [25].

5.4 Technological Analysis

Touchless Technology (T1):

Due to the fear of contagion, cruise lines have had to adopt contactless technologies. For example, Royal Caribbean has implemented seamless checking and Carnival Corporation has incorporated infra-red cameras prior to passenger's check-in in order to screen passengers.

Wearables used have been also adopted by several companies (e.g.: Princess Cruise, Royal Caribbean, and Viking Cruise) [26].

Personalized experience (T2):

A personalized experience is a current trend in many sectors such as retail, leisure, etc. Users want customized services, and organizations want to satisfy their needs. Also, cruise companies are joining this trend.

Artificial Intelligence and Virtual Reality (T3):

According to a McKinsey Survey [27], the Artificial Intelligence adoption's rate is slowing down although the current figures are double than the figures in 2017. The cruise industry has applied Artificial Intelligence in multiple ways, e.g., MSC artificial intelligence assistance called Zoe [28] Furthermore, generative models are opening new ways for AI applied.

Virtual Reality is also used in cruises in areas such as shore excursions or culinary dining [29].

5.5 Environmental Analysis

Net Carbon Neutral Cruising by 2050 (En1):

As it was highlighted in previous deliverable D9.3 Shipping industry requires great amounts of energy currently delivered mainly by fossil fuel.

According to CLIA Cruise industry is pursuing Net Carbon Neutrality by 2050, to this end the industry is working in several aspects such as looking for new recycling protocols, supply chain sustainable programs, new alternatives for water filtration, alternative fuels and a design more efficient for ships.

Environmental impact of cruises (En2):

Cruises are in the spotlight of environmental organizations. Cruise companies have to take into account this and promote green polices as organizations such as “Friends of Earth” are closely watching their impact [30] and publishing the Cruise industry report card. According to the Parliament Magazine the environmental impact of the cruise industry on local sites is eight times larger than the local benefits. [31].

5.6 Legal Analysis

Note: This subsection is an update of D9.3 Market Analysis [32]Section 4.6 Legal Analysis

Legal Frameworks (L1):

Legal frameworks were 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 were and partially still are under pressure of rapid adaptation to the quick shifting global conditions. Existing legislative frameworks were revised and extended to cover new conditions incurred by the pandemic on an almost daily basis. The analysis of legal factors in effect initially resulted to the realisation that we are in a transitional period from a pre- to a post- Covid-19 world. Some of the policies introduced during this period are expected to remain in effect even after the current pandemic, while others have started fading away or are completely gone. Legislation regulating healthcare, public health protection and people

movement were part of the changes implemented, adapted and put in effect in a short-term time horizon taking into account the prevailing conditions of specific time periods. Some of the measures kept being applied and abolished based on the assessment of a series of factors of each time period.

Measures that directly affected the passenger shipping industry concerned the traveling guidelines impairing free people movement. The last two and a half years the criteria to initiate new rounds of measures introduction were derived from highly volatile public health performance indices. Consequently, travel permissions/restrictions were a continuously changing picture, rendering operational planning a difficult task, though at this time there are no relevant measures applied, besides of limited exceptions.

Although regulatory changes were introduced to deal with the unexpected and unprecedented COVID-19 situation, as stated above, these extraordinary measures have been revised as the effects of the virus started to fade globally. Some measures though are partially adopted in some cases as new norms in regulatory frameworks.

Law No. 125 of September 16,2021.

“On July 21, 2021, Italy’s Decree-Law No. 103 approving urgent measures for the protection of Venice, including a declaration of some of its waterways as a national monument, entered into effect. (D.L. No. 103.) Law No. 125 of September 16, 2021, converted the decree into law, effectively banning cruise ships and other large vessels from the Venice Lagoon.” [33]. This law is a measure to avoid the classification of Venice as “endangered sites” by the UNESCO. Some cities could follow in Venice's footsteps to fight mass tourism.

5.7 PESTEL Summary

The cruise industry generates benefits not only for itself, but it is also a source of job creation and generates abundance for countries and localities. In the years before the pandemic, the industry continuously growth, but it has been severely affected by the pandemic. The recovery cannot be based only on cost reduction polices. To manage situations such as the pandemic, several measures should be taken into account: ships have to be restructured, risk management needs to be improved, and medical services should be improved.

Without a doubt, the environmental aspects should be carefully addressed, and investments and new policies should be implemented.

In the figure below (Figure 21) the impact on PALAEMON of each external factor analysed in this section is pondered. Each factor is valued as very positive (+P), positive (P), neutral (X), negative (N), and very negative (+N). This analysis can support PALAEMON’ s organizations to understand and assess the potential impact of external factors on their operation.

As it can be seen in the PESTEL map (Figure 21), the majority of the external factors impact positively on the project (P2, P3, although the uncertain of the current moment due to the economic situation and the Ukraine war could affect negatively (E1, E2, E4, E5, S3, S4, Env 2) to the success of PALAEMON. On the other hand, PALAEMON’s results can help boost the cruise industry by providing more confidence and safety in travel. Environmental aspects should be taken into account.

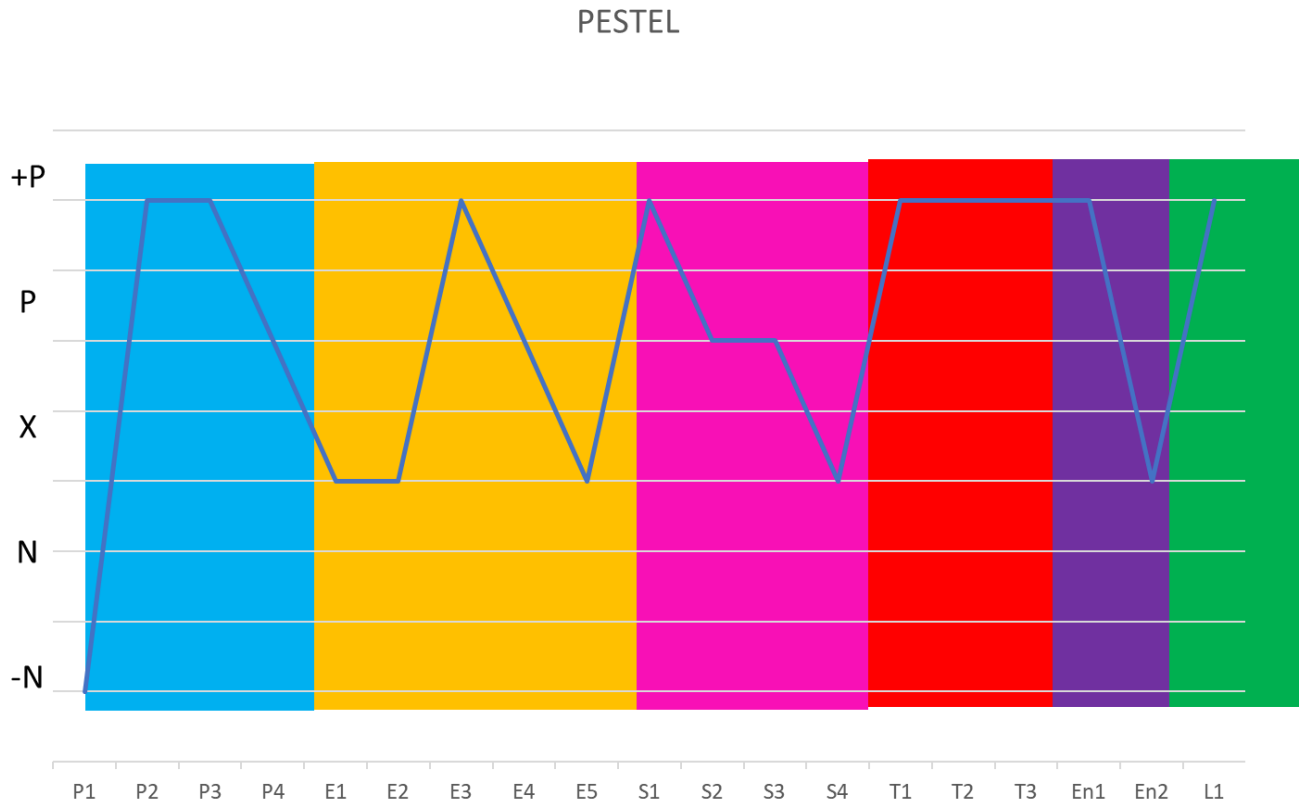


Figure 21 PALAEMON PESTEL Analysis

6 List of Assets and Results

Table 4 contains the list of PALAEMON exploitable assets (name of asset and owner).

Table 4 List of PALAEMON Exploitation Assets

Id	Asset	Owner
1	Smart Bracelets	ADV
2	Smart Cameras	UAH
3	Ship Health Monitoring (Motion and acoustic sensors)	ESI
4	VHF Data Exchange System (VDES)	WISER / THALES
5	PaMEAS	UAGEAN
6	Data Fusion Bus (Access + Core)	ITML / ATOS
7	Safety Management System (Ship & Shore)	DANAOS
8	Evacuation coordinator	ATOS
9	Weather Forecast Toolkit (DSS)	KT
10	Smart Safety System	JU
11	Ship Stability Toolkit	JU
12	Voyage Report Generator	ATOS
13	Decision Support System (DSS)	KT
14	PALAEMON Incident Management Module (PIMM)	KT
15	Smart Risk Assessment Platform (SRAP)	NTUA
16	AR Glasses	SIMAVI
17	PALAEMON Academy (eLearning Platform)	JOAFG
18	PALAEMON Academy (VR OnSite Training)	JOAFG
19	MEV + Inflatables	ASTANDER + DSB + ESI
20	Inflatables	DSB
21	Training platform	SIMAVI
22	MEV-I Interior Design	EFB

The following subsections contains detailed information of each asset enumerated above. For each asset is provided the following information:

- Problems solved by the asset
- Value proposition
- Customers
- Challenges
- Unfair advantage

Therefore, this section is a complete description of PALAEMON's main results, their proposed value and the identification of potential customers.

6.1 Smart Bracelets

Table 5 Smart Bracelets business description

Smart Bracelets Owner: ADV	
The Smart Bracelet device (SB) provides PALAEMON system with user data (passenger/crew) from the sensors embedded in the wearable device (heart rate, oxygen saturation, compass, accelerometers, and gyroscope). It is also capable of triggering asynchronous alarm events, automatically, like fall detection or generated by the users, alarm button/help request. The SB provides beacon capabilities to support PaMEAS in the localization of passengers and crew member. SB can as well deliver to the user relevant information generated by PaMEAS regarding the evacuation routes on its screen (i.e., messages, signs, symbols, etc.). The SB also features an emergency button that users can trigger to actively inform the crew of problems during the evacuation (or during cruise trip).	
	Figure 22 Smart Bracelet
What problem/s is/are the asset solving?	Value Proposition
The asset provides a cost-effective solution to track in real-time all the people inside the ship when an evacuation process starts. Knowing the information about people in the ship is the most important feature of a safety system and provides a 2-way detection system to do not left any person behind.	The smart bracelet provides a bidirectional communication channel between the evacuation and safety system and the user.
Customers	Challenges
Although this asset has been designed to be deployed in a ship, it can also be commercialized in other industrial sectors. For example, we foresee the following scenarios:	• Lack of availability of accurate health sensors in the market • Certification process as a health device • Creation of a methodology for a seamless deployment in an existing environment.

• Manufacturing employees: Smart bracelets can be used by employees in the manufacturing industry to track their health and well-being, particularly in physically demanding or hazardous work environments. For example, the device could be used to monitor heart rate, fall detections, and other vital signs to early detect potential hazardous situations. • Health and Safety managers: Smart bracelets can be used by safety managers in any industry to identify any potential health risks or hazards in the workplace to provide alerts in the event of an emergency. Besides these, data generated by smart bracelets in a working environment could be used to analyze productivity although regulations on data privacy and workers acceptance would be the main barrier.	.
Unfair Advantage	
These are the main features that makes the proposed system unique: • Communication of the data in real-time • Location of smart bracelets that have bidirectional comm. Information	

6.2 Smart Cameras

Table 6 Smart Cameras business description

Smart Cameras Owner: UAH
The use of smart cameras in different scenarios is widespread in our society. The system developed by the UAH presents a customised solution for indoor spaces on ships, which aims to find emergency situations automatically and intelligently in order to provide relevant information to the ship's bridge. Through flexible, agile and configurable custom software, each camera can detect people and count them in the scene under analysis, detect situations of entrapment and even stampedes. These features are really interesting to provide visual information in emergency situations, thus being able to identify critical areas inside the ship. Their placement in corridors,

stairways or large indoor areas such as a lobby or cafeteria of the ship has been successfully tested. Due to their flexibility, connection, and communication with different intelligent systems at different levels is possible. Its interoperability with the other ICT systems of the PALAEMON project has also been validated. From a hardware point of view, the system is composed of a low-cost and low-size commercial camera and a low-cost and low-size processing unit. This allows it to be deployed in different parts of the ship. While having different communication possibilities, the use of ETHERNET LAN is suggested. This is due to the need to have a fast and stable channel to transmit processed and raw images.

What problem/s is/are the asset solving?	Value Proposition
The asset makes it possible to detect and count people in ship interiors. In addition, in emergency situations notified from the bridge, it is possible to identify trapped people and stampede situations. By sending the processed images in real time to the central node, the status of certain parts of the ship can be known at first hand. The connectivity of the Smart Camera nodes is validated thanks to their wired Ethernet connection. This makes it possible to receive/send data and images with different ship management systems.	The smart cameras provide a real-time system applied to emergency situations which generates automatically processed images/videos with counted people and panic situations. Reviewing the CCTV cameras installed on a ship consumes a precious time, so with the processing of videos from legacy cameras or installation of new smart camera nodes the crew will have right information directly shown without wasting time that is required to assess the situation and make the right decision in time.
Customers	**Challenges**
The flexibility and adaptability of the developed solution to several scenarios allows its extension to other domains. Although the system has been validated on ships, its extension to the following fields is possible and has already been partially validated: • Any ship company would be able to install the system for monitoring and localization of people. Usually, main areas are surveillance by CCTV cameras. Even with legacy cameras, the smart camera system could be deployed capturing these video feeds. • Large Buildings: The deployment of smart cameras in those buildings with large common areas, staircases or with multiple corridors would allow the detection of alert or emergency	• Problems with the installation of cameras in optimal locations on a ship or building. • Requirement of a channel for wired communication. • General Data Protection Regulation

situations. This would require a slight adaptation of the developed software. • Shopping centres: This is perhaps the most interesting area for the use of the developed solution. The capacity to obtain real-time information on the amount of people in each area of these buildings provides extremely useful data for market purposes (for example, to know where the areas with the highest number of people) are or in emergency situations (the areas with the highest number of people or where there are panic situations would be the first to be reached by the emergency teams). • Airports/Ports: Given that both cases are large buildings with a large number of people moving daily, the product generated can be used for logistical, commercial or emergency purposes.	
 Unfair Advantage	
The proposal is customised and adapted to the environment of ships and people detection. The combination of commercial hardware and software specifically designed for this purpose means that there are no commercial solutions for the same purpose and with the same resolution and accuracy as the proposed solution. Since the designed software is compiled and downloaded on the smart camera node, possible replications of the system are not feasible without the source code. These are the main features that makes the proposed system unique: • Communication of the data in real-time • Processing Video by AI to count people and assess different situation	

6.3 Ship Health Monitoring (Motion and acoustic sensors)

Table 7 Ship Health Monitoring business description

 **Ship Health Monitoring (Motion and acoustic sensors)** **Owner: ESI**	
The Structural Health Monitoring (SHM) system is designed to measure and analyse the movements and deformations of a ship's hull. It consists of 6-degree-of-freedom (6DoF) motion	

sensors, also known as Inertial Measurement Units (IMUs), that can detect accelerations and angular velocities along three axes. These sensors are capable of measuring roll, pitch, and yaw, and when paired with appropriate software, they can calculate deflection and torsion of the hull. The SHM system can be configured to monitor one or more of these sensors, which are connected to a laptop that acts as a processing node and a communication hub for the PALAEMON system core. The sensor has a RS-485 connector interface that allows it to communicate with the laptop over a 200m cable line. A radio transmitter option is also available for wireless communication with the sensor. All sensor data is recorded and processed in real-time on the laptop using SHM software, and relevant variables such as accelerations, angles, and deflections are displayed on the screen. The differences between the sensor readings can provide insight into the stability and longitudinal deflections of the ship, helping to assess its structural health.

The Acoustic Emission (AE) system, called MicroSHM, is a standalone system that is equipped with sensors. It is designed to be deployed before the monitoring process begins and can record all events and features, as well as trigger alarms when certain parameters exceed a predetermined threshold. In this case, the AE system is programmed to trigger an alarm when the Absolute Energy Count exceeds a certain limiting value, as this can be an indicator of defects or cracks forming and growing. The AE system can be connected to a laptop and monitored in real-time using AE win software, and it can also be programmed to only trigger alarms when certain parameters exceed predetermined values.

What problem/s is/are the asset solving?	Value Proposition
The SHM can be used to ascertain the real time behavior of the ship, concerning stability and structural integrity (quasistatic-dynamic). Ships that sail today do not offer this possibility. Even in the case of container ships which have similar systems, these are way more expensive than ESI's SHM and have inherent flaws as described below in section unfair advantage.	The SHM can offer real time data as well as store historic data, concerning the ship's stability and structural behavior throughout the voyage. This can offer valuable data for trip planning, ship's behavior prediction, coupled with weather prediction and routing software can offer the full image of loads-response of the ship. It can also be used in case of accidents, incidents, and of course in arbitration situations.
Customers	**Challenges**
• Ship management companies • Ship owners • Salvage operators	
Unfair Advantage	

The SHM developed by ESI, uses inexpensive sensors (IMUs) which when paired can offer real time overview of the ship, in terms of stability (quasistatic, dynamic) but also deflection and torsion of the ship, which when paired with the section modules of the ship, through the SHM software and data from the ship, can offer the real values of bending moments and shear forces. The standard in the industry for these kind of work, is using long strain gages, attached on the deck of the ship, which cost 3.5 times as, much, do not offer the true status of the structural integrity of the ship and errors can be introduced in the calculations if the deck plating where the long strain gage is attached, is deformed. Furthermore, the SHM system can be paired with FE (Finite Element) simulations of the ship and accurately evaluate stresses and deformations on the hull girder, which can then be extrapolated to local deformations on specific parts of the ship.

The SHM addresses the shipping industry, but also the salvage sector. The SHM unique selling point is that it uses off the self-sensors and through its software can extract and interpolate values and parameters which are not produced from the sensors alone. This is accomplished by formulas which are included in the SHM. Furthermore, the combination with section modulus and FE evaluations has not been done and it is a procedure which is accomplished automatically within the SHM software.

6.4 VHF Data Exchange System (VDES)

Table 8 VHF Data Exchange System business description

VHF Data Exchange System (VDES) Owners: Thales, WISER	
VHF Data Exchange System (VDES) is a radio communication system that operates between ships, shore stations and satellites on Automatic Identification System (AIS), Application Specific Messages (ASM) and VHF Data Exchange (VDE) frequencies in the Marine Mobile VHF band. It can be seen as the second generation of the popular AIS (Automatic Identification System) technology used for vessel tracking and other navigational and safety-related purposes. For the PALAEMON project, a VDES prototype has been deployed, implementing the terrestrial radio link only, plus a software application, namely VDES gateway, in order to interface the VDES radio with the PALAEMON core platform. The VDES radio hardware has been deployed with two System on Chip (SoC) boards (one for the Base Band and one for the RF front-end) by means of the Software Defined Radio technology. The VDES Gateway is a publisher/subscriber mechanism based on the MQTT open source platform. The transceiver communicates with the gateway via MQTT, which translates to Kafka system, using the legacy SSL cert-based authentication, in order to interface with the PALAEMON core platform.	
What problem/s is/are the asset solving?	Value Proposition
Generally, with respect to the legacy AIS, VDES standard brings the following enhancements (refers to a fully standard-compliant product): VDES enables two-way communication, while AIS is unidirectional. VDES provides encryption for communications, while AIS is not encrypted VDES has been designed to operate also via satellite, thus extending globally the field of operation. VDES provides higher channel bandwidth and higher data rates than those of AIS, which is becoming to be saturated VDES allows for the integration of other communication systems	The VDES prototype currently developed, implements the terrestrial link with higher bandwidth and data rate than the legacy AIS. Also, the VDES Gateway application we have developed allows the VDES to interface with a Kafka-based publisher/subscriber system, providing a secure access (through SSL authentication and TLS-based encryption) to stored information like passengers list, ship position, etc, that can be sent to shore stations or other ships in case of emergency.
Customers	Challenges

Possible customers could be ship builders/owners, marine cost guards, national Navies and, in general, all the current AIS customers. Thanks to the satellite radio link, that was not present in the AIS system, the possible customers could be also satellite builders/operators dedicated to safety & security and search & rescue operations.	Main challenge is on funding, necessary to fill the gap between current prototype and full VDES standard compliant product.
Unfair Advantage	
We are among the firsts to have developed a VDES prototype. Thanks to the PALAEMON project, we have gained a competitive advantage in the prototype development, with respect to future market competitors.	

6.5 PaMEAS

Table 9 PaMEAS business description

PaMEAS Owner: UAGEAN
PaMEAS is a multicomponent IT system tracking the position of passengers and crew within a ship (in the various areas of a ship, from the lower decks, where the state rooms locate, to the uppermost levels, which include the promenade and activity decks) and providing real-time, location-aware and personalised notification messages to them. The system is tailored to the needs of the crowd management and the evacuation of a ship, in the case of an emergency accident. PaMEAS provides the core engine that allows for a certain degree of automation of the evacuation process in the sense that it provides technology assistance to the execution of the standard evacuation functions: a) tracking the status and the location of passengers (and crew), b) marking the appropriate evacuation path, c) engaging the notification process and providing location-based directions to and through the evacuation paths and, d) tracking the status and location of resources (crew support, etc.) and reassessing response plans. PaMEAS is tightly integrated with PIMM (the PALAMEON Incident Management Module) to offer a complete environment for process (semi) automation support and real-time monitoring to mustering and evacuation processes. It is also integrated with SRAP, the Smart Risk Assessment Platform of PALAEMON, which performs, in real time, a dynamic risk assessment to quantify the risk, from the safety of the passengers and crew members point of view, associated with the cause and the evolution of the emergency accident. The integration of PaMEAS with PIMM and SRAP in a software platform that implements a Smart Evacuation Management (SEM) approach to the evacuation process. The SEM platform is organised around a microservices architecture (PaMEAS-A/pplications) which connects to an onboard “sensing” and communication infrastructures, specifically designed and deployed for emergency situations a) a Wireless network

for people tracking made by WiFi 6 Accent Pints and Beacons (PaMEAS-W) and, b) a 5G Standalone (private) network for reliable emergency messaging (PaMEAS-Cell), with a 5G component provided by Athonet and a small-cell Radio Access Network deployed by Ericsson.

What problem/s is/are the asset solving?	Value Proposition
The Smart Evacuation Management (SEM) approach offers a cutting-edge technology infrastructure and platform and follows the principles and methods of the Intelligent Evacuation Management Systems, to improve, by increasing the level of process automation, the performance capability of passenger evacuation ("evacuability").. To passenger ships, which are mostly operated by coastal lines, often relying on an "old-style" operations management and utilising reduced crew resources, the SEM platform essentially offers them the possibility to realise the value benefits of "digitalization": monitor and control the movement behaviour of the passengers and increase the operational and coordination efficiency of the available commandment and crew resources. Specifically, the SEM platform and infrastructure solves the problem of instantly tracking the location and identifying passengers during the evacuation of dense crowds, on a passenger (or a cruise ship), to provide to the Master and Bridge Command Teams a clear picture of what is going on with the process of evacuation. Therefore, it ensures the continuous, real-time, monitoring of the mustering and evacuation operations during the whole life cycle of the emergency management process (from the initial stages of the reconnaissance of an accident until the embarkation of passengers and crew to LSAs). Allowing, precisely, the ship commandment to: a) Monitor in real time the movement of the passengers towards the muster stations. b) Instantly count and identify those joining a muster station.	The SEM platform allows a ship to overcome slow and disorganised crowd management, mustering and evacuation processes with people tracking, automated and semi-automated emergency alerts and notifications, continuous passengers counting and reporting to command team, "incident during evacuation" management via AI, and operations shared with the land-based control.

c) "Virtually" block the paths to ship zones which become dangerous, and then assess and res-schedule the appropriate escape routes. d) Locate a "rogue" passenger". At the same time, the SEM platform is capable of communicating emergency and information, pathway guidance, and interacting with the passengers, via a personalised, high reliability and low latency emergency messaging notification and voice system, connecting with their mobile devices. Additionally, the platform provides the commandment the possibility of assigning tasks to crew, in real time, through a MCPTT application (thus replacing existing walkie-talkie devices), and monitors how crew members perform the assigned tasks. An operation of crowd management and evacuation assisted by the SEM should deliver a performance that contrasts with what is reported by an international newspaper about the rescue operation of a GR-IT ferry burst into flames after a fire: "... When asked about the prospect of missing passengers, a spokesman at the Greek shipping ministry overseeing the rescue operation told the Guardian nothing could be ruled out. 'We don't have a clear picture and until everyone is counted and identified we won't have one', the spokesman said… Describing the dramatic moments when passengers were told to evacuate as flames licked the sides of the ferry, the Italian finance police vessel's captain, Simone Cicchetti, told the Italian news agency Ansa: 'When the fire broke out, the ship's commander went around the cabins and brought the passengers together on a single desk. Then he gave the order to abandon ship'…" [34].	
Customers	Challenges
The SEM platform provides a cloud service which is accompanied by a sensing and communication infrastructure that should be deployed onboard the ship. Potential customers of the SEM	The current version of SEM platform has recently reached TRL 5. However, a Minimum Viable Product needs a higher TRL that should be obtained through further research and pilot

platforms include: first, the shipping companies operating passenger ships and, secondly; second, the service providers of these companies, especially those providing satellite and mobile communication services in the context of the “connected ship”.	testing. A Smart Evacuation Management Research Infrastructure possessing the appropriate facilities, is therefore necessary to continue experimentation in an in-vivo environment, pilot tests with real users, the issue of new versions of the platform (starting from a minimum operation version), and to facilitate showcasing to investors and potential buyers. The need of a research infrastructure has been also emerged as one of the conclusions from the online workshop, recently organised by PALAEMON and the Univ. of the Aegean, with the participation of the main EU projects in the area of digital transformation of the evacuation process, and researchers from Europe and abroad -- see: Workshop (Online): The Digital Transformation of the Evacuation Process in Passenger Ships | Futurium (europa.eu). Such a Research Infrastructure may also have the role of the innovation, interaction and co-production hub for similar projects and research initiatives in Europe and worldwide.
	Unfair Advantage
N/A	

6.6 Data Fusion Bus (Access + Core)

Table 10 Data Fusion Bus business description

Data Fusion Bus Owner : ITML
Data Fusion Bus [35] is an analytics platform developed by ITML. The goal of DFB is to enable developing, deploying, operating and managing a big data environment with emphasis on real-time applications. It is combines the features and capabilities of several big data open-source applications and utilities within a single platform. The key capabilities of DFB are, see Figure 23:

- Smart Production Digitization and IoT
- Data aggregation from heterogeneous data sources and data stores.
- Real time analytics offering ready to use Machine Learning algorithms for classification, clustering, regression, anomaly detection.
- Extendable and highly customizable User Interface for Data Analytics, manipulation and filtering. The UI also includes functionality for managing the platform.
- Web Services for exploiting the platform outputs for Decision Support.

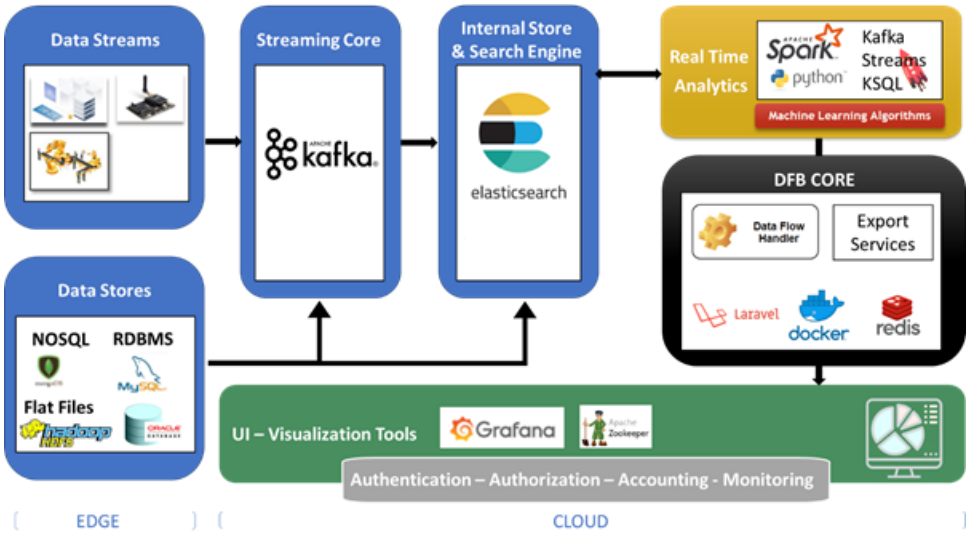


Figure 23 Data Fusion Bus (DFB)

What problem/s is/are the asset solving?	Value Proposition
Common problems that can be solved via DFB are the early detection of an incident or an anomaly coming from the monitoring of the data flow (data collection and data analysis). Improved detection is directly linked to the reduced reaction time. The second common problem can be the ambiguity that needs to be minimized. The impact of reduced ambiguity may lead to reduced human workload and better prioritization. Finally, the issues of system reliability and performance can be addressed through DFB. DFB will assist in order to avoid the entire system degradation or the operation of a system that can be characterized as redundant	Any organization, which is considered as a customer, through DFB will realize that its entire operation, based on multiple and complex data streams, may reach the big data environment. Special emphasis will be placed on real-time applications regarding data aggregation and further analytics.

Customers	Challenges
Industries like Energy, Maritime, Cybersecurity, Big Data, Automotive and Healthcare could receive benefits from the capabilities that DFB can offer. Indicative cases that DFB may stand as a potential solution are the data aggregation and real-time analytics.	Technological challenges are coming from three (3) different steps, consecutive ones, that we follow each time. These are the efficient fusion of information (data and metadata) coming from heterogeneous data sources and data stores; the choice and usage of ML (Machine Learning) algorithms for tasks as classification, clustering, and anomaly detection; and the adaptation and optimization of a User Interface for the Data Analytics operations.
Unfair Advantage	
DFB is highly scalable distributed streaming platform. DFB can achieve semantic fusion of events not coinciding in time, very accurate synchronization, a distribution mechanism interchanging data between the modules running on different machines and supporting common interfaces to share data to the third-party services.	

6.7 Safety Management System (Ship & Shore)

Table 11 Safety Management System tool business description

Safety Management System tool (SMS tool) (ashore and vessel version) including weather service map (WSM) as add-on. **Owner: DANAOS**
A maritime-specific digital safety management document system following on International Safety Management (ISM) principals. SMS Tool comprises of three main components: 1.-SMS ashore- is a standalone program hosted in the offshore servers of the management company of the vessel (and all the fleet). 2.-SMS on-board- is a replica of the SMS ashore program hosted in a remote server on-board the vessel and integrated with PALAEMON ecosystem. 3.-SMS synchro engine- is dedicated to the activation of a bridge connectivity between office-ashore and vessel-onboard (SMS instances) for versioning control. PALAEMON SMS tool has the following core functionalities:

Structuring safety information (safety manuals, checklist)

Digitalize procedures and associate response plan breakdown with response owners (Dynamic safety task list). For this purpose, interface with PALAEMON DSS and PIMM

Bridge connectivity between office ashore and vessel for versioning control.

Hold triggers for updates and control changes following post-incident investigation, safety procedures configuration and change management policy. For the purpose of PALAEMON this functionality is highlighted with a versioning update following lesson learnt registry in post-incident analysis. This functionality is semi-automated enabling an interface with incident related data captured on-board and recorded in PALAEMON Voyage Report Generator (VRG)

On top of SMS tool functionalities and working as an add-on service the weather service map (WSM) is introduced to visualise along the waypoints of the vessel's route critical information of the voyage. This service is assisting the post-incident investigation while contains data of weather conditions when the incident occurred together with other voyage details.

What problem/s is/are the asset solving?	Value Proposition
The problems addressed are reflected to the main features of the SMS tool - Compliance with SOLAS ISM code requirements for the provision of a comprehensive safety management system for vessel operation - Complete recording of the incident details, including the weather conditions in any waypoint of the vessel's voyage, for a full-fledged investigation of the causes and the registration of the lessons-learnt for future improvements in the company's safety culture - Digital configuration of the safety documents and flexible management of well-structured safety procedures for both crew and shore personnel. Digital document management is reducing paperwork and the necessity to store and manage packs of hardcopies.	SMS tool allows an intuitive, configurable and cost-effective digital management of the safety documents/manuals of a shipping company bridging the document distribution and management between shore and vessel. SMS tool is compliant with the regulatory framework. SMS tool is recording all the details of an incident (integrating with VRG) facilitating the investigation, lessons-learn registration and claims administration. The WSM add-on feature offers to the user an interactive service for deep understanding of the voyage weather conditions before during and after the incident happens. SMS tool is at the same time reactive (responsive to decision making in emergency) and proactive, following a *"plan-do-measure-act*" approach where safety procedures are modified against lessons learnt from incidents on-board.
Customers	Challenges

Ship managers/owners	Integration with third parties tools and other sources is always a challenge

Unfair Advantage
The uniqueness of the SMS tool is that digitalizes safety procedures and workflows tailored to company's specifics and policies. The integration with VRG and the semi-autonomous registration of an incident is a leap forward to a sensor-based data flow safety report which is not evident nowadays in maritime fleet safety management. By default, the SMS tool is customized to vessel infrastructure and the specifics of data recording onboard. Moreover, the safety policies for each company differ and this differentiation is embedded in the tool's configuration.

6.8 Evacuation coordinator

Table 12 Evacuation Coordinator business description

Evacuation Coordinator Owner: ATOS	
"PALAEMON - Information broker that centralizes the evacuation status notifications among all software components that may have a dependent/dynamic operation, based on the actual evolution of the evacuation process. Technically speaking, this component is responsible for translating to the digital world the decisions that induce an evacuation status switch, produced under commands exclusively done by allowed officers or the vessel's Master. In addition to this, the Evacuation Coordinator checks and monitors the operation of the different components throughout the evacuation, as their operation might be modified as long as the status level gets increased." [36]	
What problem/s is/are the asset solving?	Value Proposition
The Evacuation coordinator gathers a plethora of information from different sources and orchestrate the evacuation process taking into account the inputs for the sources. The Evacuation coordinator enables ship evacuation manager to handle threats with the greatest efficiency.	The first goal of PALAEMON Evacuation coordinator is to orchestrate and centralize the evacuation management providing digital assistance to safety office. All relevant decisions are registered in the system, and it guarantees homogenous information to all the components.

Customers	Challenges
Ships Managers Public and Private Building Managers (Airports, Terminals, etc.). Authorities.	In the case a Platform component is not designed to work with a streaming message broker (i.e., Kafka) this would lead to the search of an intermediate solution (e.g., REST API). An incident may produce an energy outage or connection cut in all or parts of the vessel. Consequently, the communications between the Evacuation Coordinator and some of the components may be interrupted.
Unfair Advantage	
The interoperability provided by the proposed architecture.	

6.9 Weather Forecast Toolkit (DSS)

Table 13 Weather Forecast Toolkit business description

Weather Forecast Toolkit Owner: Konnektable

The PALAEMON Weather Forecast Toolkit is a submodule of the PALAEMON Incident Management System that provides decision support to the Master and Bridge Crew during emergencies through the combination of historical data, current weather data and Machine Learning to produce a list of actions to be followed by the crew.
The WFT is integrated into the user-friendly Graphical User Interface of PIMM, displayed in a dedicated monitor in the Bridge along with many different components of different partners working together. The WFT integrates to the following PALAEMON components:
• Weather API (DANAOS)
• Smart Safety System (JU), Ship Health Monitoring (ESI)
  ○ SSS and SHM Provide Emergency Alerts, when an emergency occurs
• Evacuation Coordinator (ATOS)
  ○ Provides updates on the current status of the incident, as it unfolds.
Following the 6 months after the project's completion, the WFT will be integrated into KT's CONCORDE for Maritime Solution.

What problem/s is/are the asset solving?	Value Proposition
The DSS is a tool that aims to provide further decision-making support using data on the current weather only, by combining past knowledge from past incidents into a large dataset.	We think the WFT is an essential tool in every ship's arsenal. The single point of information essential for decision making the PIMM provides is very valuable for any sailor during times of emergency.
Customers	**Challenges**
The main customers of the WFT can be considered naval companies of any size with fleets of any size. As the PIMM can be deployed in the bridge of any ship, in a single server, it does not need any special infrastructure to run. The data can be provided from the sensors of the ship, if they exist.	
Unfair Advantage	
The system is as simple as possible, which allows every crewmember to use it without special training. As the system waives the use of text almost complete, there is no need for translation, which makes it usable for every crewmember regardless their education or nationality.	

6.10 Smart Safety System

Table 14 Smart Safety system business description

Smart Safety System **Owner: Jade University**
The Smart Safety System (SSS) is developed to support emergency handling on board. The solution includes tools and markers for the support of crewmembers during evacuation processes. The main function of the system is to enable an easier information flow between all involved parties to reduce the means of radio communication. Since a cruise vessel has a large amount of crewmembers to solve emergencies, the SSS can be used as assistance to reach a fluent and effective decision flow. The interaction with other systems on board allows a more effective operation.

What problem/s is/are the asset solving?	Value Proposition
The Smart Safety System shows graphically presentation of the situation and therefore reduces the need of extended radio communication to explain the situation and its exact position. By using only graphic presentation, it also reduces the risk of misunderstandings forced by language barriers during an incident.	By intention, the functions of the system are kept simple and easy to understand that no intense training for the system is necessary and every crewmember should be able to understand and use it.
Customers	**Challenges**
The target customers are shipping companies, especially owners of passenger vessels, with their nautical personal as end-users. However, it is not only limited to passenger vessels and can be useful on all kinds of commercial vessels.	The system requires are stable and safe network connection for communication.
Unfair Advantage	
The system is as simple as possible, which allows every crewmember to use it without special training. As the system waives the use of text almost complete, there is no need for translation, which makes it usable for every crewmember regardless their education or nationality.	

6.11 Ship Stability Toolkit

Table 15 Ship stability toolkit business description

Ship Stability Toolkit **Owner: Jade University**
The Ship Stability Toolkit (SST) is a motion prediction system, which main scope is to assist the Master and Bridge Command Team during an incident with predictions of the ship motion. These predictions are of major interest during the evacuation process, as due to exceeded movement of the vessel, the use of some survival crafts can be restricted. Even before embarkation of the survival crafts, the ships motion has a huge impact on the evacuation process, as the unstable underground of a rolling vessel will increase the time needed by the passengers to arrive at their respective muster station, especially if they are already handicapped in their ability to walk. Based on the ships actual navigation, stability and weather data, the SST will send their predictions to

the PALAEMON Incident Management System, where they will be displayed to the Master and Bridge Command Team. On basis of these and other information they might take more accurate decisions, e.g. when it is the right time to muster the passengers or start to embark the survival crafts. Besides, the toolkit can also be used to determine if there are ways to reduce the motions and ease the evacuation process, by giving feedback after e.g. course or speed alterations how the ship motion might change.

What problem/s is/are the asset solving?	Value Proposition
The Ship Stability Toolkit solves the problem of unknown ship motions during an evacuation process, which might lead to significant delay of the evacuation.	The Ship Stability Toolkit is a simple service, which gives the user a quick and easy overview of the predicted ship motions during an incident, without the complexity and need to run an independent system like the existing loading computer software.
Customers	**Challenges**
The target customers are shipping companies, especially owners of passenger vessels, with their nautical personal as end-users. However, it is not only limited to passenger vessels and can be useful on all kinds of commercial vessels.	Before exploitation of the Ship Stability Toolkit, the information must be verified and the whole system tested and certified by a classification society.
Unfair Advantage	
The Ship Stability Toolkit consists of two main parts, the on-board part with a database of pre-calculated motion predictions and the shore-based part to calculate the motion predictions and store them to a database. Only the on-board part and the generated database are provided to the customer, the calculation tool itself will kept close and not available to any other party.	

6.12 Voyage Report Generator

Table 16 Voyage Report Generator business description

Voyage Report Generator **Owner: ATOS**
Legacy vessels have their own VDR (Voyage data report) with information of their own systems. PALAEMON VRG complements with all the information coming from PALAEMON devices,

<table>
<tr><td colspan="2">allowing a higher level of awareness. In addition, PALAEMON generates a .pdf report where the information is displayed in a friendly manner, thus the post incident analysis time might be reduced. Furthermore, multimedia information (videos, audios) is also available.</td></tr>
<tr><td>What problem/s is/are the asset solving?</td><td>Value Proposition</td></tr>
<tr><td>Legacy vessels have their own VDR (Voyage data report) with information of their own systems. PALAEMON VRG complements with all the information coming from PALAEMON devices, allowing a higher level of awareness. In addition, PALAEMON generates a .pdf report where the information is displayed in a friendly manner, thus the post incident analysis time might be reduced. Furthermore, multimedia information (videos, audios) is also available.</td><td>Trustworthy information from all PALAEMON and non-PALAEMON (Shipboard legacy systems) devices is compiled into a single report protected with password, only allowed persons (DPA) can open the file.</td></tr>
<tr><td>Customers</td><td>Challenges</td></tr>
<tr><td>Ships owners
Port authorities
Designated person ashore</td><td>Integration of shipboard legacy systems components as part of the PALAEMON cluster.
GDPR restrictions when storing video and audio.
The report needs internet connection which could be restricted during a real incident.
Regulation issues derived from promoting VRG as the evolution of VDR.</td></tr>
<tr><td colspan="2">Unfair Advantage</td></tr>
<tr><td colspan="2">Novelty Trustworthy Digital information stored during the incident.</td></tr>
</table>

6.13 Decision Support System (DSS)

Table 17 Decision support system business description

Decision Support system Owner: Konnektable

The PALAEMON Decision Support System (DSS) is a submodule of the PALAEMON Incident Management System that provides action list drawn from the ISM Code during incidents, to aid with decision making. It draws data from other PALAEMON partners' components to enrich the action lists and provide live information, where possible to the Master and bridge crew.

The DSS is integrated into the user-friendly Graphical User Interface of PIMM, displayed in a dedicated monitor in the Bridge along with many different components of different partners working together. The DSS integrates to the following PALAEMON components

- Smart Risk Assessment Platform (NTUA)
  - Provides risk indication values to be displayed to the bridge during the incident to assist with decision making. The values are linked to specific action points
- Ship Sensors (ANEK)
  - Sensor values installed by the shipowner to the ship.
- Evacuation Coordinator (ATOS)
  - Serves as the coordination system of various PALAEMON components during all the phases of an incident. Is controlled by the bridge team.
- Ship Health Monitoring (ESI)
  - Determines the structural integrity of the ship during normal sailing and during incidents. Is used to detect grounding incidents.
- Ship Stability Toolkit (JU)
  - Provides the bridge team with the ship's movement parameters during an incident to aid in decision making.

Following the 6 months after the project's completion, the DSS will be integrated into KT's CONCORDE for Maritime Solution

What problem/s is/are the asset solving?	Value Proposition
The DSS is a tool that aims to bridge the gap between the static lists of the ISM code and the live state of the vessel by adding dynamic data and displaying the action points in a user friendly way. This results in the Master and Bridge Crew viewing less points of information at the same time, decreasing distractions during the life-critical process of incident management and/or evacuation.	We think the DSS is an essential tool in every ship's arsenal. The single point of information essential for decision making the PIMM provides is very valuable for any sailor during times of emergency.
Customers	**Challenges**

The main customers of the DSS can be considered naval companies of any size with fleets of any size. As the PIMM can be deployed in the bridge of any ship, in a single server, it does not need any special infrastructure to run. The data can be provided from the sensors of the ship, if they exist.	The majority of issues are presented when integrating to the existing ships' infrastructures. As every ship is different in this regard and they all use different technologies, some old, some new, excellent cooperation with the ship holder company is required when customizing the PIMM to fit the ship as there is the need for development of special bridging software/hardware.
	Unfair Advantage
N/A	

6.14 PALAEMON Incident Management Module (PIMM)

Table 18 PALAEMON Incident Management Module PIMM business description

PALAEMON Incident Management Module PIMM Owner: Konnektable

The PALAEMON Incident Management Module is an Incident Management System comprising of many different components of the PALAEMON ecosystem all working together to ensure the proper management of an incident aboard a Cruise Ship, from the identification of the incident to the proper mitigation procedures being followed, as per the standards set in the naval industry, to the evacuation of the passengers should the incident prove to be out of control.
 	
The PIMM is comprised of a user-friendly Graphical User Interface displayed in a dedicated monitor in the Bridge along with many different components of different partners working together, in this endeavour. Their use in the PIMM's interface is noted below:
 	
• Decision Support System (DSS) (KT)
  ○ Provides action lists during emergencies, drawn from the ISM Code.
• Smart Risk Assessment Platform (NTUA)
  ○ Provides risk indication values to be displayed to the bridge during the incident to assist with decision making.
• PaMEAS (UAEG)
  ○ Helps the bridge coordinate the alerting and evacuation of passengers.
• Smart Cameras
  ○ Provides a machine learning assisted camera system to be used during the incident for decision making.
• Evacuation Coordinator (ATOS)

- Serves as the coordination system of various PALAEMON components during all the phases of an incident. Is controlled by the bridge team.

- Smart Safety System (JU)
  - Works in cooperation with the Evacuation Coordinator (ATOS) to pinpoint incidents and alert other PALAEMON components of ongoing incidents.
- Ship Health Monitoring (ESI)
  - Determines the structural integrity of the ship during normal sailing and during incidents. Is used to detect grounding incidents.
- Ship Stability Toolkit (JU)
  - Provides the bridge team with the ship's movement parameters during an incident to aid in decision making.

Following the 6 months after the project's completion, the PIMM will be integrated into KT's CONCORDE for Maritime Solution.

What problem/s is/are the asset solving?	Value Proposition
The PIMM's interface aims to solve the problem of attention loss during life threatening emergencies, in that it provides a single source of various kinds of information and management options to the Master and the bridge team, all while using industry standards as well as bleeding edge technology. This helps the Master make concise and clear decisions during a time where their attention is most needed.	We think the PIMM is an essential tool in every ship's arsenal. The single point of information essential for decision making the PIMM provides is very valuable for any sailor during times of emergency Challenges
Customers	**Challenges**
The main customers of the PIMM can be considered naval companies of any size with fleets of any size. As the PIMM can be deployed in the bridge of any ship, in a single server, it does not need any special infrastructure to run. The data can be provided from the sensors of the ship, if they exist.	The majority of issues are presented when integrating to the existing ships' infrastructures. As every ship is different in this regard and they all use different technologies, some old, some new, excellent cooperation with the ship holder company is required when customizing the PIMM to fit the ship as there is the need for development of special bridging software/hardware. Moreover, when exploiting using the Joint Exploitation framework (noted below), the other components will need to be retrained/redesigned to adapt to new ship types and designs, where

	needed. A good example would be the Smart Risk Assessment Platform, as it needs different data for different types and sizes of ships.
	Unfair Advantage
N/A	

6.15 Smart Risk Assessment Platform (SRAP)

Table 19 Smart Risk Assessment Platform (SRAP) business description

Smart Risk Assessment Platform (SRAP) Owner: NTUA	
The PALAEMON Smart Risk Assessment Platform (SRAP) is a real-time risk assessment platform developed to assist the decision-making process of the Master and Bridge Command Team regarding the evacuation process. Its purpose is to provide decision support for the following aspects: 1) the decision to sound the General Alarm (GA) following an accident on board, 2) monitoring the progress of the mustering process, in order to take any additional actions (if necessary), and 3) the decision to abandon the ship or not. SRAP will dynamically assess the risk to the safety of the passengers and crew in the different phases of the evacuation process. To achieve this, it will exploit real-time data provided by other components in the PALAEMON ecosystem.	
What problem/s is/are the asset solving?	Value Proposition
The success of ship evacuation strongly depends on the performance of the human element i.e. the crew, under extremely challenging and stressful conditions. Probably the most contributing factors for a positive outcome are the decisions to be made and exercised by the Master and the Bridge Command Team, which need to be taken timely and be the most appropriate for managing the incident effectively and with the minimum possible losses. In this respect, SRAP improves the perception and the	SRAP is a dynamic risk assessment digital tool that provides decision support to the Master and the Bridge Command Team during emergencies throughout all phases of the evacuation process and enhancing their situational awareness. Specifically, the output of SRAP is a color-coded indication to the PALAEMON dashboard to provide assistance for the following decisions that should be taken after the occurrence of an accident: • to sound the General Alarm (GA); • to monitor the progress of the mustering process in order to take any additional actions if required; and

comprehension of the Master and his team regarding an accident onboard. Its goal is to support the human element effectively in terms of the necessary vigilance, early risk identification and adequate situation evaluation, in order to minimize human error and the response time during accidents.	• to abandon the ship or not.
Customers	Challenges
The main customers of this asset are shipping companies as they can utilise SRAP in order to ensure a better executed evacuation procedure for their ships, in case it is needed.	Mainly technological and funding challenges are faced in the exploitation process of SRAP.
Unfair Advantage	
SRAP is a dynamic risk assessment digital tool that intends to support the decisions of the Master and the Bridge Command Team throughout all phases of the evacuation process given the occurrence of an accident. The output of SRAP will be available in real-time to the Master and Bridge Command Team as an appropriate risk level indication regarding the following aspects: sounding the General Alarm (GA); monitoring the progress of the mustering process and taking any additional actions if required; and abandoning the ship or not. Emphasis has been given on the form of the risk information so that it will be comprehensible for the decision-makers, and to the reasoning of the risk evaluation to help them identify both the facts and the assumptions that influence the risk level. SRAP will be copyrighted in order to avoid being copied.	

6.16 AR Glasses

Table 20 Augmented Really Glasses business description

A.R. Glasses Owner: SIMAVI
AR Glasses component has a crucial role in supporting the implementation of evacuation scenarios. The headset used for AR solution is provided by Microsoft, Hololens 2, which will help the crew members with live information and assist them during various kinds of situations (emergency, safety procedures, processes, ...).

The crew members and participants are going to benefit of vital information on ship status, changes or updates on the evacuation strategy but also passengers and environment information.

What problem/s is/are the asset solving?	Value Proposition
• Need for real-time assistance and guidance of staff (crew members) in case of emergencies and critical situations • Need for continuous monitoring and assessment of ship status, changes, passenger and environment information and updates on the evacuation strategy • Need for fast, secure and reliable data exchange, providing the crew members to easily access services to speed up decision-making due to efficient data analysis and processing	• The AR component has a crucial role in supporting the implementation of evacuation scenarios in case of critical situations, contributing to the smart evacuation management • The AR component provides the crew members in real-time vital information on ship status, passengers and environment, to speed up decision-making in case of emergencies, major incidents and critical events • The AR component is compliant with the safety management procedures specific to maritime domain • The AR component enables users (crew members) to learn and assess various aspects concerned to passengers, ships, transfer and boarding infrastructure overall safety • The AR component is a solution based on innovative technologies and open architecture capable to integrate various types of realistic data. The AR component has a dedicated intuitive User Interface for end-users.
Customers	**Challenges**
• Owner of ships • Crewing Agencies	• Economic (require additional effort/resources to be marketable)
Unfair Advantage	
The AR component is the first solution of this complexity, developed within the project, so as to meet as many requirements as crew members face both in their daily work and critical situations. The solution is based on cutting-edge technologies and open architecture capable	

to integrate both realistic data and data provided by simulation programs/applications to create a mixed reality environment designed to manage emergencies and complex situations.

6.17 PALAEMON Academy (eLearning Platform)

Table 21 PALAEMON Academy (eLearning Platform) business description

PALAEMON Academy (eLearning Platform) Owner: JOAFG	
The PALAEMON Academy (eLearning Platform) is an easy to use Moodle system, as it is used for eLearning in academic sector very often. With this framework, it is possible to provide lessons and trainings with a controlling and monitoring to check if content was read, understood and learned. Therefore, the system is monitoring the access, provides quizzes and can provide exams. The PALAEMON Academy (eLearning Platform) is providing content for the crew to learn about the use of the PALAEMON system and the evacuation drills as well as for First Aid and how to handle people with special needs (from mobility limitations towards psycho social diseases). With this eLearning Platform, new technologies can be introduced and trained already before instalment at the ship. All theoretical background and limited presentations can provide a positive learning effect and can reduce the time for onboarding of new crew.	
What problem/s is/are the asset solving?	Value Proposition
If the crew is exchanged, this new crew needs to be onboarded to the ship with knowledge about the ship, the internal systems, the embarkation etc. Especially if a NEW ship is launched, the crew needs a full training on all aspects. How to handle people with mobility limitations and special needs, is also something very important to be trained also to speed up the evacuation process. eLearning can be used on a local server on the ship. It provides with low resources already its full functionality with a decent scalability and has already a lot of material for learning how to create new lessons/courses/lectures.	With the PALAEMON Academy (eLearning Platform) focused information and knowledge can be provided to specialized target groups. The presentation format can be adjusted from text to video as a multi media platform. With an easy administration and monitoring of participants, it is possible to organize lectures and exams to ensure the sufficient and correct reception of content to the audience. New lectures and content can be provided fast and effective. Hardware and software requirements are minimal and can be deployed on a virtual machine and work without internet connectivity, as long as there is a local network available.

Customers	Challenges
Customers would be the owner of a ship or the travel organisation/provider of the crew. They need to ensure the proper training of their crew member. With an easy to handle system, that allows also to easily create new content, they are flexible and can adjust their trainings to the use case at hand. They profit from the reduction of downtime of crews for training, as it can be done decentralized and is not limited to certain times a day.	Costs are limited to the content creation. Hardware and Software can be low cost. The main challenge of such an eLearning system is the constant maintenance of content.
Unfair Advantage	
Main Advantage is that the content is already developed. In combination with the other elements of the PALAEMON Academy, it is unique at this time. Additional trainings for a blended learning approach can be easily deployed.	

6.18 PALAEMON Academy (VR OnSite Training)

Table 22 PALAEMON Academy (VR OnSite training)

PALAEMON Academy (VR OnSite Training) Owner: JOAFG	
Within the software VR Onsite, a VR training toolkit, a bridge, a deck and the MEV of PALAEMON have been provided. The full integration of the PALAEMON System is visible on the bridge. The crew can train to check the cabins, if there are people in. The Crew can train to support in a MEDEVAC. The MEV is virtualized as a full scale model to test the seating and to get a feeling for the new lifesaving raft. As part of the Academy, it provides a training facility on its own. Together with a VR trainer, teams of up to 4 crew members can coordinate their actions during evacuation procedures while using the PALAEMON system from the bridge.	
What problem/s is/are the asset solving?	Value Proposition
The deployment of new technologies can be very cost intensive. The training of these new technologies is time	With the PALAEMON Academy (eLearning Platform) focused information and knowledge can be provided to specialized target groups. The

consuming and can be costive as well. Additionally, the training needs to be devoted to a special day and an available ship. These problems are solved with the VR representation of a ship and the PALAEMON system.	presentation format can be adjusted from text to video as a multimedia platform. With an easy administration and monitoring of participants, it is possible to organize lectures and exams to ensure the sufficient and correct reception of content to the audience. New lectures and content can be provided fast and effective. Hardware and software requirements are minimal and can be deployed on a virtual machine and work without internet connectivity, as long as there is a local network available.
Customers	Challenges
Customers would be the owner of a ship or the travel organisation/provider of the crew. Either as a simulation at an early stage, this system can support in the development of new technologies or as a cost-efficient training for the crew for a new ship or technology or lifesaving raft, the VR system can provide a full environment for training the SOPs.	To train by IMO standards, each ship would need to be “virtualized”. This is a cost factor. Additional to this, VR sickness is a problem, affecting est. 15-20% of trainees. It is recommended to have VR trainers with experience for running the first trainings.
Unfair Advantage	
Main Advantage is that the content is already developed. In combination with the other elements of the PALAEMON Academy, it is unique at this time. Additional trainings for a blended learning approach can be easily deployed.	

6.19 MEV and Inflatables

Table 23 MEV Inflatables

MEV and Inflatables Owner: Asantander + DSB + ESI
The PALAEMON project proposes to replace the lifeboats at each side of the ship with MEVs, which can accommodate at least 2X more people than the traditional life boats. New

MEV designs which can offer increased passenger accommodation as well as more efficient use of the space on board the ship for storing and operating the MEVs.

- This MEV was manufactured, tested as part of the PALAEMON demo. Design and analysis of the MEV I demo for as a scaled down demo of the real MEV I, as well as stability assessment of the vehicle
- LCA (Life Cycle Assessment) for the materials which was used to manufacture the MEV I demo but also the real MEV I. These materials are Composites, for lightness of the Vehicles, which are from bio fibres and bio resins. Bio-composites are chosen because they present greater biodegradability and lower emission of greenhouse gases in their manufacturing compared with the traditional synthetic compounds derived from petroleum.

The MEV I has been designed to occupy as much space as possible on the deck of the ship, without obstructing the whole deck. In this sense there is ample room behind the MEVs for passage of people (Figure 24).

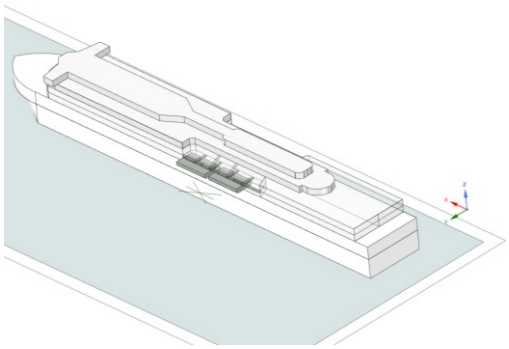


Figure 24 Placement of the MEVs on deck of HELLENIC SPIRIT

Figure 25 closer look at the placement of the MEVs on deck 8,

Figure 25 shows the space behind the MEVs for free passage of people.

Main Particulars of MEV

L = 14.6 m

B= 8 m

D = 2m

The weight groups imposed as boundary conditions in the numerical simulation are:

a) Weight of structure 13 tns
b) Weight of 315 passengers (35.4 tns, with SF)
c) Weight (front section) of navigation equipment = 500 kgr
d) Weight of engine = 1 tn

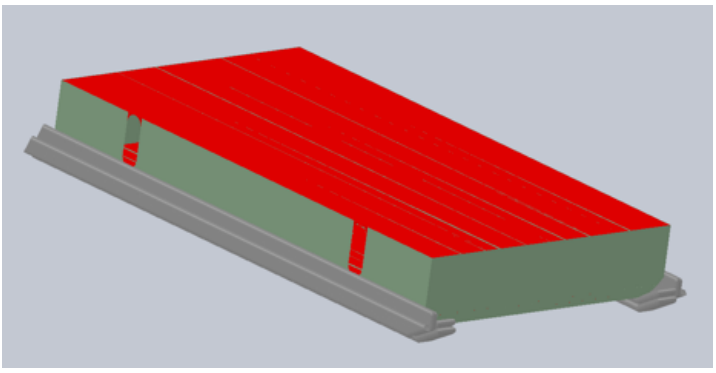
Three loading cases were simulated, considering fully loaded condition (all 315 passengers on board, Navigation and engine weight:

a) The MEV is on sagging condition (is supported by the crest of waves, fore and aft)
b) The MEV is supported on the inflatables (crest of waves in the inflatables)

What problem/s is/are the asset solving?	Value Proposition
The main problem is the demonstration that a boat can be made that can be recycled to 90% at the end of its useful life with a large capacity of passengers on board.	The clear value proposition is the possibility of recycling the material at the end of its useful life and its great stability due to the built-in floats so it cannot be an expense for the shipowner when disposing of it and fast manufacturing
Customers	**Challenges**
Main client are owners that they have an ecological conscience in their facilities (ships) and they want to innovate in the capacity to disembark people in case of abandonment.	The biggest challenges are adapting the MEV to each type of vessel according to the appropriate design and the owner sees that it is interesting to bet on this new model of rescue boat.
Unfair Advantage	
Manufacturing material and stability with inflatables. The MEV will not be easily copied due to the specific manufacturing process of this recyclable material and the material of the inflatables.	

6.20 Inflatables

Table 24 Inflatables business description

Inflatables Owner: DSB
The inflatable buoyancy elements for MEV-I are made up of a set of buoyancy elements consisting of two mirror-image structures which are attached to the two long sides of the MEV-I base body. Each of the two structures in turn consists of different structurally separate groups of individual chambers, which are connected via overflow valves with non-return device. The main chambers are made of coated drop-stitch material. Pressure relief valves in the chamber segments prevent overfilling but are designed in such a way that no pressure losses occur due to wave impact. Filling of the buoyancy chambers is done by using interconnected pressure vessels which are filled with compressed air. The filling process can be activated either automatically on contact with water or manually by the boat operator. For both buoyancy elements, independent but jointly activatable filling systems are provided, each consisting of a set of pressure vessels, associated valves, and filling hoses, which are integrated into the base body of MEV-I. The inflatable buoyancy elements for MEV-I are dimensioned considering the dimensions of the MEV-I main body. The MEV-I base body has corresponding installation spaces along the two longitudinal sides to accommodate the packed buoyancy bodies.    *Figure 26 – General Arrangement Buoyancy Chambers* The inflatable buoyancy bodies are connected to the structure of the MEV-I basic hull by means of non-positive and positive-locking elements in the area of the frames. Loads occurring during use are thus transferred directly into the structure. This also ensures that the required movement distances of the buoyancy chamber during inflation are kept as short as possible, thus ensuring that they can develop unhindered until the operating pressure is reached.

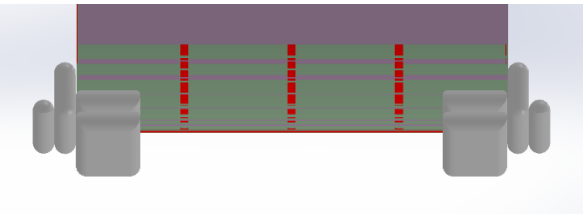


Figure 27 – Front Shape Stern Section Inflatable against MEV-I

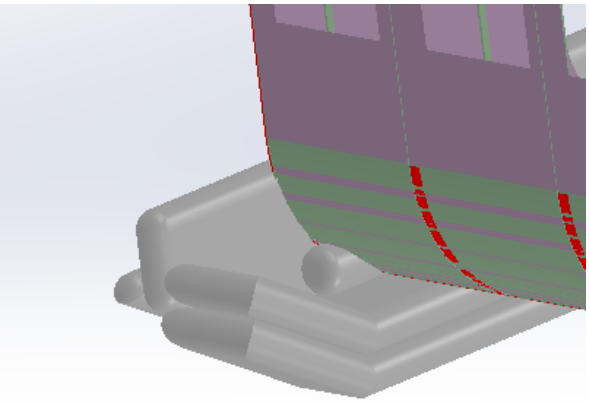


Figure 28 – Detail Stern Section Inflatable against MEV-I

What problem/s is/are the asset solving?	Value Proposition
The buoyancy bodies for the MEV solve the following problems • Ensuring sufficient buoyancy of the MEV • Improving the stability of the MEV in waves • Improving the MEV's handling characteristics in the water due to the catamaran effect • Increasing the distance between the MEV and the water surface	The inflatables will only be sold in cooperation with the MEV OEM.
Customers	**Challenges**

Cruise lines and their operators	There are alternative large capacity rescue means in the market and potential customers might only be favouring one approach.
Unfair Advantage	
N/A	

6.21 Training Platform

Table 25 Training Platform business description

Training Platform Owner: SIMAVI	
In maritime domain, safety comes first. The scope of the Training Platform Software component is to provide crew members with a modern training program but also to provide companies the tools needed to create, update, or modify training scenarios with ease. The main role is to train the crew members and to increase the safety on board. Training Platform Software offers 3 types of innovative facilities: 1. Scenario Player is a module used in training where crew members can access the training materials from a list of developed scenarios. 2. Scenario Editor is a module used in creation of the scenarios and training materials. The application requires internet access to upload the newly created scenarios to the server but also to download the existing ones. 3. VR Simulator is a module used for showcasing the system in a virtual environment. Training Platform Software can be used for academic purposes, providing the students a more efficient learning way about the dangerous situations they could be exposed to and helping on their future maritime carriers. It is a complex tool designed for end-users to avoid the dangerous situations, but also to gain experience for their future position by attending VR simulations with live information inspired from real scenarios. The scope of the VR simulation is to develop their skills and to show them how to escape from the unexpected critical situations and more even to avoid a dangerous scenario.	
What problem/s is/are the asset solving?	Value Proposition

• Need of training the crew members in a modern environment (Virtual Reality) and use innovative tools for creating and managing complex scenarios for critical situations and learn about safety procedures in maritime field • Need of companies for innovative tools with capabilities to create, update or modify training scenarios with ease when implement specific training programs	• Training Platform Software allows crew members to experience training exercises but also complex simulations • Training Platform Software is cost effective and can be used by multiple users at the same time • Training Platform Software, designed as VR solution for the maritime domain, allows trainers to simulate safety procedures, trigger alarms, hazards on multiple environment areas (e.g. stairs, cabin, lift, corridors, open space, deck area etc.) and use virtual avatars to add more realism to various scenarios / scenes The platform has a dedicated intuitive User Interface for end-users
Customers	Challenges
• Owner of ships • Crewing Agencies	• Economic (require additional effort/resources to be marketable)
Unfair Advantage	
The Training Platform Software acts both as a player and as an authoring tool, enabling the users to follow training programs and create training scenarios based on their specific needs. The solution allows the implementation of training programs in a virtual environment (VR/simulations), based on scenarios specific to operational modes, according to the status of the emergency type or the evacuation process.	

6.22 MEV-I Interior Design

MEV-I Interior Design Owner: EFB
MEV-I interior design layout is part of the MEV-I design proposal. The main features of the layout and elements proposed can be summarised in enhancing safety, energy efficiency, ambient conditions, inclusivity of passengers and crew members mission efficiency. The seating is uniquely designed to allow for persons that need assistance supporting their torso to be securely seated. The layout also has a number of seats that allow for extra space ahead of the passenger. The individual support packs can be used to provide an elevated footrest for

lower stature persons (including children). A central air conditioning system has been integrated in the design; LED energy efficient lighting is used while skylights take advantage of daylight. Furthermore, the crew has access to runways that make all seats accessible.

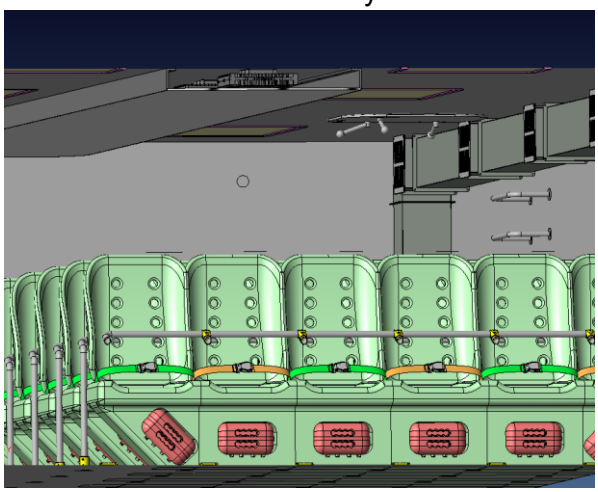


Figure 29 MEV-I Interior Design

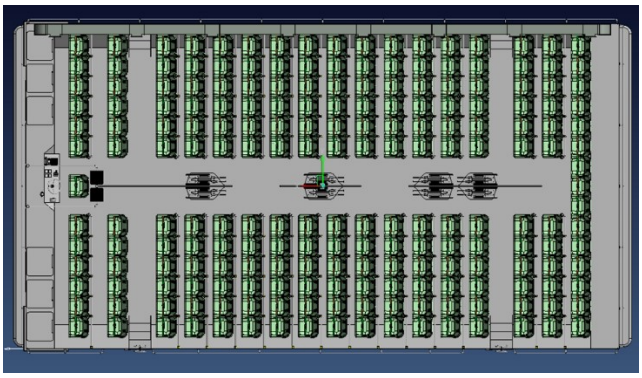


Figure 30 MEV-I Interior Design

What problem/s is/are solving the asset?	Value Proposition
MEV-I interior design introduces a seating system that accommodates varying body types. Furthermore, it takes into account special needs like passengers that need to support their bodies in seating or passengers that are visually impaired. Furthermore, the design includes subsystems that ensure a pleasant and viable environment, while also contributing to energy efficiency. Last, the design aspires to accommodate the needs of the crew when the MEV is in operation.	MEV-I interior design is a detailed and thought-out proposal for interior design of next generation of MEV's and contains elements that may be transferable to other design problems.

Customers	Challenges
Main customers are shipyards, shipping companies and any other organization that is in need of holistic approach to a bodily and ability diversified audience.	For the maritime industry in particular there are many regulations that limit the ability to design optimised to the needs of the passengers.
Unfair Advantage	
The proposed design is based on modularity of elements, making them reusable and adaptable to spatial requirements and the whole design proposal up- or down-scalable	

7 Individual Exploitation Plans

This section contains the following information for each partner:

the organization profile of each partner in the PALAEMON Consortium, as well as: a description of the business development possibilities envisaged by each organization, a short description of the exploitable results, the exploitation interests evinced, the potential market and customers to be addressed and the potential detected risks that are provided.

Note: Some individual Exploitation Plans remains without update from D9.4 [45]

7.1 AIRBUS DEFENCE AND SPACE SAS (ADS)

7.1.1 Organization profile

ADS core business is to address the defence and security topics in Airbus Group. As such, it has several lines of business that develop the components of large integrated systems. In particular for PALAEMON, two lines of business are specifically interested:

- Maritime Security Solutions for the information systems aboard vessels and the connections with external organisations (National maritime safety centres, including Rescue Coordination Centres, European Maritime Safety Agency (EMSA), Vessel Traffic Services (VTSs), etc.);
- Military Aircraft that develops UAVs in different sizes and for different missions.

In addition, ADS are the coordinator of the project, so they are interested in enriching their portfolio of large integrated systems.

7.1.2 Business Development Possibilities

7.1.2.1 Identification of individual exploitation possibilities for the project

The safety system integrated to vessels can be used to enhance the Search and Rescue missions. ADS have developed a Maritime Surveillance, Styris © [37] which is also the base of the French Navy surveillance system SPATIONAV that also equips the Rescue Coordination Centres (RCC). The capability to share information with the vessels can bring an added-value to our customers.

Regarding the UAV, it has been years that the Navies and Maritime Companies would like to have UAVs on board for surveillance and SAR purposes. The conflict between VTOLs and fixed wings (range vs operability from a ship) still exist and few decisions have been made. So PALAEMON should bring important decision support for the development of on-board UAVs.

7.1.3 Short description of key outcomes to be exploited and the innovation potential

The key outcomes are: 1. A first version of on-board UAV for safety support and 2. A better knowledge of Maritime companies' expectations for the future in order to propose new versions of ship-shore exchanging capabilities.

7.1.4 Potential addressable market & customers

Navies and Maritime companies as ADS provide 85% of long-range communication solutions for vessels.

7.1.5 Timetable for exploitation

The exploitation will take place in the mid-term (ca 5 years) to meet the requirements of the new generation of cruise ships.

7.1.6 Potential risks, barriers or limitations

Since the cruise activity is raising a lot, the market should be there for numerous years.

7.2 ATOS (Atos Spain)

7.2.1 Organization profile

Atos is a global leader in digital transformation with 112,000 employees and annual revenue of c. € 11 billion. European number one in cybersecurity, cloud and high-performance computing, the Group provides tailored end-to-end solutions for all industries in 71 countries. A pioneer in decarbonization services and products, Atos is committed to a secure and decarbonized digital for its clients. Atos is a SE (Societas Europaea) and listed on Euronext Paris.

The purpose of Atos is to help design the future of the information space. Its expertise and services support the development of knowledge, education and research in a multicultural approach and contribute to the development of scientific and technological excellence. Across the world, the Group enables its customers and employees, and members of societies at large to live, work and develop sustainably, in a safe and secure information space.

Atos Research and Innovation is the R&D hub for new technologies inside ATOS' BDS division focusing on research and development projects, specially within the frame of the EU funded programs.

Thanks to ARI, Atos is a full member of the Big Data Value Association (BDVA); the 6G Infrastructure Association (6G-IA) and the Euro Cyber Security Organization (ECSO)

7.2.2 Business Development Possibilities

7.2.2.1 Identification of individual exploitation possibilities for the project

ARI is firmly encouraged to support the strategy [38] of Atos in the Transport industry.

This strategy is summarized as follows:

- Provide seamless and personalized customer experiences
- Accelerate development and competitiveness during unpredictable times
- Support new disruptive business models in transport infrastructure
- Enhance operational efficiency and allocation of limited resources
- Reduce environmental impact and support decarbonization
- Improve security and accessibility

PALAEMON ecosystem is able to contribute to this strategy as personalized and customer services can be provided through the platform, the assets developed in the project can improve the competitiveness of solutions in the maritime industry by enhancing safety on board and increasing passenger confidence. This can also lead to new business models and more efficient operations by controlling the evacuation process and improving safety and accessibility for passengers and crew.

The focus of ATOS exploitation in the project will be based on the two main components described in the section below.

In addition to the area of transport, the impact of the results in the area of emergency management is being studied [39].

7.2.2.2 Short description of key outcomes to be exploited and the innovation potential

This information is extracted from sections 6.8 and 6.12.

Evacuation coordinator: PALAEMON - Information broker that centralizes the evacuation status notifications among all software components that may have a dependent/dynamic operation, based on the actual evolution of the evacuation process.

Voyage report generator. Legacy vessels have their own VDR (Voyage data report) with information of their own systems. PALAEMON VRG complements with all the information coming from PALAEMON devices, allowing a higher level of awareness. In addition, PALAEMON generates a .pdf report where the information is displayed in a friendly manner, thus the post incident analysis time might be reduced. Furthermore, multimedia information (videos, audios) is also available

7.2.2.3 Potential addressable market & customers

Shipping companies are the main customer, nevertheless ATOS is considering extrapolating the solution to other sectors in which a massive evacuation can be useful as stadiums, hotels and resorts and nursing homes.

7.2.3 Concrete exploitation path

Further research: ARI strategy to evolve the assets developed in the project (Evacuation coordinator and the Voyage Report Generator) consists in including the assets in new research proposals with the main objectives of improving the assets ,adding new functionalities and demonstrating their value e.g.: Test the portability of the assets to other domains, in this case, emergency management coordinator the idea was to use the asset as the evacuation coordinator of a hospital during COVID in conjunction with other risks (flooding, firing, etc.). The proposals are mainly presented in the Horizon Europe research domain e.g.: HORIZON-CL3-2021-INFRA-01-01 European infrastructures and their autonomy safeguarded against systemic risks in the program Horizon Europe - Cluster 3: “Civil security for society” and in the cluster 5: "Climate Energy and Mobility".

Presenting the results to ATOS product owners. The main purpose of this action is to evolve the TRL of the results from TRL5-6 to TRL7-8.

One of the identified actions is to propose a pilot with an ATOS' client. To this end, solutions are presented to the business units, with the main goal of informing them of cutting-edge technologies to convey the results to clients to propose controlled pilots to the customers in which the validation of the solution will be the main objective.

7.2.3.1 Work done and achievements

- **Presentation in the European Big Data Value Forum 2021**

During the event European Big Data Value Forum , ATOS presented their cutting edge technologies projects in a virtual booth European Big Data Value Forum 2021 | Participations (b2match.io) . PALAEMON was presented in the virtual both on 29th November 2021

Figure 31 Atos virtual both agenda in the European Big Data Value Forum 2021

- **Presentation in the event TRA Lisbon 16/11/2022**

In the TRA event link the evacuation coordinator was presented by Alexandros Koimtzoglou (NTUA) in the session “A radical rethinking of traditional Waterborne Solutions to increase Accessibility and Remove Barriers” organized together with the projects Current Direct [40]and SEABAT [41]. According to the TRA organization the event was attended by more than 2000 participants.

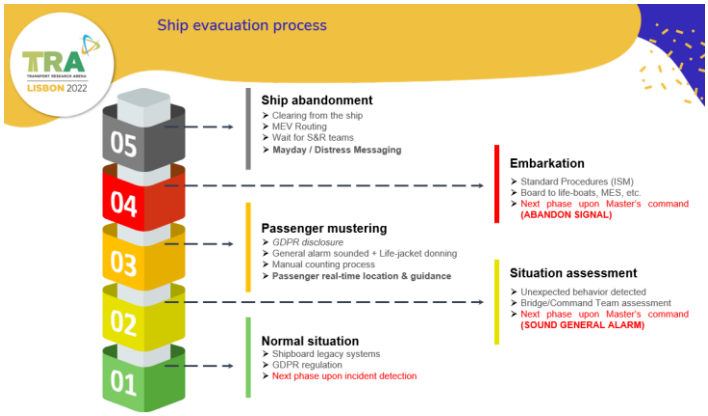


Figure 32 TRA Lisbon 2022

7.3 KONNEKTABLE TECHNOLOGIES LIMITED. (KT)

7.3.1 Organization profile

Konnektable technologies Ltd. is a software development firm based in the Republic of Ireland, with offices located also in Greece and the USA. We combine the latest technologies in the fields of AI & Machine Learning, IoT technologies, Big Data and Analytics to build data-driven products in the areas of Compliance and Business Optimisation & Resilience. Our belief is that innovation thrives best through trust and good work synergies. Our employees embrace this vision and contribute by bringing forth their unique way of thinking and expertise into our R&D and commercial projects producing cutting-edge innovations.

7.3.2 Business Development Possibilities

7.3.2.1 Identification of individual exploitation possibilities for the project

Konnektable will capitalise on the commercialisation of the technology created in PALAEMON and on the R&D knowledge gained through developing a beyond the current state of the art solution, further details can be found on section Potential addressable market and customers.

7.3.2.2 Short description of key outcomes to be exploited and the innovation potential

PALAEMON weather forecast tool finalised at M30

The weather forecast tool has been developed under a dynamic framework that will fuse a range of weather information (waves height/frequency, winds force scale/ direction, currents, temperature, pressure at sea level, etc.) in predefined time intervals (every 3h). A bilateral communication between weather information sources from third party meteorological providers and PALAEMON Weather forecasting toolkit is set for dynamic updates. Multi model stochastic weather forecast is displayed in both tabular and graphic visual form (images, videos). Seamless Integration with KT's CONCORDE DSS module has been realized for correlation of weather conditional algorithms to evacuation planning optimization. A library of recorded correlations between weather conditions and evacuation strategies will be stored up in a centralized repository for historical reference.

PALAEMON On-Board Decision Support System finalised at (M32) of the project

PALAEMON's on-Board Decision Support System is the intelligence layer to the PALAEMON platform. It generates alerts in the different use cases covered by the project; decide on the action to be performed in real-time; predicts the crew next moves; prioritizes / ranks the severity and related criticality of unfolding events. The DSS features the latest advances on machine learning and artificial intelligence and includes metrics to evaluate the performance of the algorithms thus optimizing the values of their parameters depending on the use case.

PALAEMON Incident Management Module (PIMM) finalised at (M32) of the project

PALAEMON's PIMM is a central multi-layer agent that is capable of: (i) real time prediction and prevention, (ii) early detection, (iii) multi-response and (iv) risk mitigation. The PIMM system has been fused with expert knowledge to create a concise IF-THEN-ELSE statements table, detailing the events and setting up contingencies (e.g. Classification, Regression, Anomaly Detection, etc.). The system supports a multivariate input scheme, where raw-data, features and decisions can be accessed to provide the necessary outputs. Each layer of the Incident Management Module is able to seamlessly exchange information, as to coordinate the plan of action. It is capable of running in an automated infinite loop manner, where it continuously monitors everything and records the results. Embedded in the PIMM engine is a reporting system, with results, alerts, statistics, localizations, visualizations and plans of action. Furthermore the engine work in closely with any disaster response module including KT's CONCORDE EMS platform.

7.3.2.3 Potential addressable market & customers

On the commercial front KT will exploit the knowledge gained from PALAEMON project by creating new business opportunities and enhancing KT'S software solutions and processes, by leveraging its knowledge to develop niches and specific software applications which can be derived by PALAEMON project technologies and methodologies. These three newly developed solutions will be integrated to Konnektable's EMS platform called COncORDE

Crisis Management Platform – [42] extending its features and clientele to the maritime sector. The modular architecture of the CONCORDE platform will allow for an easy risk free integration to the disaster response, Decision Support System and incident management module of the platform. The maritime sector has significantly less competition in the areas of emergency / crisis management compared to the crowder area of emergency management so we consider it an ideal opportunity to penetrate the market with a customised SaaS version of CONCORDE EMS built for the maritime sector.

On the R&D front KT will participate in additional R&D projects and will capitalise from its extensive experience in the area of designing and implementing DSS and EMS platforms in an effort to always use and test the latest state of the art in underpinning technologies to extend it's current research portfolio and to transfer this knowledge to its platforms as a unique selling point against the competition mobilising also pre-defined dissemination and communication strategies and channels.

7.3.2.4 Timetable for exploitation

Phase.1: Technology characterisation and IPR has been already completed internally by our technical and legal departments.

Phase.2: Refactoring and integration to CONCORDE EMS (Duration: 2-4 months)

Phase.3: Technical testing & documentation (Duration: 1 month)

Phase.4: Marketing material (promotional 2 min video, full explainer 10 min video, relevant posts / campaigns on social media) – (Duration: 1 month)

7.3.2.5 Potential risks, barriers or limitations

We do not foresee any technological risks at this moment, the only risk we see is the time to penetrate a new market which can be mitigated with appropriate business development and targeted marketing campaigns.

7.3.3 Concrete exploitation path

7.3.3.1 Goals

To expand our commercial portfolio and more specifically the features of CONCORDE creating an instance for the Maritime sector

7.3.3.2 Work done and achievements

Most of the technical work has been already achieved through the project, the focus will be on the technology transfer / commercialisation, refactoring and branding

7.3.3.3 KPIs to measure the achievement

CONCORDE instance for the Maritime sector in 6 months after the expiration of the project

7.3.3.4 Roadmap

The roadmap has been explained in section Time table for exploitation.

7.4 Engitec Systems International Ltd. (ESILimited)

7.4.1 Organization profile

ESI main focus is technical and development work of solutions in the marine, offshore, underwater and oil & Gas sectors. We focus on CM (Condition Monitoring) and NDT (Non

Destructive testing) solutions using many different sensors and in house developed sw, as well as design and analysis work of custom or bespoke structures and equipment for the aforementioned industries. In the PALAEMON project ESI's main focus is the design and analysis of the MEV I and II (Mass Evacuation Vessels) which represent novel solutions for evacuation vehicles in high capacity Passenger and Cruise ships. The goal for these vehicles is to design vehicles which:

- Can accommodate 50% more passengers than common life boats
- Use the available space on the deck of the ship as used by ordinary life boats
- Novel launching methods, with fewer moving parts as well as simpler launching sequence
- Novel bio-composite materials thus contributing to the circular economy of the EU.

The aforementioned solutions have been designed and developed in WP4 and showcased in WP8. A scaled down MEV I demo has been tested in the premises of ASTANDER shipyard and the evaluation of the results has been successful.

ESI is also involved, in the development of ship monitoring solutions for both global and local structural integrity of the ship.

The SHM (Ship Health Monitoring) system, which is used for assessing stability and global ship's structural integrity has been trialled during the work performed in Task 6.1 and reported in D6.1. This system is comprised of IMUs (Inertial Measurement Units) which can offer real time measurements of displacement, velocities and accelerations of the ship's motions (6 dof). In this sense when combined these can also offer hull girder's deflection and bending moment data. A in house sw has been developed for recording, storing, evaluating and transmitting the data to the PALAEMON core. The SHM has been tested in several cases with the PALEMON core and real time data (status reports and alarms) have been transmitted in the framework of demo cases accomplished.

Lastly an AE (Acoustic Emission System) has been employed for the identification of defect forming events (cracks, damages) on the critical places of the hull of the ship. In this context. The AE has been used for the identification of crack like events using the AE processed signals of counts (number of events that surpass a given threshold) and AE energy (energy of the signal. When these signals have been identified the occurrence or the propagation of a damage can be detected and monitored.

In a last note both the SHM and the AE system are real time CM methods which are connected to the PALAEMON core

7.4.2 Business Development Possibilities

7.4.2.1 Identification of individual exploitation possibilities for the project

The MEV I and II designs are intended to be showcased to interested partners such as shipyards, marine design offices. These designs can offer future solutions for evacuation vehicles as well as ship designs and procedures accommodating these MEV vehicles. The MEV I and MEV II are custom made for each ship design, so it's not straight forward to ascertain the value proposition for the design process of these vehicles.

For the SHM and AE system, these are intended for Ship owners of Passenger and Cruise ships and looking at the broader marine market, to merchant shipping (bulk carriers, tankers, Container ships, etc.). A niche market where the SHM can be of real value is the Salvage

industry. The SHM system can be used to real time monitor the stability and structural integrity of the ship, while the rescue and recovery teams are trying to salvage the ship, crew, cargo etc., after an incident, e.g. grounding, collision, excessive roll or trim due to damage, etc.

7.4.2.2 Short description of key outcomes to be exploited and the innovation potential

- Design and analysis process of MEV I and II vehicles
- SHM for ship's real time monitoring of stability and structural integrity
- AE system for real time monitoring of local structural integrity and the formation or propagation of local damages.

7.4.2.3 Potential addressable market & customers

- Ship owners
- Salvage Companies
- Insurance companies for arbitration and disputes
- Ship yards and marine design Offices

7.4.2.4 Timetable for exploitation

- Design and analysis of MEV I and II during and after the project presentation to related stakeholders
- SHM system already presented to key stakeholders and possible market peach in 2023

7.4.2.5 Potential risk barriers or limitations

The current market for high-capacity Passenger and Cruise ships has been hit by the COVID crisis and MEV vehicles might not be too appealing to shipyards and operators. The situation will improve as time goes by and the Cruise market improves and the MEV proposition might get traction.

7.4.3 Concrete exploitation path

7.4.3.1 Goals

Market roll out of the SHM system to interested stakeholders by late 2023. Both, Ship owners and Salvage operators, approached. AE system demonstrated and showcased for local damage detection to relevant stakeholders, with Salvage Operators as the candidates for initial market roll out.

7.4.3.2 Work done and achievements

Design and analysis completed for MEV I and MEV II and discussion with ASTANDER shipyard for next steps.

SHM system has been finished and the GUI is being reworked for a more user friendly access. It has been tested and real time data to the PALAEMON core showcased on multiple occasions.

7.4.3.3 KPIs to measure the achievement

Design and analysis of MEV I and II has been accomplished and relevant KPIs have been verified during testing of the MEV demo.

SHM verified and tested

KPI 1: measure stability and hull girder deflection. Showcased on T6.1

KPI 2: SHM Real time monitoring and communication with PALAEMON core, transmitting status reports and alarms. Showcased in WP7 and WP8

KPI 3: AE system detection of local damages formation and propagation. Preliminary tested in T6.1

7.4.3.4 Roadmap

– SHM finished towards end of 2023 and showcased to relevant stakeholders

- AE showcased to relevant stakeholders during 2023

- MEV design and analysis, showcased to relevant stakeholders from end 2023 to 2025.

7.5 IOTAM INTERNET OF THINGS APPLICATIONS AND MULTI LAYER DEVELOPMENT LTD (ITML CY)

7.5.1 Organization profile

ITML provides novel, tailor-made software solutions based on a variety of technologies, such as big data analytics, advanced data mining and machine learning. ITML's vision is to deliver products and services close to the real customers and market needs, ultimately improving the user experience and the access to technology. ITML solutions cover a very wide range of applications, including e-shops, e-learning, Business Process Management (BPM), or any other customized application.

The primary competence of ITML relies in the design and development of software prototypes based on technologies that include machine learning algorithms, advanced data mining techniques, data aggregation and data analytics in IoT systems, as well as visualisation tools; all of which are applied in different operational domains, such as energy, logistics, health, education, maritime, and security.

Specifically, in PALAEMON project, ITML has to tackle the following objectives:

- The customization and deployment of a data fusion middleware able to handle complex critical events from multiple data streams. This middleware / messaging bus will be responsible for the pre-processing and providing data to the modules deployed in WPs3-5. It will be based on the customization of ITML's Data Fusion Bus, that carries out data fusion for multiple modality data streams.
- The development of the interoperability framework between the various PALAEMON components by designing common interfaces (APIs) and providing adapters for modules to connect to DFB.
- The development of Human-Machine Interfaces (HMI) and a virtual control room between the field crew and the bridge, using AR. HMIs are essential resources for crew members, who use them to review and monitor different processes, diagnose problems, and visualize data. HMIs can be used to (i)visually display data, (ii) track evacuation time, crew force, evacuation area, (iii) oversee KPIs and (iv) monitor sensors inputs and outputs.

7.5.2 Business Development Possibilities

7.5.2.1 Identification of individual exploitation possibilities for the project

ITML aims to exploit the outcomes of PALAEMON, to enhance its market position with respect to intelligent management of advanced evacuation methodologies, as well as on providing security services in multiple domains. Moreover, ITML will exploit the project's findings in enhancing and strengthening its positioning within the EU market and research domain, establishing partnerships and agreements for further collaborations with the large corporations participating in PALAEMON.

ITML will exploit its existing dissemination channels (partners, Twitter and LinkedIn accounts) as well as its expertise as Dissemination Manager in large EU-funded projects (e.g. I-MECH project under the Ecsel JU funding scheme) to ensure maximization of the communication of PALAEMON outcomes

7.5.2.2 Short description of key outcomes to be exploited and the innovation potential

ITML's Data Fusion Bus enables organizations in developing, deploying, operating and managing a big data environment with emphasis on real-time applications. It combines the features and capabilities of several big data applications and utilities within a single platform. ITML plans to use DFB to support a Big Data as a service solution that is currently implementing.

7.5.2.3 Potential addressable market & customers

The key capabilities of DFB are: Smart Production Digitisation and IoT, Data aggregation from heterogeneous data sources and data stores, Real time analytics offering ready to use Machine Learning algorithms for classification, clustering, regression, anomaly detection, An extendable and highly customizable User Interface for Data Analytics, manipulation and filtering. The UI also includes functionality for managing the platform, Web Services for exploiting the platform outputs for Decision Support. Due to the range of its usage, Data Fusion Bus, can be deployed in a series of platforms that are in a need of these kind of services. To be more precise, DFB could be a potential solution for data aggregation and real time analytics to industries like: Energy, Maritime, CyberSecurity, Big Data, Automotive and Healthcare..

7.5.3 Concrete exploitation path (to be updated in several iteration along the project)

At this stage, ITML is following a high-level business plan which in turn matches with the needs, provisions and progress of the PALAEMON project. For this planning, ITML has defined a major mission statement and two (2) strategic objectives. Regarding the mission statement, ITML will develop, deploy, and maintain a feasible data fusion solution engineered and oriented towards added value for data management and exploitation. ITML will also enrich and re-enforce our data analytics framework offer. Regarding the strategic objectives, these are: (i) to establish fully productive deployment of the solution in key industry players; to leverage the consortium's Industrial Partners and ITML R&D and commercial ecosystem, and (ii) to achieve and attain sustainable market growth (customer acquisition and revenue).

7.6 Johanniter Osterreich Ausbildung Und Forschung Gemeinnutzige GMBH (JOAFG)

7.6.1 Organization profile

JOAFG is the Johanniter Austria Education and Research Ltd. Its activities are focused on the training of medical staff as well as supporting with research the developments in the security area and civil protection as well as health support and wellbeing for vulnerable groups. JOAFG is connected to other Johanniter Ltd.s in Austria through the friendly association of Johanniter Austria. Following this, JOAFG covers areas of patient transport, ambulance service, disaster relief, personal emergency services, mobile care, palliative care, training for first responders etc.

JOAFG is with its research and development department responsible for the strategic development and the organisation development to future trends and adjust existing services to modern requirements.

In this special case of PALAEMON, JOAFG is providing a new kind of training (VR training), eLearning system (moodle) with didactic measures and digital administration for this sector and innovative testing methodologies (MEV testing in Simulation and in VR Environment). Additionally, JOAFG provides the medical background and human transport aspects of vulnerable groups from patient transport perspective and advanced first aid.

7.6.2 Business Development Possibilities

7.6.2.1 Identification of individual exploitation possibilities for the project

For JOAFG, the advanced training and teaching chances, won through the experiences with PALAEMON, allow a better training and supported also during the COVID-19 crisis the teaching of first responders by the moodle elearning system, which was initiated for PALAEMON by JOAFG.

With the developed content and the cooperation with Jade University, it is envisaged to provide more trainings for ship crews within the next years.

With the VR system, it was first time possible for JOAFG to provide a full virtual environment with mock ups in the VR environment. This leads to new possibilities for testing of technologies, as it was done now for another Horizon Project (METICOS) to support pilot actions. In near future, the VR system will support special training for extreme situations of first responders and be part of the PALAEMON Training Concept by JOAFG.

7.6.2.2 Short description of key outcomes to be exploited and the innovation potential

eLearning Platform

The PALAEMON Academy (eLearning Platform) is an easy-to-use moodle system, as it is used for eLearning in academic sector very often. With this framework, it is possible to provide lessons and trainings with a controlling and monitoring to check if content was read, understood and learned. Therefor the system is monitoring the access, provides quizzes and can provide exams.

The PALAEMON Academy (eLearning Platform) is providing content for the crew to learn about the use of the PALAEMON system and the evacuation drills as well as for First Aid and how to handle people with special needs (from mobility limitations towards psychosocial diseases).

With this eLearning Platform, new technologies can be introduced and trained already before instalment at the ship. All theoretical background and limited presentations can provide a positive learning effect and can reduce the time for onboarding of new crew.

VR component

Within the software VR Onsite, a VR training toolkit, a bridge, a deck and the MEV of PALAEMON have been provided. The full integration of the PALAEMON System is visible on the bridge. The crew can train to check the cabins, if there are people in. The Crew can train to support in a MEDEVAC. The MEV is virtualized as a full-scale model to test the seating and to get a feeling for the new lifesaving raft. As part of the Academy, it provides a training facility on its own. Together with a VR trainer, teams of up to 4 crew members can coordinate their actions during evacuation procedures while using the PALAEMON system from the bridge.

7.6.2.3 Potential addressable market & customers

eLearning

Customers would be the owner of a ship or the travel organisation/provider of the crew.

They need to ensure the proper training of their crew member. With an easy-to-handle system, that allows also to easily create new content, they are flexible and can adjust their trainings to the use case at hand.

They profit from the reduction of downtime of crews for training, as it can be done decentralized and is not limited to certain times a day.

VR component

Customers would be the owner of a ship or the travel organisation/provider of the crew. Either as a simulation at an early stage, this system can support in the development of new technologies or as a cost-efficient training for the crew for a new ship or technology or lifesaving raft, the VR system can provide a full environment for training the SOPs.

7.6.2.4 Timetable for exploitation

PALAEMON Exploitation Timetable																
	Q1 2023	Q2 2023	Q3 2023	Q4 2023	Q1 2024	Q2 2024	Q3 2024	Q4 2024	Q1 2025	Q2 2025	Q3 2025	Q4 2025	Q1 2026	Q2 2026	Q3 2026	Q4 2026
Final product definition																
Preparation of sales documents																
Advertising and Sales for product																
Running of first trainings																
Content adjustment																
technical refinements																
Product development																

Figure 33 JOAFG Exploitation timetable

7.6.2.5 Potential risks, barriers or limitations

The main risk is that the request for a VR and eLearning training is running low by maritime stakeholders.

Barriers are the IMO guidelines that have to be closely watched for the content development. During the PALAEMON project, the IMO regulations have been used as an orientation. For

the final product launch, they have the be followed to the point. This can lead to some adjustments and further developments before the final launch.

A potential accreditation is envisaged by IMO for the PALAEMON training. Nevertheless, the chances for this are low. The mitigation strategy is to have a cooperative training with the Jade University or another naval academy to gain better credibility for the market.

The current limitations are mainly at the VR system. It allows at this moment (01/2023) 4 trainees at once. Even if they can be already working on different places on the globe, it is not easy to have more than 4 people at a cooperative site with the current system. Next generations of VR system will cope with this limitation and allow larger trainings.

7.6.3 Concrete exploitation path

7.6.3.1 Goals

- Get a positive revenue within 3rd year of product.
- Create 4 new jobs with the product, allow expansion after 3rd year
- Use findings for other projects – partly already achieved

7.6.3.2 Work done and achievements

First trainings have been run with JU and OELS in a restricted session to ensure the proper setup for teaching and lecturing.

The VR Onsite System with JOAFGs adaptations and its advanced usage and scope is already in action for further projects (METICOS, TREEADS) and in first responder trainings at Johanniter and fire fighter academies in Germany and led to a constant cooperation between the original development company and JOAFG

7.6.3.3 KPIs to measure the achievement

1. New projects funded for VR
2. Courses and participants of the eLearning
3. Sales figures for the new product line of training content

7.6.3.4 Roadmap

Figure 34 JOAFG Roadmap

7.7 National Technical University of Athens. (NTUA)

7.7.1 Organization profile

The National Technical University (NTUA) is the oldest and most prestigious educational institution of Greece in the field of technology and has contributed unceasingly to the country's scientific, technical and economic development since its foundation in 1836. The scientific staff in the Schools, together with post-graduate researchers, apart from their teaching and related educational activities, conduct research work assisted by postgraduate students and a considerable number of external collaborators; the amount and the high standards of this research is proved by the numerous publications in International Scientific Journals and Proceedings of International Conferences as well as by the prominent place of NTUA among all European Universities, due to the increasing number of research projects financed by the EU and other Greek and foreign organizations of the public and the private sector.

The School of Naval Architecture and Marine Engineering (SNAME), was founded in 1969 and teaching commenced during the academic year of 1969-70. Ever since its inception, the School has been heavily involved in research activities. Following Greece's rich maritime tradition, SNAME is active in practically all areas of maritime transport R&D. NTUA-SNAME has substantial experience in the following scientific domains (indicatively): ship-design, design, development and simulation of maritime and intermodal transport, risk analysis, cost-benefit analysis, financial analysis, optimization of logistical systems, Life Cycle Cost analysis (LCC), Life Cycle Analysis (LCA), business process modelling, and dissemination activities. Apart from issues related to shipping operations, NTUA-SNAME's research also includes issues related to the human factor (i.e., seafarers & passengers onboard) for both routine and

emergency situations, Human Centred Design (HCD), Non-Technical Skills (NTS), and issues related to stress and fatigue. NTUA-SNAME has also completed or is involved in numerous EU and National projects in areas such as technology, management, economics, telematics, environment and safety. It has also been involved in projects and studies with a substantial policy analysis element.

7.7.2 Business Development Possibilities

7.7.2.1 Identification of individual exploitation possibilities for the project

Besides the exploitation of the PALAEMON project through the participation in conferences and paper publications in journals, NTUA's exploitation plan includes actions regarding the strengthening of the PALAEMON research, the communication between the academic and maritime communities and the transferring of knowledge to undergraduate and postgraduate students. The project results from the NTUA’s side will be used for academic and research purposes in general.

First of all, the results will be used for educational purposes, by integrating them into undergraduate and postgraduate courses or used to create new. In addition, the results will be used for future research purposes as well, by utilising them for PhD researches, surveys and publication of papers in journals as well as future scientific conference participations. Moreover, the outputs of PALAEMON project have already been used for the conduction of workshops. The outcomes of the project will be presented to undergraduate students, postgraduate students and people of the maritime domain with workshops and seminars, in order to familiarize with the innovative technologies that came up through the work done in PALAEMON.

NTUA-SNAME aims to use the gained knowledge for supporting decision making in the maritime industry. NTUA will contribute in the value chain of the project by helping in the design and establishment of innovative technologies in the maritime domain.

7.7.2.2 Short description of key outcomes to be exploited and the innovation potential

As mentioned above, the main goal is to impart knowledge to undergraduate and postgraduate students for aspects concerning the innovative ideas of the project, such as the way the Smart Risk Assessment Platform (SRAP) works. In more detail, the component that NTUA developed, SRAP, is a real-time risk assessment platform developed to assist the decision-making process of the Master and Bridge Command Team regarding the evacuation process. Its purpose is to provide decision support for the following aspects: 1) the decision to sound the General Alarm (GA) following an accident on board, 2) monitoring the progress of the mustering process, in order to take any additional actions (if necessary), and 3) the decision to abandon the ship or not. SRAP dynamically assesses the risk to the safety of the passengers and crew in the different phases of the evacuation process. To achieve this, it exploits real-time data provided by other components in the PALAEMON ecosystem. The outcome of the SRAP is a color-coded Risk Indicator on the PALAEMON dashboard.

The ultimate goal besides transmitting the knowledge to young naval architects and marine engineers in order to be ready for the demanding maritime domain is to use their force to possibly grow or evolve new ideas. Moreover, besides the above-mentioned actions and goals, NTUA intends to exploit the innovations of PALAEMON for the evacuation systems to the academic as well as maritime community.

7.7.2.3 Potential addressable market & customers

NTUA will mainly focus to the academic community, i.e. undergraduate, postgraduate students and PhD candidates. These groups and entities will make concrete use of the results. By transmitting new information to the above-mentioned groups of the NTUA the innovative outcomes of the project will be spread and create more chances and opportunities for publications in well-known scientific journals, and conferences which will help the results to be exploited to the academic community.

7.7.2.4 Timetable for exploitation

After the completion of the PALAEMON project, the outcomes could be incorporated into existing courses. In the meantime, research from the completed deliverables have been used and will be used for publications in scientific journals and for presentations in conferences. In addition, workshops have been conducted, in order to present the results of PALAEMON project to people of the maritime domain, get their feedback but most importantly familiarize them with the innovative technologies and methods which are raised through it.

7.7.2.5 Potential risks, barriers or limitations (if any)

N/A

7.7.3 Concrete exploitation path

7.7.3.1 Goals

The goal of NTUA from the aspect of the exploitation is to disseminate the results to the undergraduate and post graduate students by transmitting as much information as possible through specially designed courses or additions to existing ones. In that way the skills and knowledge of the above mentioned NTUA members will improve, shaping more skilled and informed people for the maritime domain, increasing the possibilities of creating a better or new invention, innovation, or prototype by their work or possibly their academic research. Another key point is the successful transfer of the outcomes to people of the academic community who can really make the best out of it and have the potential to take it even further hopefully through reports, dissemination materials and publications. In this way the impact of research will be maximized.

7.7.3.2 Work done and achievements

- On November 25, 2019 (M6 of the project), NTUA coordinated a 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 who offered valuable feedback.
- On January 2021 (M20 of the project), NTUA made a presentation titled “Introducing an innovative evacuation tool for passenger ships- The PALAEMON H2020 project” at the World of Shipping Portugal 2021 Conference (Lisbon, Portugal).
- On April 24, 2021 (M23 of the project), NTUA coordinated the second PALAEMON workshop, which was hosted online due to the COVID-19 related measures. The workshop was attended by twenty-five (25) participants (external guests and consortium members) representing the stakeholders of the PALAEMON project. The

objectives of the workshop were to receive feedback on the first version of the stakeholder requirements identified to that date in D2.2, to elicit additional needs and expectations of the stakeholders regarding the PALAEMON ecosystem, to validate the system requirements by collecting the opinions and views of the participants on the PALAEMON platform and the characteristics/functions of its component and to gather additional information regarding the evacuation process.

- On December 2021 (M31 of the project), NTUA presented the successfully submitted paper “Mass Evacuation of Large Passenger Ships: A State-of-the-Art Analysis-Setting the Foundations for the Intelligent Evacuation Ecosystem PALAEMON” at the Hellenic Institute of Marine Technology Annual Conference (Piraeus, Greece).
- On May 2022 (M36 of the project), NTUA presented the successfully submitted paper “Evaluating risk during evacuation of large passenger ships: A smart risk assessment platform for decision support” at the 6th International Conference on Maritime Technology and Engineering (Lisbon, Portugal).
- On September 2022 (M40 of the project), NTUA presented the successfully submitted paper “Assessing the risk during mustering in large passenger vessels: A digital tool for real time decision support” at the 19th International Congress of the International Maritime Association of the Mediterranean (Istanbul, Turkey).
- NTUA participated in the Transport Research Arena 2022 Conference (TRA 2022), in Lisbon in two ways:
    - Presentation of SRAP in a joint session with Current Direct project and SEABAT project. Presentation’s title: “A digital tool for real time decision support in large passenger vessels”.
    - Participation at Waterborne Technology Platform booth with a poster.
- NTUA participated in the pilot of PALAEMON in January 2023 (Athens, Greece), which was coordinated by the University of the Aegean. SRAP was integrated in the pilot actions (TRL5).

7.7.3.3 KPIs to measure the achievement

Three KPIs that can be used to measure the achievement are the number of publications in scientific journals, the number of papers presented in conferences and the number of participants of workshops that have been organized.

7.7.3.4 Roadmap

NTUA is planning to make one more paper publication (journal) concerning the SRAP (D3.10) on March 2023.

7.8 ADVANTIC SISTEMAS Y SERVICIOS SL (ADV)

7.8.1 Organization profile

Established in 2009, ADVANTICSYS is a high-tech SME specialized in the field of monitoring and control systems with an important background in the field of Internet of Things (IoT) comprising hardware, embedded software and cloud solutions development. Its main market niches are in the field of energy, environmental monitoring, and industrial processes automation. Thanks to its solid technological background, its collaboration network (including Asia and Latin America), and its highly skilled multidisciplinary professionals it is capable of offering its clients competitive and effective technological solutions in more than 40 countries,

also participates in R&D projects at National and European level in different areas such as: Internet of Things (IoT), Big Data and innovative software technologies, including fog/edge/cloud architectures for applications in the industrial sector. Business Development Possibilities

7.8.2 Business Development Possibilities

7.8.2.1 Identification of individual exploitation possibilities for the project

Our main asset is the so-called smart bracelets. A tentative business model canvas has been created:

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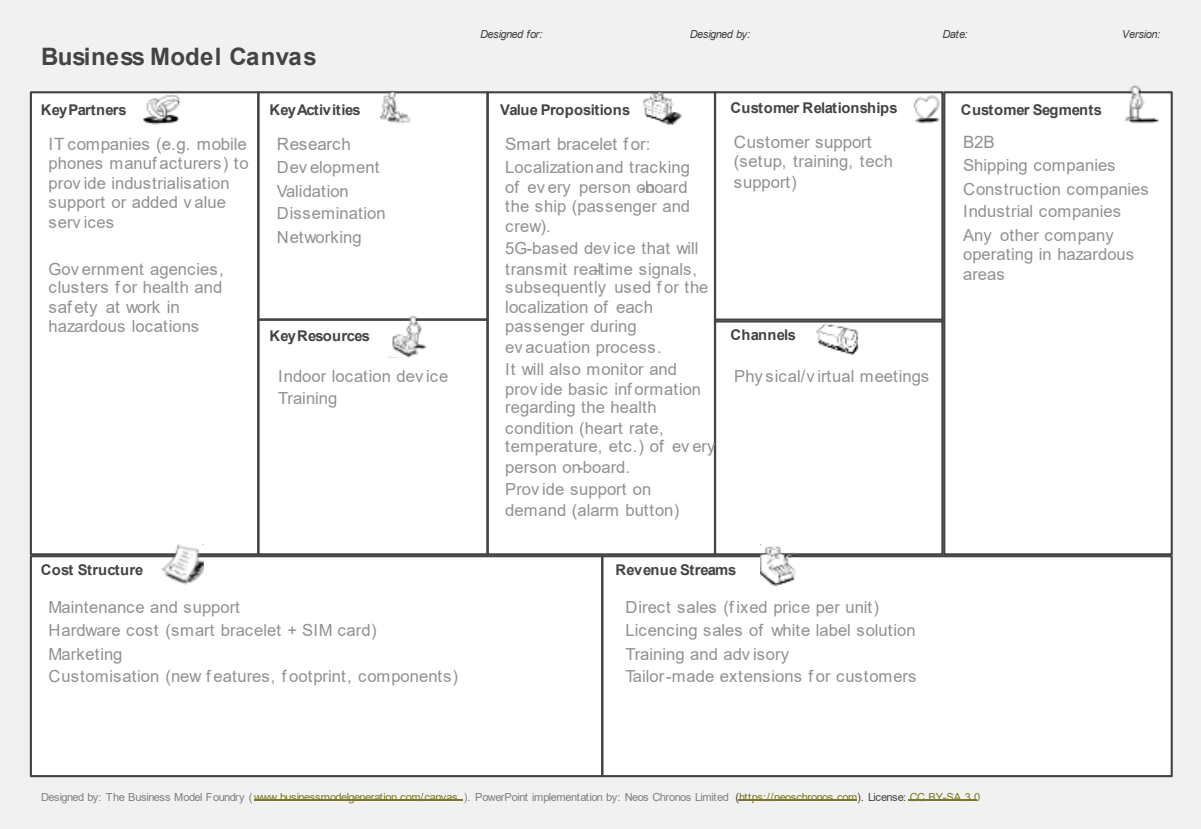

Figure 35 Advantic Sistemas Business Model Canvas

7.8.2.2 Short description of key outcomes to be exploited and the innovation potential

The Smart Bracelet device (SB) provides PALAEMON system with user data (passenger/crew) from the sensors embedded in the wearable device (heart rate, oxygen saturation, compass, accelerometers, and gyroscope) It is also capable of triggering asynchronous alarm events, automatically, like fall detection or generated by the users, alarm button/help request. The SB provides beacon capabilities to support PaMEAS in the localization of passengers and crew member. SB can as well deliver to the user relevant information generated by PaMEAS regarding the evacuation routes on its screen (i.e., messages, signs, symbols, etc.). The SB also features an emergency button that users can trigger to actively inform the crew of problems during the evacuation (or during cruise trip)...

7.8.2.3 Potential addressable market & customers

Although this asset has been designed to be deployed in a ship, it can also be commercialized in other industrial sectors: manufacturing industries, construction, shipyards, etc

7.8.2.4 Timetable for exploitation

It is expected to be ready to be commercialize in a 2-year timeframe

7.8.2.5 Potential risks, barriers or limitations

- Data privacy and security concerns
- Insufficient health sensors data accuracy which could lead to incorrect conclusions
- Shipping industry not fully convinced of initial investment

7.8.3 Concrete exploitation path

This asset has reached a TRL level 5/6. Thus, it is still early to clearly quantify exploitation goals and KPIs.

The roadmap includes deployment in a fully operational environment during the next 2 years. In that process, we will carefully analyze potential market acceptance and a clear value proposition model.

7.9 SIMAVI

7.9.1 Organization profile

Based on the expertise gained along the years in building complex software systems (information retrieval, content management, AR/VR solutions, decision-making, application integration), SIMAVI setups a comprehensive and suitable strategy for the exploitation of the projects for emergency management / critical situations and infrastructures. The exploitation strategy takes into consideration the business relationships already developed with the clients of the company and will be oriented at the same time toward the potential clients identified on different occasions (conferences, seminars, workshops, demonstrations, trade fairs, etc.). SIMAVI intends to turn the research results into products, which will be commercialized in the European market. As a strong technological and commercial partner, SIMAVI aims to ensure the project sustainability and provide resources in the post-project period.

7.9.2 Business Development Possibilities

7.9.2.1 Identification of individual exploitation possibilities for the project

Five choices were analyzed for the exploitation of PALAEMON project results, namely:

- Further R&D&I projects (e.g. knowledge transfer, know-how, components, parts of developed software applications, algorithms...)
- Customizations (Tailor-made extensions for customers) for both components - AR Glasses and Training Platform Software
- Sales and marketing
- Licensing
- Partnerships

Role in Value Chain:

- Services: Development / customizations, technical support, training
- Services: Sales and marketing

7.9.2.2 Short description of key outcomes to be exploited and the innovation potential

- Internal use in SIMAVI (for testing purposes, further research and future products / services)
- Reuse of the know-how
- Sales of marketable products (PALAEMON platform / Full Package) and services
- Licensing (AR Glasses, Training Platform Software)
- Partnerships-collaborations in future relevant projects (research/innovation or commercial)

Major innovation potential:

- The AR Glasses component is the first solution of this complexity, developed within the project, so as to meet as many requirements as crew members face both in their daily work and critical situations. The solution is based on cutting-edge technologies and open architecture capable to integrate both realistic data and data provided by simulation programs/applications to create a mixed reality environment designed to manage emergencies and complex situations.
- The Training Platform Software, designed as an innovative VR solution for the maritime domain, allows trainers to simulate safety procedures, trigger alarms, hazards on multiple environment areas (e.g. stairs, cabin, lift, corridors, open space, deck area etc.) and use virtual avatars to add more realism to various scenarios / scenes.

7.9.2.3 Potential addressable market & customers

- Owner of ships
- Crewing Agencies

7.9.2.4 Timetable for exploitation

5 years after the end of the project; during the first year, an additional effort will be necessary to improve the technical solution.

7.9.2.5 Potential risks, barriers or limitations

- Economic (require additional effort/resources for both components to be marketable)
- Specificity of the market
- Legislation
- Joint agreement in the Consortium

7.9.3 Concrete exploitation path

7.9.3.1 Goals

- Commercial exploitation (i.e. new products and services)
- R & D potential
- Community-building around the subject of the project and raising awareness (Networking)

- Knowledge transfer and collaborations (Partnerships)

7.9.3.2 Work done and achievements

- Achieve the preliminary market analysis
- Define the Value Proposition for both components
- Define the preliminary commercial strategy

7.9.3.3 KPIs to measure the achievement

Depends on various scenarios implemented, implying a lot of parameters and models.

Final goals:

- Streamlining the rescue / evacuation operations and making optimal decisions in case of emergencies and critical situations
- Ensuring fast, secure and reliable data exchange, providing the crew members to easily access services to speed up decision-making due to efficient data analysis and processing

7.9.3.4 Roadmap

- Organize workshops / presentations about the benefits that PALAEMON can bring to the stakeholders from the maritime field
- Identify the specific key partners and the most appropriate delivery channels for reaching the targeted customer segments
- PALAEMON community building: Gain support through early adopters of the whole platform or components
- PALAEMON community building: Partnerships-collaborations in future relevant projects

7.10 DEUTSCHE SCHLAUCHBOOT (DSB)

7.10.1 Organization profile

DSB Deutsche Schlauchboot GmbH is specialized in the design and production of textile, flexible and / or inflatable constructions and solutions. Within the German manufacturing site the focus is on inflatable boats, special products, life rafts and personal protective clothing. Being part of the Survitec Group of companies DSB has global access to the targeted markets being Marine, Aerospace and Defence. Our subject matter experts are internationally recognized and trusted advisors for safety and survival related tasks.

7.10.2 Business Development Possibilities

7.10.2.1 Identification of individual exploitation possibilities for the project

The assets can only be taken to the market with the OEM MEV manufacturer and DSB will introduce the complete system to their existing customer base.

7.10.2.2 Potential addressable market & customers

Cruise liners and operators which are already widely partnering with Survitec will be the prime contacts to approach.

7.10.2.3 Timetable for exploitation

After final development of the system, we can see following outline steps and activities:

- Completion of the development 2 years (2025)
- Initial introduction (2026)
- Budget provisioning (2028)
- Initial series supply (2030)

7.10.2.4 Potential risks, barriers or limitations

Possible competition with the group designed SeaHaven system.

7.11 JADE HOCHSCHULE WILHELMSHAVEN/OLDENBURG/ELSFLETH (JHS)

7.11.1 Organization profile

On August 20, 1832 the Oldenburg Navigation School was founded in Elsfleth. The new courses of study "Maritime Transport and Port Management" (1992), "International Transport Management" (1997), the Master's course in "Maritime Management" (2009) and finally the dual course of studies "Nautical/ Ship Mechanic" (2011) were introduced. The steadily increasing number of students led to the construction of the new ship navigation simulator (2001) and the foundation of the Maritime Campus Elsfleth (2009), which combines university and vocational school education, further vocational training and maritime research on a common site. Today, the Department of Maritime Studies is the largest maritime higher education institution in Western Europe at the Jade University Wilhelmshaven/ Oldenburg/ Elsfleth, founded in 2009.

The University is now named “Jade University” with maritime focus in Elsfleth.

Jade University and the maritime and logistic department establishing teaching norms accredited by IMO for Nautical Studies as also for Research and development.

One of the main parts of research at the Jade university focuses on secure software-based technologies for increasing technical operational safety and the associated increases in cost efficiency and environmental protection as also various types of research associated with Human Resources, Autonomous maritime.

7.11.2 Business Development Possibilities

7.11.2.1 Identification of individual exploitation possibilities for the project

Main target for the university is research and educational purposes. This gives potential for enormous development within the maritime sector, working with various Partners and schools worldwide. Therefore, the university cannot take any position in a commercial part.

7.11.2.2 Short description of key outcomes to be exploited and the innovation potential

One of the key outcomes of the systems developed within the Jade University are to relief some amount of the stress produced through incident on ships on the Crew. The innovation is a practical implementation of the ideas of non-verbal communication together with known normal communication and standard systems used on board, that may result to improvement of procedures

7.11.2.3 Potential addressable market & customers

Mainly Management and Crew on Board. The End users should evaluate the new developed systems and adjust their needs to the assistant system.

7.11.2.4 Timetable for exploitation

There was 2 Steps planned with the PALAEMON project, the first one was to develop a stand-alone software to adjust the needs and requirements based on previous knowledge from our researcher (Mostly Management Nautical Level). The second part was to integrate the systems in whole PALEMON DSS and be part of the final Delivery.

7.11.2.5 Potential risks, barriers or limitations

As we stated before was the Implementation can't be done and used directly on real ship from the start. The End users and installing of the software needed more time to evaluate and analyse the outcome, which showed that is not applicable in this stage of the project.

7.11.3 Concrete exploitation path

7.11.3.1 Goals

As an academic partner with focus on the maritime industry, Jade University aims on research to increase safety onboard seagoing vessels.

7.11.3.2 Work done and achievements

Two systems were developed to support the Bridge Team of a passenger vessel in case of an incident and the need of evacuation. The first system is the Smart Safety System which adds an additional, non-verbal layer of communication to the evacuation process. The other system, the Ship Stability Toolkit supports the team by delivering import information about the predicted motions of the vessel, which helps planning a successful and time-effective mustering of the passengers.

7.11.3.3 KPIs to measure the achievement

We agreed at the Jade university on the basis of the current situation at the PALAEMON stage that the most effective was to measure is by the end users involved in the project, since there were no possibilities to integrate any more test with extern users. The efficiency indicator was measured by the most of feedback with "good" with possibility to adjust the needs later on.

7.11.3.4 Roadmap

At the moment both assets of Jade University demonstrate the possibilities of the tools developed, For the us in a real productive environment further development and profound testing will be necessary. Especially with the Ship Stability Toolkit it is crucial to compare the results against real measurements and results of certified equipment, after completion of thorough testing the certification by a classification society of the developed tools is essential, to provide a legal basis for the use on board a passenger vessel.

7.12 ERICSSON HELLAS SA TILEPIKOINONIAKOY ILINOX (Ericsson Hellas)

7.12.1 Organization profile

Ericsson (Telefonaktiebolaget LM Ericsson) is the largest supplier of mobile systems in the world. The world's 10 largest mobile operators are among Ericsson's customers and some 40% of all mobile calls are made through Ericsson systems. Ericsson currently provides managed services to networks that serve one billion people. Ericsson has been active worldwide since 1876 and the company has today around 114,000 employees in more than

140 countries. It is listed in the Stockholm Stock Exchange and in the NASDAQ New York. Its headquarters are located in Stockholm, Sweden.
Ericsson Hellas S.A. is an affiliate of LM Ericsson AB and was established in Greece in 1979. Ericsson Hellas today employs more than 170 highly educated employees and is the Hub for the company's operations in Greece and Cyprus. For the past 38 years, Ericsson Hellas has been a key ICT market player in Greece, having greatly contributed to grow and develop the ICT industry in Greece, consistently investing in the Greek market and in local talent.

7.12.2 Business Development Possibilities

7.12.2.1 Identification of individual exploitation possibilities for the project

Ericsson's Business Possibilities are referring to the challenge that is critical to all 5G value chain actors providing reliable End-to-End (E2E) network environments for timely validation of innovative 5G services and applications. This project will contribute to the widespread development of 5G end-to-end networks in several industries. This will be done by offering all 5G experimenters a 5G end-to-end installation, which will allow them to validate the performance of 5G-ready technology solutions before 5G networks are commercially available.

7.12.2.2 Short description of key outcomes to be exploited and the innovation potential

The key outcomes are presented below:

- Applications of 5G technology in emergency evacuation systems
- Develop innovative technologies for sensing, people monitoring and counting and localization services as well as real-time data during accident time
- To be integrated into an independent, smart situation-awareness and guidance system for sustaining an active evacuation route for large crowds.

7.12.2.3 Potential addressable market & customers

- Cruise companies
- Indoor buildings (industrial spaces, malls etc)

7.12.2.4 Timetable for exploitation

The installation, integration and deployment of the solution that Ericsson will provide, requires in total 2-3 months since the proposed ship(to demonstrate PALAEMON) by ANEK will be accessible.

7.12.2.5 Potential risks, barriers or limitations

From Ericsson's side, there is no limitation or any potential risk to consider. The external limitations that may delay the deployment are in relation to the:

- Position System, in cooperation with PaMEAS
- Access to the ship of ANEK

7.13 Romanian Naval Authority (RNA)

7.13.1 Organization profile

Romanian Naval Authority is a specialized executive agency subordinated to the Ministry of Transports, playing the role of state authority with the purpose of ensuring safety of navigation.

Romanian Naval Authority is a self-financing institution, with legal personality, based in Constanta Port Enclosure, established by merging the Civil Navigation Inspectorate and the Romanian Register of Shipping.

RNA role will not confine itself only on maintaining the safety and security standards on its field of activity. It will also actively involves in promoting and sustaining the naval transports operations, so that will minimize at the lowest the bureaucratical impact on the system, will provide technical assistance and promote worldwide the Romanian naval transport image. Our motto "Safety through Quality" best illustrates RNA's vision to become a leader in safety and security of naval transports, by the high quality of the services provided and professionalism of the staff.

7.13.2 Business Development Possibilities

7.13.2.1 Identification of individual exploitation possibilities for the project

For RNA as public authority, business development is not its main field of interest as RNA activity does not imply any economic interest. However, we find to the following, as main paths, of fruitful business development and objectives we try to reach through this project:

- Safe environment for passengers and crew members;
- For rescuers, cooperate with the provided equipment;
- To keep the safety level as high as possible and comply with regulations;
- Safe practice in ship operation;

7.13.2.2 Short description of key outcomes to be exploited and the innovation potential

For RNA, the main outcome is the creation of tailored intelligent evacuation services, in the context of IMO requirements and the corresponding national and European regulations and polices. In this context, at least 5 scenarios/services/applications will develop and integrate.

7.13.2.3 Potential addressable market & customers

The project's results will be used by RNA for the development and enhancement of best practises in relation to passenger ships safety as well as the base for drawing future related regulations.

7.13.2.4 Timetable for exploitation

RNA exploitation plan will be in line with future legal developments in the field of passenger ships safety.

7.13.2.5 Potential risks, barriers or limitations

N/A

7.13.2.6 Concrete exploitation path

Developing and integration of 5 scenarios/services/applications in accordance with project activity timetable, during M32-M36.

7.14 DANAOS SHIPPING COMPANY LIMITED (DANAOS)

7.14.1 Organization profile

DANAOS Shipping is the vessel manager of DANAOS Corporation, a leading international owner of 60 containerships. DANAOS is chartering containerships to a geographically diverse group of liner companies, including most of the largest ones globally. DANAOS Shipping has established its reputation worldwide by providing first class operation service to many of the major container sea carriers.

DANAOS is strongly investing in research and innovation. Organization has been actively engaged in both bona fide and applied operation research through its prestigious research

and innovation hub, DANAOS Research Centre (DRC). DANAOS has been participating in more than 30 EU projects, funded under different EU research programs, with a strong motivation to apply innovation and creative thinking across all aspects of maritime operation. DANAOS is a laureate member of FRANZ EDELMAN academy and winner of the homonymous award in 2012 (the highest worldwide distinction in applied operation Research).

7.14.2 Business Development Possibilities

7.14.2.1 Identification of individual exploitation possibilities for the project

DANAOS is engaging in sea cargo transportation. As an organization stands as prestigious provider of shipping service the quality of which meets high standards in safety, security and environmental aspects. DANAOS is continuously looking at improvements on safety standards bundled with technology advances. In this context, organization is highly investigating project results in terms of exploiting over a comprehensive emergency end evacuation ecosystem comprised of various technologies. PALAEMON ecosystem is demonstrated in passenger vessels. DANAOS will investigate means of exploiting and adapting technology to the needs of large ocean-going cargo ships that company operates.

7.14.2.2 Short description of key outcomes to be exploited and the innovation potential

PALAEMON will provide a digital assistance to the Captain to assess an emergency situation while offering a bundle of sophisticated technology means to respond to the emergency in the most efficient way. PALAEMON brings digital revolution to emergency response with an aim to safeguard safety on-board. DANAOS will exploit PALAEMON ecosystem in full as far as project outcomes will be configured to address cargo shipping environment.

On top of that, DANAOS will assist in the digital transformation of the traditional emergency and evacuation processing. Under this scope, DANAOS will exploit innovation in regards with real time multi-source incident assessment and digitalization of safety procedures and process monitoring. Having said that, DANAOS will explore the possibility to communicate or present to the maritime industry outcomes of PALAEMON projects related to safety management digital processing, risk management intelligence and multi-attribute life cycle assessment.

7.14.2.3 Potential addressable market & customers

DANAOS in principal will validate and consume rather than commercialize project outcome. However, DANAOS will assist in the communication of project innovation to the maritime community (ship owners/managers/operators)

7.14.2.4 Timetable for exploitation

Exploitation will be aligned with project development stages. Starting with the exploitation of individual technologies and ending with the exploration of the integrated solution.

7.14.2.5 Potential risks, barriers or limitations (if any)

7.14.3 Concrete exploitation path

7.14.3.1 Goals

Main goal is summarized as below:

- Investigate means of exploring PALAEMON technology in cargo sea transportation
- Joint or single exploitation of DANAOS' generated foreground within the project in regards with digital Safety management system (SMS tool), weather forecast toolkit and Life cycle performance assessment

7.14.3.2 Work done and achievements

Work to be done in order to effectively exploit PALAEMON achievements:

- Develop or co-develop technology components (SMS tool, weather forecast toolkit, LCA) and integrate them with PALAEMON ecosystem
- Design path to effectively adopt PALAEMON technology in ship management.

7.14.3.3 KPIs to measure the achievement

- Incorporation of at least one component/asset of PALAEMON technology to DANAOS fleet

7.14.3.4 Roadmap

Steps as following:

1. Test and validate PALEMON system,
2. Design effectively the road of adapting technology to cargo shipping standards,
3. Explore technology so to enhance DANAOS procedures in response to emergency on-board

7.15 ENGINEERS FOR BUSINESS IPIRESIES TECHNOLOGIAS KAI MICHANIKIS ANONIMI ETAIRIA (EfB)

7.15.1 Organization profile

Engineers for Business Ipiresies Technologias kai Michanikis A.E. (EFB) is a technology-based SME company founded by post-doc engineers with the aim to provide advanced research, development, and consulting services. The company provides holistic services and products that link entrepreneurship, engineering and sustainability. It is a dynamically growing company based in Thessaloniki, Greece and operating throughout Europe. EFB's human resources include both business and technical experts, with extensive experience in engineering design, operations management (OR) - related services, development of optimisation algorithms, innovative ICT applications, decision support systems, and integrated sustainability management. EFB's co-founders and collaborators have significant experience in EU funded projects. EFB builds and promotes multi-disciplinary applications of ICT for interfacing three interrelated pillars of development: (i)Engineering, (ii) Business and (iii) Sustainability.

Within the PALAEMON project, EFB's contribution will utilize all three core competences of the company. In more detail Dissemination activities powered by the strong entrepreneurship drive of the company. These are not limited to EFB's own activities but include the consortium's collective work.

Technical expertise in a both hard engineering and soft engineering field, the interior design of MEV I that needs to comply with current standards but also take MEV designs one step further.

7.15.2 Business Development Possibilities

7.15.2.1 Identification of individual exploitation possibilities for the project

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Technical expertise in a both hard engineering and soft engineering field, the interior design of MEV I that needs to comply with current standards but also take MEV designs one step further.

7.15.2.2 Short description of key outcomes to be exploited and the innovation potential

The interior design of the MEV is going to be EFB's main engineering contribution. The MEV is going to be part of a greater advanced mass evacuation ecosystem that will act as the last shelter provided by the main vessel to its passengers in case of an emergency. The continuity of high-level service provision is of outmost importance. At the same time the MEV needs to satisfy the requirements of the core function of a life-saving vessel. The balance between the two aspects can be achieved by advanced ergonomic engineering and detailed interior design covering all dimensions of such a vessel and its typical use-case scenario. Seating that optimizes limited spatial resources while extending functionality towards groups of people with special needs was developed. Furthermore, elements that enhance passenger experience and contribute to establishing a safe and positive environment were introduced.

The design has introduced the use of low energy lighting, seating that can be mass manufactured, and offers an extend of adaptability due to the modular design. Also, sustainability is increased as the materials used for the seating are lightweight and recyclable. As the project progressed, the needs of the crew operating the MEV have become a major influence and the design proposed has integrated numerous design choices that enable the crew to execute their mission. This increases the value of the design for the industry stakeholders, that are offered higher operational efficiency. Also, the core function of the vessel, safeguarding and supporting lives, is further supported by a crew that can function in an environment designed to facilitate their needs.

Summing up, a holistic approach on user experience and requirements was followed to enable the emergence of a novel interior design of perceivable added value. This will set a new standard in MEV and other emergency equipment design language.

7.15.2.3 Potential addressable market & customers

Such services in design are of interest mainly to shipyards that are interested in providing highly detailed and defined projects. The main advantage of such a service is the extension of the product from a hard engineering dimension to a holistic approach that outlines exploitation potential to the partner that commissions the engineering drawings. Besides shipyards and companies active in passenger shipping business are going to be interested as this new approach to life-saving vessels begins to become more popular and a contributing factor in potential end-user attraction.

Additionally, as the design can be broken down to individual elements, there is transfer potential to other types of vessels, or even general interior design projects.

7.15.2.4 Timetable for exploitation

The exploitation of the project's outcomes will take place in the next 5 years. The addressable market has high potential; however, awareness needs to be raised as the product itself is usually not of high visibility to the end-users of the industry. The first 12 months parallel to marketing activities, designs need to be finalized to be able to be mass produced and providers for elements used need to be sourced out. By the end of the first year EFB aims to have one assignment for designing an interior layout and by the end of the 5-year horizon to be able to showcase in service designs.

7.15.2.5 Potential risks, barriers or limitations

To pass regulatory inspection for technical objects designed. A redesign for some objects is feasible, however there some elements that may prove to be hard to redesign. Even worse, there are elements that play a crucial role to the differentiation compared to conventional MEVs decreasing the innovative factor of the design.

The desired outcome of extending the knowledge and experience gained in this project to other applicable fields, might be limited by the specialization level needed to comply with the user needs and the regulations of this task.

7.15.3 Concrete exploitation path

7.15.3.1 Goals

To receive assignments for delivering custom interiors based on this design.

To offer manufacturable and easy to outsource elements for interested parties.

To consult in similar projects.

7.15.3.2 Work done and achievements

User requirements research both for passengers but also for crew.

Designed manufacturable elements that can be adapted to varying layouts.

Introduced elements that extend the ergonomic range of fixed seating.

7.15.3.3 Roadmap

The design team will work further on details and finite element analysis to optimize designed elements so that they can be sourced out to tool and die manufacturers.

Business analysts and sales managers will formulate a detailed cost plan for the production and design versions that EFB will pitch to stakeholders in the first 2 years of after the project.

7.16 ASTILLEROS DE SANTANDER SA (ASTANDER)

7.16.1 Organization profile

Located at the southern end of the Port of Santander (Northern coast of Spain), Astander is a modern shipyard with 130 years of expertise in the shipbuilding and ship repair industry. Over this time, it has accomplished an important international recognition thanks to the firm commitment reached to its clients. This huge responsibility involves flexibility, transparency, fair pricing and reliable delivery times.

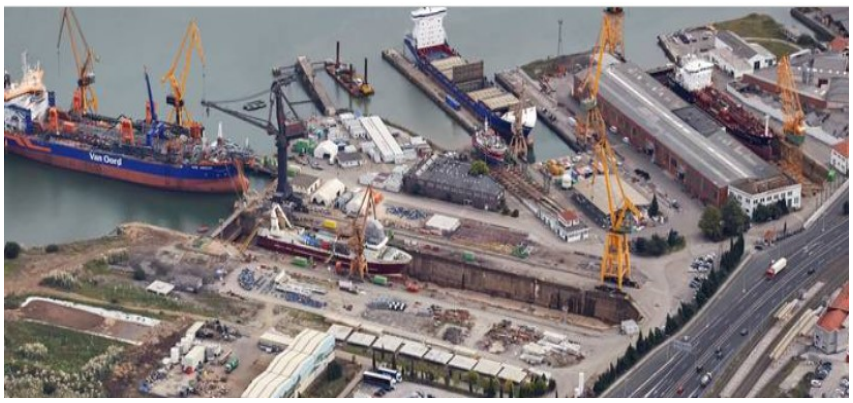


Figure 36 Astander shipyard

About our facilities:
2 drydocks :

Length: 230 m
Breadth: 34 m
DWT: 55,000
Draft: 8.5 m
Cranes: 200t + 40t + 15t
2 Thruster pits

Piers, quays, slipway, storage area, thrusters pits, workshops with:

Mechanical area-
2,000 m²
Clean area for engines repairs.
Pit for dismantling of CPPs.
Hydraulic tests room.
Large lathe machine for 15 m shafts and 6 lathe machines.
Ultrasonic cleaner.
Hydraulic press 200 T and Gantry cranes (8 T – 2 x 6.3 T).
Steel area
3,000 m2
Cadmatic 3D modelling.
Plasma cutting machine and computerized flame cutting
machines.
Bending cylinder, hydraulic cutter, vertical and horizontal
presses, profiles bending machine, heavy plate leveller. • Several gantry cranes (25.5 T – 6.3 T).
Magnetic cranes.**Pipe area**
1,000 m2
GRE, submerged arc welding, TIG, HP pipes welding, non-welding, overly welding.
Hydraulic pipe benders, portable pipe benders.
Pressure testing of hydraulic pipes.

2 frame cranes 6.3 T.
Electrical area
Overhauling of electrical motors
Rewinding
Baking
Varnished
Balancing

7.16.2 Business Development Possibilities

7.16.2.1 Identification of individual exploitation possibilities for the project

Within the MEV model, Astander would position itself in the service chain towards also shipowners, developing the model that best suited their needs, designing and integrating the new boat.

Based on an annual increase of one MEV per year starting from 3 MEV, it would be necessary to carry out a company apart from the traditional work of Astander since it would be a serial product in principle, so an agreement could be reached with a rescue boat factory. and we expand the business portfolio of retrofit vessels having a new line based on the integration of MEV into vessels.

The first proposal is if it were finished correctly to put the MEV on the market. The following proposal is to make the MEV commercial and for this we would need a ship owner to make a real retrofit in his vessel and to obtain the Solas and CE marking certifications, based on these premises we start from a project to place the MEV product on the market. based on the experience of this project and the feedback from end users and shipowners who have seen MEV in the shipyard Astander.

7.16.2.2 Short description of key outcomes to be exploited and the innovation potential

The main innovation of the project is the integration of manufacturing biomaterials that will go on the ships, guaranteeing the life cycle and complying with the requirements of the green card applicable to the ships, being the first recyclable rescue boat in the world. Another important innovation is the simulation of a descent ramp designed similar to the use of airplanes, avoiding strong falls into the sea and breaking the neck or sword, although it was not manufactured due to the impossibility of integrating it into a real vessel, and finally, the MEV inflatables designed and manufactured. in the project they guarantee a greater stability of the same avoiding swaying and dizziness of the people on board the MEV without impeding the navigation of the MEV when moving away from the ship as observed in the navigation tests.

What in the future in economic terms innovation could be for the shipyards a new line of business if this rescue boat were to be implemented in the ships due to its adaptation to the different ships and then its recycling.

7.16.2.3 Potential addressable market & customers

The potential clients would be the shipowners and the classification houses of the ships and, as a value chain, suppliers of the manufacturing material or companies that manufacture it.

7.16.2.4 Timetable for exploitation

When an assembly will allow the vessel to be integrated once approved by all the classification houses.

7.16.2.5 Potential risks, barriers or limitations

The requirements for final approval of use, the vision of the owner in the integration in his vessel are barriers but not insurmountable and as a risk the price of the biodegradable material that is unaffordable for its manufacture and sale.

7.17 DNV GL HELLAS SA (DNV GL)

7.17.1 Organization profile

Driven by its purpose of safeguarding life, property and the environment, DNV GL enables organisations to advance the safety and sustainability of their business. DNV GL provides classification and technical assurance along with software and independent expert advisory services to the maritime, oil & gas and energy industries. It also provides certification services to customers across a wide range of industries. Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, DNV GL empowers its customers' decisions and actions with trust and confidence. The company continuously invests in research and collaborative innovation to provide customers and society with operational and technological foresight. DNV GL operates globally in more than 100 countries with its 16,000 professionals dedicated to helping their customers make the world safer, smarter and greener.

7.17.2 Business Development Possibilities

7.17.2.1 Identification of individual exploitation possibilities for the project

DNVGL's exploitation plan is based on two pillars, safety (reduction of risk) and digitalization. Safety is an inherent part of classification societies, as also identified in the first line of our company's description. At the same time, digital solutions are also in the forefront of our company, even more now during the troublesome times of coronavirus. PALAEMON perfectly combines both pillars by promoting the adoption of smart solution on cruise ships, aiming at reducing accidents, and incidents, at sea, eventually decreasing loss of life, and property, and environmental impact.

From the Classification perspective, DNV GL is strongly motivated to explore new technologies with advanced research and development work, contributing digital and automation expertise to enhance safety, efficiency, reliability and passenger experience, and streamlining class and certification services.

Having approximately the 23.5% of the global fleet in its class, DNV GL is the leading class society and thus its role is crucial in achieving increased safety performance of the global cruise ship industry.

7.17.2.2 Short description of key outcomes to be exploited and the innovation potential

In more detail, digitalization of many of DNVGL's field work (i.e. surveys) is progressing with a very fast pace, especially now during the coronavirus pandemic, where travel restrictions hinder the physical presence of our colleagues. To this end, PALAEMON outcomes will further support the ongoing developments of digital class and some of implemented solutions may facilitate the communication between shore (class surveyor) and ship.

Finally, the on-going work on PALAEMON and especially the fermentation that takes place during the workshops between partners, will potentially become the outline for future class

rules that will be necessary to design and operate innovative solutions, like the ones being developed in PALAEMON.

7.17.2.3 Potential addressable market & customers

PALAEMON aims at a novel concept in marine evacuation systems by introducing advanced ICT technologies, ship sensor data and big-data analytics for increased safety performance. Key target group for the PALAEMON developments are passenger vessel owners, yards, equipment manufacturers and ICT service providers.

For yards, moving the technology forefront beyond the spectrum of conventional solutions is important as a differentiation factor, especially for the very demanding cruise vessels industry.

For shipowners, increased safety of passenger services is of paramount importance for high competitiveness and reputation.

For equipment manufacturers and ICT service providers, novel systems are door openers for new markets, ensuring business continuity and sustainability.

Though passengers are part of the end solution, the proposed systems fall into the infrastructure offered to the customers rather than a service that passengers would optionally use (in this case, passengers would be included in the target group as well).

So, for DNVGL the main addressable market and customers will be mainly the cruise/passenger ship sector and secondary yards and integrated solutions providers.

7.17.2.4 Timetable for exploitation

DNV GL will participate in dissemination activities to exploit the PALAEMON results, in line with the partners' individual benefits and the overall objective of knowledge increase and sharing. The activities foreseen are:

- Participation in International Maritime Conferences related to safety and ICT advancements in shipping.
- Customer presentations dedicated to the PALAEMON results, as well as integrated in the framework of other events.
- Participation in the publication of results via press releases, conference presentations, magazines, etc. The means of publication will be selected and agreed between the partners, with key criterion the maximization of mutual benefits. Intellectual property rights will be carefully handled during dissemination, with the agreement of all partners.

DNV GL is participating in various events in annual or bi-annual frequency:

- Posidonia Exhibition: One of the biggest events for world shipping industry is held every four years in Athens. Next Posidonia is planned for 2020 http://posidonia-events.com/
- Annual meetings of marine technology, Hellenic Institute of Marine Technology. http://www.elintconference.gr/.
- International Marine Design Conference IMDC, performed every 3 years at various places around the globe.
- Annual European Safety and Reliability Conference.
- Bi-annual International Conference on Maritime Technology and Engineering MARTECH.

- Annual International Conference on Computer Applications and Information Technology in the Maritime Industries COMPIT.

The DNV GL team of PALAEMON is regularly participating with presentations and papers in the afore-mentioned events and conferences.
However, due to unprecedent situation of the coronavirus pandemic, several of these conferences and events have been cancelled, and the future ones still being quite uncertain.

7.17.2.5 Potential risks, barriers or limitations (if any)

The major barrier/limitation may be the unprecedent situation of the coronavirus pandemic, which has led in the cancellation of several of these conferences and events, and the future ones still being quite uncertain.

This is also valid for all the partners participating in PALAEMON, so a solution will be fined during the progression of the project.

7.18 ADMES MONOPROSOPI IDIOTIKI KEFELAIOUCHIKI ETAIREIA (AdMeS)

7.18.1 Organization profile

ADMES will be involved mainly in evaluation and demonstration tasks for the Passengers evacuation scenario contributing to Obj. 5 & 7. Further to this will support the structural monitoring toolkit and the definition of requirements is aimed at the creation of a specification sheet of the motion prediction system to be developed. During this working package a steady and intense interchange between the consortium partners is required to elaborate the desired output of the system in detail. It is targeted at defining the individual subsystems as well as the required interfaces with other systems, e.g. AI-DSS and it will closely collaborate with the ship stability monitoring ecosystem of Task 6.1. This working package results in the performance sheet. The prepared specification and performance sheets will be used as a central guideline for the following work process. During this main package the function modules of the prediction system will be integrated. This will ensure a smooth and reliable communication between individual components and lay the foundation for the development phase. The focus therefore will shift to development of the motion prediction system for the vessel. Next to setting up the environment and a fundamental parameterization of the vessel, the individual modules will be designed. As the components have to interact strongly with each other, the development process has to be run in parallel. After setting up the development environment and a profound hydrodynamic parameterization of the vessel, the individual modules of the system will be designed. Extensive model testing will be conducted at the Maritime Training Centre Wesermarsch (MTZW). This working package is intended to cover the preparation, execution and post processing of these tests. The on-site coordination of tests as well as communication and coordination between the consortium and MTZW is part of this package as well.

This task consists in the adaptation of a fixed wing UAV to accommodate a hyper-spectral camera/ a LIDAR (2 configurations) and the receiver of the bi-static radar). The legacy Ground Control Station of the UAV will be adapted so it can be integrated as part of the PALAEMON communication platform. The task will contribute towards the fulfilment of D5.3.

7.18.2 Business Development Possibilities

7.18.2.1 Identification of individual exploitation possibilities for the project

AdMeS is a Technical Advisor Company providing advanced mechanical services on Maritime and Energy Industry sectors worldwide. It is certified according to the provisions of **ISO 9001:2015 with activities' scope "Services Provision of Preventive Maintenance (Condition Monitoring Services)".** It is specialized in Condition Based Maintenance (CBM), Non-Destructive Testing (NDT), In-Situ Balancing, Alignment and Resonance Fatigue Studies with an important portfolio of Greek and international clients. In cooperation with the Certification Body **CERT1**[43], it undertakes inspection services as well. Constantly watching the latest technology trends and innovations, the company owns modern equipment in order to take vibration and magnetic measurements following the latest technical methods. Aiming to offer quality services, the company relies on its expanding specialized personnel, which consists of mechanical, automation and computer engineers who receive constant education by attending seminars and specialization programmes acquiring the relevant certifications.
AdMeS undertakes inspection services of critical infrastructure using specialized equipment to cover any possible requirements a Client may request. Its well- trained and certified personnel with a multi-copter UAV, a dual sensor (optical – thermal camera), a portable handheld thermal camera and many other modern sensors and instruments can scan, monitor and inspect infrastructure like Windfarms, Solar Panels, Funnels and Industry Facilities on land, at a height above sea level and underwater.
ADMES expects that the technologies demonstrated in PALAEMON will attract the interest of relevant solution providers for safety procedures and can initiate new collaborations with industrial partners towards technology transfer and commercialisation. A direct exploitation may be achieved by means of protecting the knowledge created by ADMES in the course of the project (foreground knowledge) through e.g. by patents or copyright and granting licenses for its use, collaboration with the PALAEMON's industrial partners or by participating in a potential joint venture with other project partners. Indirect exploitation may be realised by increasing ADMES's leadership in the respective technology and application areas of research on a European scale.
PALAEMON project is relevant to ADMES in terms of initializing drones and sensors to make the provided services more accurate and advanced.

7.18.2.2 Short description of key outcomes to be exploited and the innovation potential

The technological effort on the PALAEMON project led to the utilisation of an Autonomous Aerial Drone System, with the appropriate sensors for missions during evacuation. The Aerial Drone System is composed of the drone itself, with sensors and the suite is completed by a Graphic User Interface to easily monitor and control the overall aerial mission. The innovation for the company is that the aerial system will be used for missions required for evacuation and search and rescue procedures. More specifically the company will enhance its' competencies in the following areas: Reconnaissance and Mapping, Structural Assessment; Temporary Infrastructure / Supply Delivery; Search and Rescue Operations

Besides the technical activities, we see great value in the expertise that will be acquired by other partners and the interaction with the Industrial partners. Last but not least, as an inspection company ADMES shall enhance the knowledge that PALAEMON will bring in terms of methodologies for safety, data models analysis and risk assessment which are main aspects of the companies' offerings.

7.18.2.3 Potential addressable market & customers

Admes intends to exploit the project results via direct industrial use to the companies' customer base. The targeted market consists of the shipping and maritime sector, the energy sector and the critical infrastructure sector. Potential new customers from the above sectors are national and international companies.

7.18.3 Timetable for exploitation

The company already exploits the project results to the current customer base and specific actions have been performed:

- Definition of primary and secondary customers;
- Customer involvement through bilateral meetings;
- Exploitation of all the companies' channels to intercept potential large customers
- Establishment of new potential partnerships.

7.18.3.1 Potential risks, barriers or limitations

7.18.3.2 Concrete exploitation path

Admes goal is to expand the project experience and outcomes to all the targeted customers and integrate the drones and sensors use in various business lines.

7.18.3.3 Work done and achievements

Introduction of the new methods and services based on the work under progress is already presented in current and potential new customers. The company is currently expanding the service portfolio based on the work developed within the project.

7.18.3.4 KPIs to measure the achievement

- Time to market: integration of similar service to the current projects and projects
- Customers' acceptance and validation – willingness to pay for a new service based on drone usage and sensors.
- Potential new services inline with ADMES business activities.

7.18.3.5 Roadmap

The introduction of the new services based on PALAEMON experience has already started. The aim of the company is to be able to offer a new service to the market by the end of the project.

7.19 THALES ITALIA SPA (THALIT)

7.19.1 Organization profile

Thales Italia provides mission critical solutions and applications for assets and citizens security (supervision, control and information management systems) as well as cybersecurity. Thales offers solutions to protect the information systems and critical data of its civilian and military customers and helps its customers to detect and prevent cyberattacks by devising secure architectures from the design stage, overseeing these architectures and ensures that they are kept in secure working order. Italy is Thales Group's competence centre for Airport security and operations management solutions.

7.19.2 Business Development Possibilities

7.19.2.1 Identification of individual exploitation possibilities for the project

The VDES prototype can be further developed in order to become a commercial VDES product, compliant to the VDES standard and interoperable with other manufacturer's VDES products. Thales Italia could industrialize the device and exploit its worldwide customer network at Thales Group level in order to sell the product.

7.19.2.2 Short description of key outcomes to be exploited and the innovation potential

The VDES (VHF Data Exchange System) standard has been introduced to improve the capabilities of AIS (Automatic Identification System), a widely used radio system for vessel tracking and other navigational and safety-related purposes, which, in the last years, had become overloaded. VDES provides higher data rates, signal encryption, a terrestrial and satellite link and a two-way communication between ship and shore stations.

These characteristics, in addition to improve safety and security of navigation, open the way to added-value services that in the future can be built around the VDES, like e-navigation and autonomous navigation.

7.19.2.3 Potential addressable market & customers

Possible customers could be ship builders/owners, marine cost guards, port authorities, national Navies and, in general, all the current AIS customers. Thanks to the satellite radio link, that was not exploited in the AIS system, the possible customers could be also satellite builders/operators dedicated to safety & security and search & rescue operations.

7.19.2.4 Timetable for exploitation

- To validate the current system in the relevant operative environment (radio link above sea)
- Gap analysis between current prototype and VDES standard
- Creation of partnerships to cover all aspects of the development
- To further develop the product, possibly through other funded research projects
- To relate with other VDES manufacturers in order to work on interoperability
- Prior to put into commerce, to obtain the needed certifications (CE marking, EM compatibility, MIL-STD, REACH, etc)
- To exploit Thales group commercial channels, worldwide

7.19.2.5 Potential risks, barriers or limitations

Potential lack of funds.

7.19.3 Concrete exploitation path

7.19.3.1 Goals

Possibly, to arrive at a fully commercial, standard-compliant VDES product.

7.19.3.2 Work done and achievements

Prototype developed in the context of the PALAEMON project, tested in Lab and officially demonstrated (28/10/2022) in Lab with RF transmission.

7.19.3.3 KPIs to measure the achievement

Signal waveform and physical layer parameters (BER, etc);

Capability to properly interact with PALAEMON DFB through the VDES Gateway application and to exchange Kafka messages.

7.19.3.4 Roadmap

Refer to Timetable.

7.20 Universidad De Alcalá (UAH)

7.20.1 Organization profile

Tradition and modernity are the words that identify the University of Alcalá. Founded in 1499, the UAH still preserves its mission of transferring knowledge to society from its origins. The application of the research carried out by its different research groups towards scenarios of social and economic development is a key factor in the aims of the University.

UAH is a multidisciplinary university in terms of teaching and research that tries to bring together different disciplines in its research. It brings together the five main branches of knowledge: Sciences, Humanities, Health, Social and Legal Sciences, and Engineering/Architecture.

With a high participation in regional, national and international calls, the research group involved in PALAEMON develops different lines of research and development in the field of SMART Sensors, Image Processing, Indoor Localisation, Efficient Engineering Management or Electronic Design.

This has allowed him to be in permanent contact with technology companies (LE and SME) with which he has been able to develop different R&D projects applied to domains such as defense, IoT, space or transport.

7.20.2 Business Development Possibilities

7.20.2.1 Identification of individual exploitation possibilities for the project

Particularly the researchers participating in the PALAEMON project are integrated in a research group, GEINTRA, the larger research group at University of Alcala.

The main goal of the GEINTRA research group is to develop basic and applied research activities on issues connected to smart spaces and intelligent transport and infrastructure systems. This general objective includes research lines related to the design and conception of electronic systems, sensor systems and sensory fusion, detection, positioning, and behavioural analysis systems, intelligent transport systems and infrastructure, computer vision and medical imaging, control, automation and robotics, independent living and support products.

The research lines more related with the PALAEMON project are sensor fusion systems, smart infrastructures, systems for detection, positioning and analysis of behaviour and embedded computer vision.

Additionally, to publish the results in the journals of greatest impact within the technological area of knowledge, UAH researchers will pursue to extend the project results and give rise to social and/or economic benefits, therefore the research team group from the UAH contemplates the following exploitation possibilities:

- Elaboration and diffusion of the technological offer presenting the smart camera product/service.
- Demonstration sessions

- Agreements with companies (mainly private entities) that show their interest in the results of the project.

Besides, the following is a list of possible dissemination mechanisms, to be used:

- Publication in scientific journals.
- Contributions to scientific congresses.
- Participation in professional forums or congresses.
- Participation in national or international fairs of a professional nature or new technologies.
- Publication in business, professional or sectorial magazine.
- Dissemination via websites, blogs and social networks.

7.20.2.2 Short description of key outcomes to be exploited and the innovation potential

The main exploitable output is the smart camera node based on an embedded hardware plus the AI computer vision algorithms. In this regard, Smart cameras shall enable the detection and tracking of people in different scenarios: corridors, rooms, large areas. Additionally, each camera node will monitor the people behaviour in order to detect anomalous situation, such as stampedes, multiple people running. Network connectivity and multiple protocols allow the installation as many nodes as needed to secure/monitor a particular installation. Therefore, the smart camera system might be commercialized as an stand-alone solution or as part of the complete PALAEMON system.

Next, we show the Business Model Canvas for Smart Camera System:

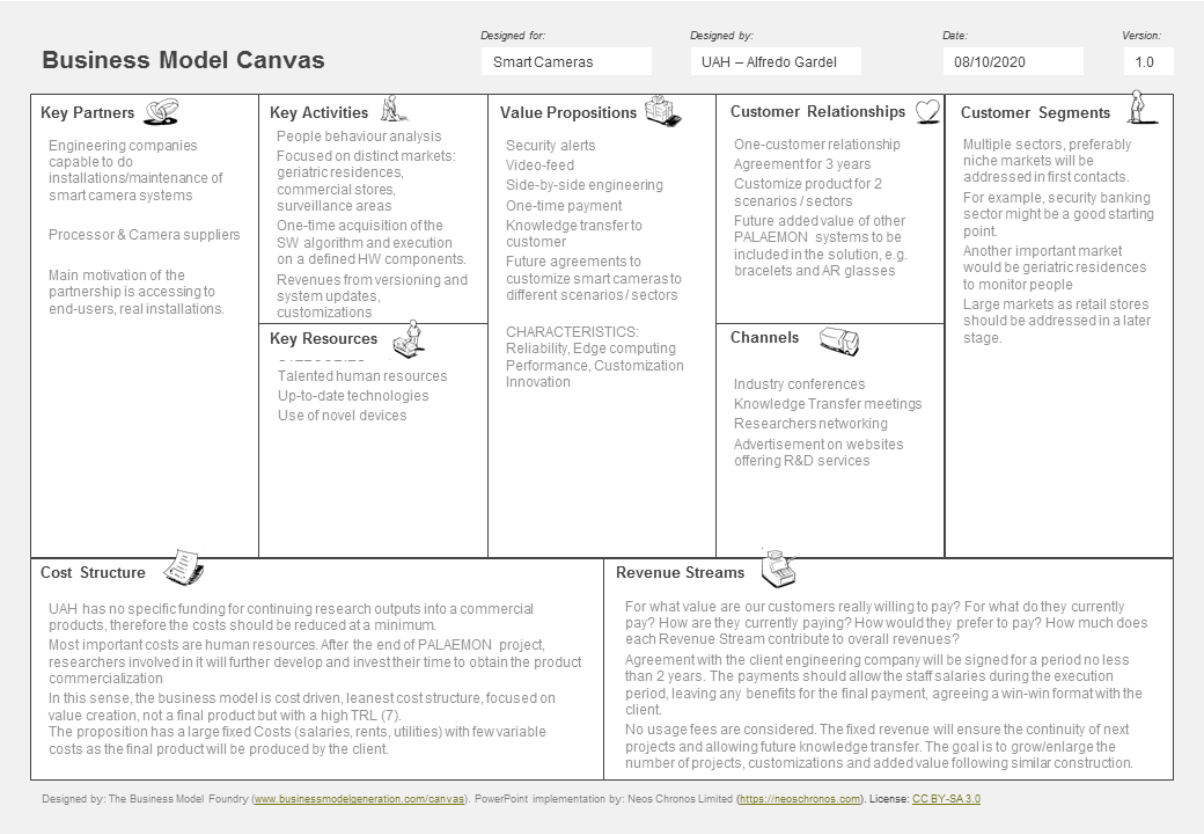


Figure 37 Smart Camera system Business Model Canvas

7.20.2.3 Potential addressable market & customers

Concerning the commercialization of the Smart Camera System, UAH together with other partners participating in the development, will seek an engineering company capable to do installations/maintenance of the system/technology.

The main motivation of the looking company partnership is accessing to end-users, real installations. Especially, the companies involved in the consortium will be the initial potential customers to be addressed.

The main key activity is to focus in sectors where people behaviour analysis represents a large added value. In this sense, the idea is to focus the efforts on different sectors: geriatric residences, security services, commercial stores, etc. where the surveillance of areas are required.

The pursued selling agreement is a one-time acquisition for the engineering company including both the SW algorithm and its real-time execution on a embedded HW system. This will ensure fixed costs, minimizing risks, seeking future revenues from versioning and system updates, customizations for different sectors.

7.20.2.4 Timetable for exploitation

The timetable would be to seek for such a distributor/installation company of the system and, one the agreement is signed, work for the customization and features of the first end system.

7.20.2.5 Potential risks, barriers or limitations

The main risk is obsolescence as innovation/novelties included in the output algorithms executed on the smart camera system will be sooner or later improved by other technological competitors

7.20.3 Concrete exploitation path

The current status of this asset in terms of the TRL is 4-5. Thus, it is still early to clearly quantify exploitation goals and KPIs.

7.21 University of the Aegean (UAEGEAN)

7.21.1 Organization profile

University of the Aegean (UAegean)[44] has a strong international academic and research profile, having been an active member of the European Universities Association (EUA) and a leading academic and research institution in Greece and abroad. UAegean has received consistently excellent feedback in evaluations that have taken place at national, European and international level, as a result of the study programmes offered by the institution and its competitive research projects and initiatives. UAegean i4m Lab is part of the Financial and Management Engineering Dpt (School of Engineering) and focuses on the design, development, management and use of Information Technology (IT) and IT-based Service Systems in complex organizations, including government, industry value chains and value systems, inter-organizational business processes for SMEs and large enterprises. Recent work includes applications e-identity management systems, Business Process Automation, e-logistics and e-government.Business Development Possibilities.

7.21.1.1 Identification of individual exploitation possibilities for the project

UAegean plans to use the results of the project in the education of the young engineers and in the education programs of the School of Business (Department of Shipping, Trade and Transport). Besides, the University wants to use the results of PALAEMON to establish as a leading player in the field of evacuation management using the methods and techniques of business process automation and benefiting from the opportunities of 5G networking and the bpotential of Heterogeneous Nets (Het Nets).

7.21.1.2 Short description of key outcomes to be exploited and the innovation potential

UAegean will focus in particular on the exploitation of the project results related to the high coordination and streamline of the ship evacuation process, as proposed by PALAEMON. More specifically, UAegean wants to implement and promote the concept of Smart Evacuation Management and prove the business potential of Smart Evacuation Management Systems. The term “Smart Evacuation System” is defined at the operational level, as a layer of additional to existing evacuation functionality to allow for technology-aided Evacuation Management in cruise and RoPax vessels. More specifically, it refers to the development of a software suite providing technology-enhanced evacuation possibilities, which can be used by evacuation coordinators to: a) support the effective application of an Evacuation Plan (EP) by providing proper guidance to crew and passengers, b) manage incidents that could possibly hinder the timely execution of the EP from the initial time the incidence is reported to the conclusion of the incidence, c) track the status & location of resources and passengers, and reassess response plans if needed and, d) design and post-evacuation analysis of the response, on the basis of Key Performance Indicators (KPIs).

7.21.1.3 Potential addressable market & customers

The PALAEMON Smart Evacuation System addresses the needs of evacuation optimization in the specific markets of cruise shipping (where important activity has been transferred in the last years outside of EU) and coastal shipping (where there is a lot of improvement potential for the evacuation process with obvious consequences at the level of passengers’ safety and sustainability of investments).

7.21.1.4 Timetable for exploitation

The work on Smart Evacuation Exploitation Plan will follow a timetable with specific milestones

- Ship Evacuation Market Analysis with reference to cruise and coastal shipping
- Business Models for a Smart Evacuation Management System
- Market Positioning Actions (includes the promotion of PAMAEMON Smart Evacuation System in industry and engineering forums).

7.21.2 Concrete exploitation path

7.21.2.1 Goals

The exploitation plan for the SEM platform will not make use of strategies yielding a competitive advantage. The SEM platform developers envisage, at first, the development of a public good, through public funding for research and from private support (i.e., retroactive funding) obtained via a NFT (Non-Fungible Token).

A small number of NFT collections will be progressively issued, depending on the interest of the investment community. The Univ. of the Aegean, with help from a specialised provider, will manage the operation and coordinate the fundraising activities. The NFT issuer will

announce their intention to build a new TRL 8 version of SEM that will be working under a “public good with a pricing scheme” business model and provided as-a-service to ships that make a base investment in network and sensing infrastructure elements. The adhesion to the pricing policy of “SEM-as-a-service” and the deployment of the necessary infrastructure will permit a ship to consume online, as a complement of their own evacuation plan, the evacuation management assistance services, provided by a Land-based Emergency Control Center (LbEC) - operated by the SEM developers. The NFT strategy has the potential to incentivize the global community of ship owners and traders to contribute to a facility that might improve the safety of passengers and crew.

7.21.2.2 Work done and achievements

a. Document the differences with the existing approaches (optimization of the evacuation process through simulations and by deploying Decision Support Systems) – M14
b. Architecture and Components Design of a Smart Evacuation System – M18
c. Passenger Privacy Management by using Disposable Identities (based on Verifiable credentials and SSI technologies)

7.21.2.3 KPIs to measure the achievement

1. Publications
2. Presentations in industry and engineering forums

7.21.2.4 Roadmap

a. Development of an early prototype of a Smart Evacuation Management System
b. Functionality Demo and Feasibility Analysis

7.22 WISER SRL (WISER)

7.22.1 Organization profile

WISER is a small consulting company, whose mission is to provide technical support in the field of signal processing for wireless communications and navigation. WISER team experiments with low-cost technologies based on "Software-Defined-Radio" architectures for a number of applications: transmission of digital terrestrial television to vehicles, trucks fleet control through satellite data packets, highly-accurate GPS receivers. The main customers of WISER are both large national and international companies that need to outsource specific highly technical activities, and local smaller companies operating in the field of ICT.

7.22.2 Business Development Possibilities

7.22.2.1 Identification of individual exploitation possibilities for the project

WISER aims at developing a VDES-compliant transceiver during PALAEMON project. Specifically, WISER has been developing the transmitter and receiver algorithms and their efficient software implementation. These software implementations will be then ported over a COTS hardware platform, composed by an RF tuner and an embedded board. These activities concerning software porting over the COTS platform will be carried out jointly with Thales Italia. The target TRL for the VDES transceiver prototype is TRL 7.

7.22.2.2 Short description of key outcomes to be exploited and the innovation potential

WISER outcome of PALAEMON project is represented by the knowledge, the algorithms and the software implementation of the VDES transceiver, tested over a COTS x64 architecture. The property of these outcomes is 100% of WISER.A more market-oriented implementation

running over a COTS SDR hardware platform will be obtained by modifying the original software (tested over the x64 architecture) during the project, thanks to the joint effort of WISER and Thales Italia. The property of the resulting SW will be shared among the two entities, with percentages to be agreed.

7.22.2.3 Potential addressable market & customers

WISER is an SME, so it is unlikely to face the maritime market by itself. For this reason, a joint venture with Thales Italia is the target strategy to be followed by WISER. Hence the customer identification will be carried out by Thales Italia.

7.22.2.4 Timetable for exploitation

WISER and Thales Italia aim at moving from TRL 7 to TRL 9 (product) in maximum two years' time after the end of PALAEMON project. After that period, the VDES transceiver will be ready to be launched on the maritime market.

7.22.2.5 Potential risks, barriers or limitations

No technical risks/barriers are foreseen as far as the activities to be carried out into the project are concerned. A potential risk lies into the actual capacity of WISER (and/or Thales Italia) to address the reference market of VDES equipment. In this respect, development of professional-grade equipment is foreseen (defence, civil protection etc.).

7.22.3 Concrete exploitation path

7.22.3.1 Goals

Possibly, to arrive at a fully commercial, standard-compliant VDES product

7.22.3.2 Work done and achievements

Prototype developed in the context of the PALAEMON project, tested in Lab and officially demonstrated (28/10/2022) in Lab with RF transmission.

7.22.3.3 KPIs to measure the achievement

Signal waveform and physical layer parameters (BER, etc);

Capability to properly interact with PALAEMON DFB through the VDES Gateway application and to exchange Kafka messages.

7.22.3.4 Roadmap

Refer to Timetable.

7.23 Athonet

7.23.1 Organization Profile

Athonet is an innovative small-medium enterprise active in the field of mobile private core networks.

Athonet provides a complete software-based mobile packet core solution for centralised or highly distributed edge-cloud deployments in Enterprise & Industrial private networks, CBRS, Challenger Telcos, Tier 1 Operators, Governments and Public Safety or mission critical applications. The full 5G and beyond core network solution set includes also Voice (vIMS for VoLTE-VoNR), Broadcast (eMBMS), supports NB-IoT and MC-PTT. It can be deployed in fully virtualised environments such as private and public clouds, enterprise data centres or on standard off-the-shelf servers.

Athonet provides the 5G core network functionalities to support the rescue operations on the cruise and practically integrates with the radio equipment of the partner Ericsson and with the mission critical application provided by the partner Airbus.

7.23.2 Business Development Possibilities

7.23.2.1 Identification of individual exploitation possibilities for the project

ATH will exploit the knowledge and expertise acquired with the project to develop innovative commercial solutions, to strengthen its position in the market as a 5G provider in the short term and as a designer and developer of 6G network components and solutions in the longer term. Further, ATH will leverage the project's activity to disseminate its industrial research results at international conferences, journals, and fairs, so to increase awareness among experts in the field of ATH's capabilities and expertise.

7.23.2.2 Short description of key outcomes to be exploited and the innovation potential

Athonet expects to benefit from the results of this project not only to promote top level private 5G products, but also to accelerate the market growth, and, to a broader extent, to increase the awareness and business opportunities of private cellular networks for verticals involving entertainment, rescue operations, logistics, and mission critical applications.

7.23.2.3 Potential addressable market & customers

Target verticals are entertainment, rescue operations, logistics, and mission critical arena.

7.24 PALAEMON End users. ANONIMI NAFTILIAKI ETERIA KRITIS (ANEK) S.A. and OESTERREICHISCHER LLOYD SEEREEDEREI (CYPRUS) LTD (OELS)

As end users ANEK and OELS do not foresee any exploitation of the results. They collaborate with the project as follows:

1. Updating the knowledge of the state-of-the-art technologies in PALAEMON

2. Obtaining information to better be able to specify the next generation if systems to

be integrated in vessels

3. And/or benchmarking various solutions through the assessment of the system capabilities

during the test sessions

4. And/or purchasing systems parts from the project if interesting.

8 Intellectual Property Management and Standards contributions

Intellectual property management and standardization efforts contribute to improving the exploitation of the project's results.

Solid management of the intellectual properties of the assets, also contributes to smooth relations between the partners. These actions provide the knowledge beforehand of the licenses' assets and their compatibility. With favours in case of studying joint exploitation.

Actions devoted to following and contributing to standards in the results also facilitate the adoption of the results. For this reason, the consortium has carefully taken care of both activities.

8.1 Intellectual Property procedure

As it was stated in D9.4 [45] to "guarantee the correct use and application of software licenses in PALAEMON, the consortium followed the following IPR management procedure.
The procedure can be summarized as follows:

- Per each PALAEMON software component the following steps should be followed.:
  - All the components that are part of a component and its licenses are collected.
  - Study one per one the compatibility between the sub-components licenses.
  - Publish the component with a license compatible with the sub-components license."

See Figure 38 below to see common licenses compatibility.

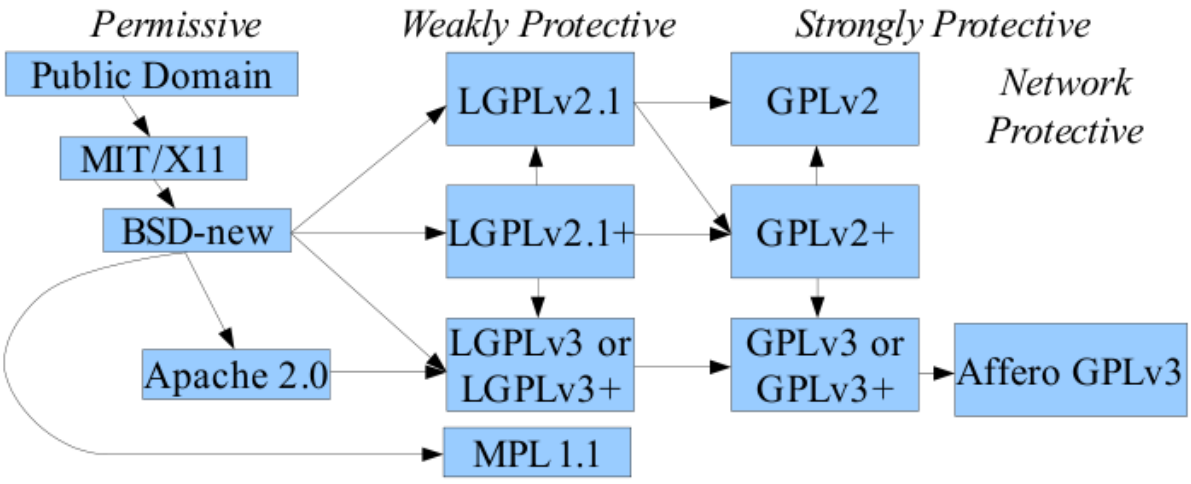


Figure 38 Licenses compatibility David A. Wheeler (2007)

In order to facilitate the accomplishment of the IPR Procedure, it has been recommended to use a software repository. In the case of PALAEMON, GitLab has been recommended.

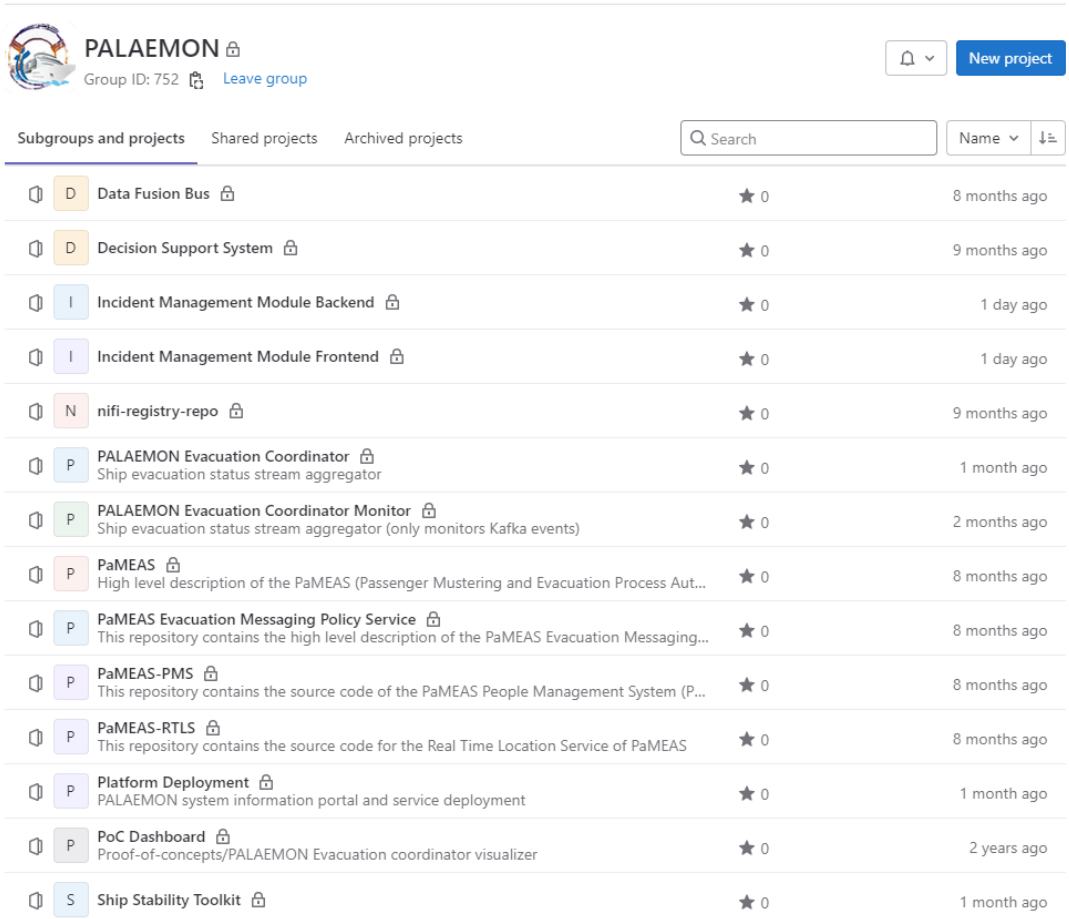


Figure 39 PALAEMON GitLab Repository [46]

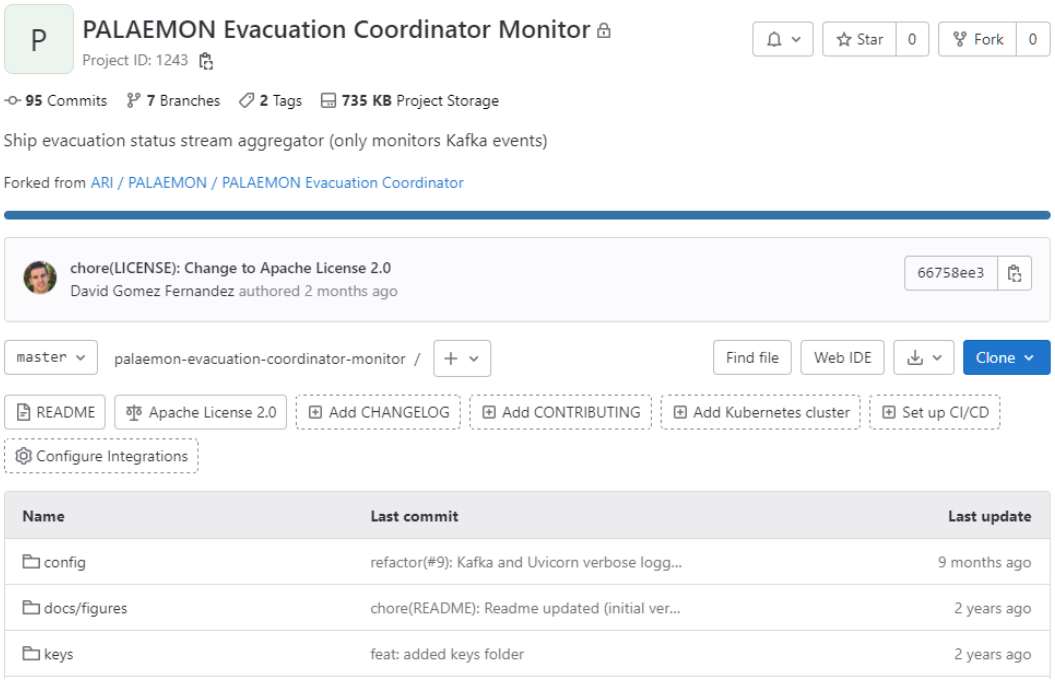


Figure 40 PALAEMON Gitlab

Table 26 PALAEMON. List of ICT software licenses

Asset	Owner	License
Smart Bracelets	ADV	Proprietary
Smart Cameras	UAH	Apache 2.0
Ship Health Monitoring (Motion and acoustic sensors)	ESI	Proprietary
VDES Transceiver + SW	WISER / THALES	Proprietary
PaMEAS	UAGEAN	AGPL
Data Fusion Bus (Access + Core)	ITML / ATOS	Proprietary
Safety Management System (Ship & Shore)	DANAOS	Proprietary
Evacuation coordinator	ATOS	Apache 2.0
Weather Forecast Toolkit (DSS)	KT	Dual license GPL3.0 outside the consortium, Apache 2.0 for Palaemon partners
Smart Safety System	JU	MIT License
Ship Stability Toolkit	JU	The onboard components are under MIT License, the shore-based calculation-tools are closed and not public available
Voyage Report Generator	ATOS	Apache 2.0
Decision Support System (DSS)	KT	Proprietary
PALAEMON Incident Management Module (PIMM)	KT	Dual license GPL3.0 outside the consortium, Apache 2.0 for Palaemon partners
Smart Risk Assessment Platform (SRAP)	NTUA	Apache 2.0
AR Glasses	SIMAVI	TBD
PALAEMON Academy (eLearning Platform)	JOAFG	Freeware
PALAEMON Academy (VR OnSite Training)	JOAFG	License for VR Onsite
Training platform	SIMAVI	TBD

8.2 Technological Readiness Level

This subsection enumerates the Technological Readiness Level reached for each result.

Table 27 PALAEMON Assets TRL

Asset	Owner	TRL
Smart Bracelets	ADV	TRL 5-6
Smart Cameras	UAH	TRL 4-5
Ship Health Monitoring (Motion and acoustic sensors)	ESI	TBC
VDES Transceiver + SW	WISER / THALES	TRL 7
PaMEAS	UAGEAN	TRL5-6
Data Fusion Bus (Access + Core)	ITML / ATOS	TRL5
Safety Management System (Ship & Shore)	DANAOS	TRL 9
Evacuation coordinator	ATOS	TRL 6
Weather Forecast Toolkit (DSS)	KT	TRL7
Smart Safety System	JU	TBC
Ship Stability Toolkit	JU	TBC
Voyage Report Generator	ATOS	TRL 5
Decision Support System (DSS)	KT	TRL 8
PALAEMON Incident Management Module (PIMM)	KT	TRL7
Smart Risk Assessment Platform (SRAP)	NTUA	TRL4-5
AR Glasses	SIMAVI	TRL5
PALAEMON Academy (eLearning Platform)	JOAFG	TRL 9
PALAEMON Academy (VR OnSite Training)	JOAFG	TRL 7
MEV + Inflatables	ASTANDER + DSB + ESI	TBC
Inflatables	DSB	TBC
Training platform	SIMAVI	TBC
MEV-I Interior Design	EFB	TBC

8.3 Standards

PALAEMON partners have taken into account relevant standards when developing the main assets of the project. This subsection is a summary of the standards used, as well as the

standards identified to be analysed. In addition, some propositions are enumerated to enhance some standards.

The Decision support system Konnectable

The DSS provides the significant element of dynamic data display to the International Safety Management ISM [47] code through enhancement of the action lists it processes. This, in turn makes the ISM code more readable and useful as the Master and bridge crew has a live feed of information on their screens.

MEV APPLICABLE REGULATIONS:

Following standards were taken into account for the final manufacturing and testing:

IMO/SOLAS requirements, LSA Code and Directive 2014/90/EU of the European Council on Marine Equipment (MED). Standard EN-818 indicates the load reduction coefficients, according to the branches used in slings

Smart Safety system

The main usage of communication during incidents on board is mostly stated in IMO-standards such as (SOLAS, ISM, ISPS, and ITU). The SSS will promote a joint assistant system that ease the usage of standards as supporting through non-verbal communication. It does not replace the communication standards known, it contributes as additional lay out of communication.

Inflatables

The MEV integrating our inflatables are a new approach to passenger / crew safety and as such would be any civilian or military application require a full type approval from a notified body.

Smart Bracelets

The SB supports IEEE 802.11 b/g/n-compliant Wi-Fi and 802.11mc FTM support to allow localization trough Wi-Fi networks. It is also complaint with Bluetooth Low Energy standard: Bluetooth 5, Bluetooth mesh.

Smart Camaras

At this stage there is no contribution to standards but monitoring systems providing real-time data should be included in the safety regulations.

Architecture and Data Model

The PALAEMON proposed architecture is prepared to use the standard ETSI NGSI-LD [48], and this is the basis of the Data Model used in the project.

eLearning Platform

With the eLearning Platform, IMO standards can be provided to a larger audience. Also new technologies can be introduced fast and effective, which allows a better understanding of how and why standards are necessary.

Ship stability toolkit

The toolkit targets to improve the time needed to successfully evacuate a passenger ship as required by SOLAS.

ITML is following 2 standards, one relevant to the quality management and one related to the security management. More specifically, we are using ISO 9001: 2015 and ISO/IEC 27001:2013. Both standards are followed for the scope of design, development, deployment and support of Software products. ISO 9001: 2015 is defined as the international standard that specifies requirements for Quality Management Systems-Requirements, while ISO/IEC 27001:2013 is an international standard which is designed for Information Security Management System.

9 Business Model Canvas

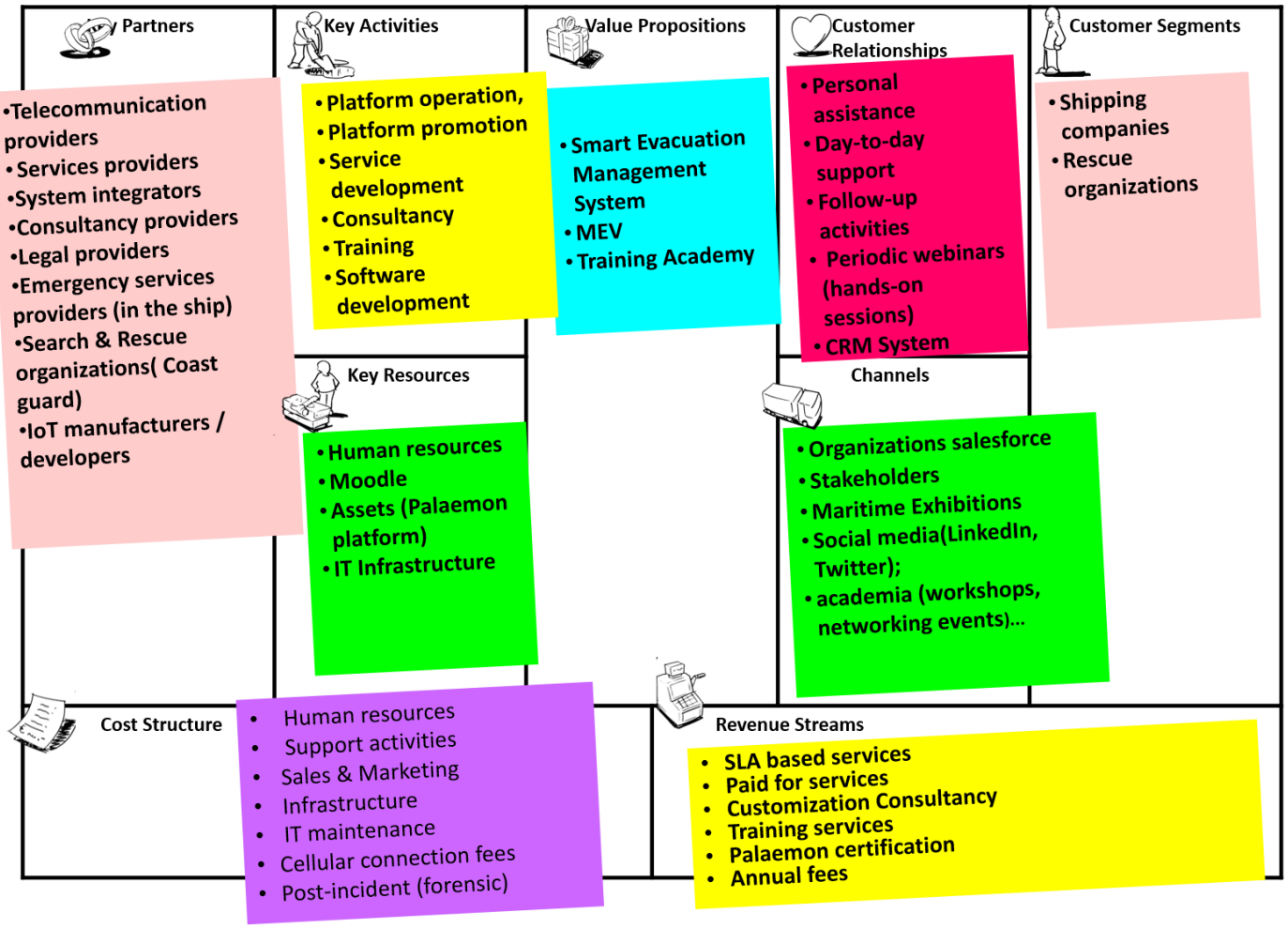


Figure 41 PALAEMON Business Canvas (Source: Strategyzer)

In the figure above, the PALAEMON Business Model canvas is shown, and the information is placed in 9 building blocks. The Business Model canvas was filled in collaboration with the consortium members.

Note : This PALAEMON Business Canvas is an updated version of D9.4 [45]

10 Exploitation pathways

The consortium has identified several pathways for asset exploitation. The alternatives are not unique, and they can occur simultaneously. For example, an asset can be exploited individually by the owning organisation, or it can be exploited jointly with another asset.

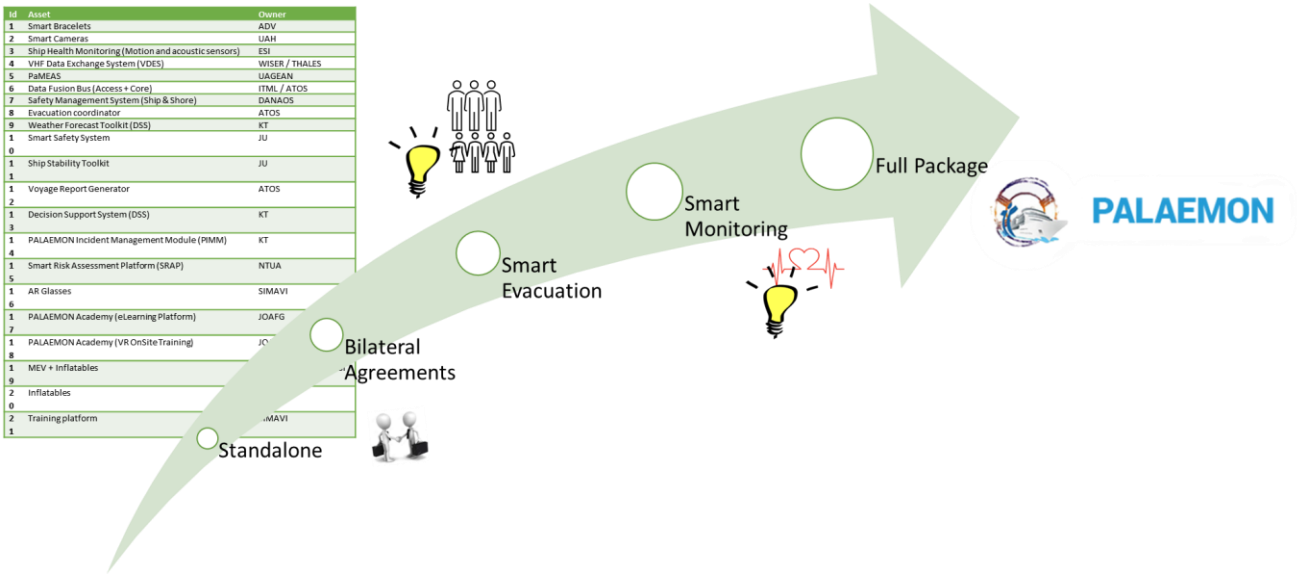


Figure 42 PALAEMON Exploitation pathways

10.1 Standalone (Individual Exploitation)

Each component can be commercialized independently. As the intellectual property rights have been identified per each partner, individual exploitation can be undertaken, and it is clearly explained in the individual exploitation plans of the partners section 7 of this document.

10.2 Bilateral Agreements

As it was stated in previous deliverable D9.4 [45] the intention to enter into bilateral/multilateral agreements has been expressed by several partners this will occur when jointly agreements to commercialize together their solutions developed during the PALAEMON.

Some examples of these bilateral agreements are:

- **WISER and Thales** in the commercialization of the VDES**.**

  "*WISER is an SME, so it is unlikely to face the maritime market by itself. For this reason, a joint venture with Thales Italia is the target strategy to be followed by WISER. Hence the customer identification will be carried out by Thales Italia"*

- Cooperative training with the Jade University or another naval academy to gain better credibility for the market.
- **Advantic and University of Alcalá** with the commercialization of the monitoring people and localization.
- Commercialization of the SEM component with the collaboration **UAGEAN, NTUA, KT, ATHONET and Ericsson.**

10.3 Smart Evacuation System:

This exploitation pathway is composed by the following components:

- Smart Bracelets
- Smart Cameras
- Ship Health Monitoring (Motion and acoustic sensors)
- Data Fusion Bus (Access + Core)
- Evacuation coordinator
- Weather Forecast Toolkit (DSS)
- Smart Safety System
- Voyage Report Generator
- Decision Support System (DSS)
- PALAEMON Incident Management Module (PIMM)
- Smart Risk Assessment Platform (SRAP)
- AR Glasses
- PaMEAS

All these components provide an intelligent layer on top of traditional evacuation systems. This solution complements the shipboard legacy systems. Potential customers might select a subset of components from this list, yielding a bespoken evacuation process.

The value offered by this solution is to improve the evacuation procedure reducing the risk and casualties in the event of incidents.

10.4 Smart Monitoring System

This pathway is composed by the following components:

- Ship Health Monitoring (Motion and acoustic sensors)
- Data Fusion Bus (Access + Core)
- Evacuation coordinator
- Weather Forecast Toolkit (DSS)
- Voyage Report Generator
- Decision Support System (DSS)
- PALAEMON Incident Management Module (PIMM)
- AR Glasses

The value offered by this solution is to provide a standalone and reliable platform that captures all the information and events generated by the digital sources. Thanks to this system, we can support a real time monitoring of ship and people's health. Potential customers might select a subset of components from this list, yielding a bespoken monitoring process.

10.5 Full package

This option is to commercialize the software components as a whole as it was stated in the previous deliverable D9.4 [49] terms and conditions should be agreed between the parents

Partners willing to continue the exploitation beyond the PALAEMON project life should agree in the terms and contents of the agreements.

This document usually contents the following sections:

- Definitions: in this section the definitions used in the agreement are detailed.
- Scope: Define the scope of the agreement.

- Duration: Establish when the agreement takes effect.
- Exploitation Committee: Detail the main entity which will be in charge of the exploitation of the Product(s).
- Results of the project: Describe the list of results that can be part of the solution.
- Commercial Setting for the Use of Assets owned by the other Parties: this section describes the model and price list, the roles and responsibilities and the revenue sharing program.

The following sections are common in an exploitation agreement

- Liability
- Confidentiality
- Termination
- General Clauses
- Signatures: the list of parties involved in the agreement duly sign the document.

11 Business cases

The purpose of these business cases is to outline the potential revenues and, costs associated with each proposed project. They serve to justify the allocation of resources and to gain support and approval from stakeholders. Also, the business cases support the demonstration that the proposed projects are sound and viable solutions.

11.1 PALAEMON Academy Business Case

As it was described in section 6.17 the PALAEMON Academy (eLearning Platform) is an easy-to-use Moodle system, as it is used for eLearning in academic sector very often. With this framework, it is possible to provide lessons and trainings with a controlling and monitoring to check if content was read, understood and learned. Therefore, the system is monitoring the access, provides quizzes and can provide exams.

The PALAEMON Academy business case is drafted in this section.

It is assumed to have a development time of 18 person months to finalize a full product. This includes a leap from TRL 4 to TLR 9 as the development is then focused on the commercialization. From a graphic design, adaptation to new VR system (e.g., Meta Quest Pro or Meta Quest 3, Pico 4 etc) available and to adjust the content of the academy to customer needs and branding and price models for individual customers. This development time is dedicated to allow the product a higher flexibility and more stability and user friendliness. See Table 28.

The adjustment for each project is based on the experiences from the project and the learning to make the needed adjustments faster and more effective. The developments from Project to Product are not included.

Table 28 PALAEMON Academy Costs Calculation

Asumptions :			
Rate Partner A	€	7.400,00	
Project manager rate	€	8.000,00	
Developers	€	8.000,00	
Business analyst	€	7.000,00	
Marketing & sales Staff	€	5.000,00	
Partner A Initial Costs	**Time PM**		
Partner A	18,00		133.200 €
EU	0,00		0 €
Total initial investment	18,00		133.200 €
Cost from Prototype to product			
Cost Type	Time- PM		Cost (€)
Further asset development	6		44.400 €
Business strategy Implementation	3		22.200 €
Initial Promotion	4		29.600 €
Others	0		0 €
Total initial investment	13		96.200 €
Cost per project			
Cost Type	Time - PM		Cost (€)
Project manager	0,2		1.600
Developers	0,2		1.600
Business analyst	0,2		1.400
Marketing & sales Staff	0,5		2.500
Other yearly costs Platform	0,5		34.800
TOTAL YEARLY COSTS			41.900

The revenues, see Table 29, are defined on a basic price model, that allows 1. The coverage of all costs, 2. A sustainable development to ensure the product is longer available 3. According to market size and initial market entrance time.

It is assumed that it takes 3-6 years to get well known within the travel industry with this product and to allow a mouth-to-mouth propaganda, which is securing the sustainable outcome of the product. It is also assumed that contracts with one or two ship companies or travel agencies are done in the beginning as exclusive rights to provide an additional sales argument. So, in the first years, mainly a pilot of the product will be available, and sales will start in the second and third year. As results need to settle in a small market and being convincing, this will result in a “observation state” of the product in year 4 and 5. After this period, sales numbers are expected to increase. On a longer perspective and with a growing reputation, year 8,9 and 10 will be the most beneficial years with a rapid increase in sales numbers. After 10 years, a stable level should be reached with approximately annual turnovers of 1,023 million Eur. Including valorisation estimations, this will reach nominal in 2032 probably 1,5-1,8 million Eur. for the European market. Extensions towards US and Asian markets are envisaged; but not before the 4th year and are not taken into consideration at this moment as not sufficient knowledge on these markets is available.

Table 29 PALAEMON Academy Revenues estimation

Constants	
%Sales increase	0,02

Prices	
PALAEMON Academy Basic I	€ 19.000
PALAEMON Academy VR Training	€ 9.500
PALAEMON Academy Assessment Training	€ 6.000,00
PALAEMON Evacuation Training	€ 6.000,00

Sales (Units)					
	Year 1	Year 2	Year 3	Year 4	Year 5
Product I	1	3	4	3	2
Product II	1	3	4	2	4
Product III		1	2	1	1
Product IV		1	3	1	2
Total	2	8	13	7	9

Revenues					
	Year 1	Year 2	Year 3	Year 4	Year 5
Product I	€ 19.000,00	€ 57.000,00	€ 76.000,00	€ 57.000,00	€ 38.000,00
Product II	€ 9.500,00	€ 28.500,00	€ 38.000,00	€ 19.000,00	€ 38.000,00
Product III	€ 0,00	€ 6.000,00	€ 12.000,00	€ 6.000,00	€ 6.000,00
Product IV	€ 0,00	€ 6.000,00	€ 18.000,00	€ 6.000,00	€ 12.000,00
Total	**€ 28.500,00**	**€ 97.500,00**	**€ 144.000,00**	**€ 88.000,00**	**€ 94.000,00**

	Year 1	Year 2	Year 3	Year 4	Year 5
Sales	€ 28.500	€ 97.500	€ 144.000	€ 88.000	€ 94.000
TOTAL Revenues	€ 28.500	€ 97.500	€ 144.000	€ 88.000	€ 94.000
Initial Costs	€ 133.200				
Cost from Prototype to product	€ 96.200				
Yearly costs	€ 41.900	€ 125.700	€ 167.600	€ 125.700	€ 83.800
Total Operating Expenses	€ 271.300	€ 125.700	€ 167.600	€ 125.700	€ 83.800
EBITDA	-€ 242.800	-€ 28.200,00	-€ 23.600,00	-€ 37.700,00	€ 10.200,00

11.2 ICT

As a first exercise, to evaluate the potential revenues and cost of joint ICT solution, a rough estimation with an initial calculation of the costs and revenues of the offering of a joint ICT solution is provided in this section.

For this first approach, the solution consists of the following software components:

- Smart Bracelets
- Smart Cameras
- Ship Health Monitoring (Motion and acoustic sensors)
- Data Fusion Bus (Access + Core)
- Evacuation coordinator
- Weather Forecast Toolkit (DSS)
- Smart Safety System
- Voyage Report Generator
- Decision Support System (DSS)

- PALAEMON Incident Management Module (PIMM)
- Smart Risk Assessment Platform (SRAP)
- AR Glasses

First, per each component involved in the solution, it has been calculated the cost to evolve the current asset from prototype to product. See Table 30.

Table 30 ICT components costs from prototype to product

Cost from Prototype to product	
Smart Bracelets	€ 114.500,00
Smart Cameras	€ 102.000,00
Ship Health Monitoring (Motion and acoustic sensors)	€ 137.500,00
Data Fusion Bus (Access + Core)	€ 60.000,00
Evacuation coordinator	€ 75.000,00
Weather Forecast Toolkit (DSS)	€ 20.000,00
Smart Safety System	€ 80.000,00
Voyage Report Generator	€ 80.000,00
Decision Support System (DSS)	€ 35.000,00
PALAEMON Incident Management Module (PIMM)	€ 55.000,00
Smart Risk Assessment Platform (SRAP)	€ 75.000,00
AR Glasses	€ 200.000,00
	€ 1.034.000,00

Secondly, the joint solution integration costs have been estimated in 275.000 €. See Table 31.

Table 31 Joint ICT Solution Integration costs

Partner Costs	Time PM	Integration Costs
Partner A	55,00	275.000 €
EU	0,00	0 €
Total initial investment	55,00	275.000 €

Three different solutions are offering, depending on the type and size of ship on which the solution is to be deployed. The costs have calculated as follows (see Table 32):

Table 32 Costs per type of project

Cost per project		Type I	Type II	Type III
Cost Type	Time - PM	Cost (€)	Costs	Cost (€)
Project manager	2	8.000	12.000	14.400
Developers/engineer	10	35.000	52.500	63.000
Business analyst	3	12.000	18.000	21.600
Marketing & sales Staff	1	3.000	4.500	5.400
Other yearly costs Platform	1	15.000	22.500	27.000
TOTAL YEARLY COSTS		73.000	109.500	131.400

Regarding revenues, the following prices are established for the different type of product, see Table 33.

Table 33 Price per type of product.

Prices	
Price Product I	200.000
Price Product II	300.000
Price Product III	400.000

Sales have been calculated as follows, see Table 34:

Table 34 Sales per type of product

Sales (Units)					
	Year 1	Year 2	Year 3	Year 4	Year 5
Product I	3	4	5	6	7
Product II	1	2	3	4	5
Product III		1	1	3	4
Product IV					
Total	4	7	9	13	16

Bellow, the revenues calculation is shown, see Table 35:

Table 35 Revenues estimation per type of product

Revenues					
	Year 1	Year 2	Year 3	Year 4	Year 5
Product I	€ 600.000,00	€ 804.000,00	€ 1.008.000,00	€ 1.212.000,00	€ 1.416.000,00
Product II	€ 300.000,00	€ 600.000,00	€ 900.000,00	€ 1.200.000,00	€ 1.500.000,00
Product III	€ 0,00	€ 400.000,00	€ 400.000,00	€ 1.200.000,00	€ 1.600.000,00
Product IV	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00
Total	**€ 900.000,00**	**€ 1.804.000,00**	**€ 2.308.000,00**	**€ 3.612.000,00**	**€ 4.516.000,00**

To conclude, the final revenues subtracting the costs are shown in the table below.

Table 36 Revenues estimation

	Year 1	Year 2	Year 3	Year 4	Year 5
Sales	€ 900.000	€ 1.804.000	€ 2.308.000	€ 3.612.000	€ 4.516.000
TOTAL Revenues	€ 900.000	€ 1.804.000	€ 2.308.000	€ 3.612.000	€ 4.516.000
Integration costs	€ 275.000				
Cost from Prototype to product	€ 1.034.000				
Yearly costs	€ 328.500	€ 643.860	€ 827.820	€ 1.274.580	€ 1.589.940
Total Operating Expenses	€ 1.637.500	€ 643.860	€ 827.820	€ 1.274.580	€ 1.589.940
EBITDA	-€ 737.500	€ 1.160.140,00	€ 1.480.180,00	€ 2.337.420,00	€ 2.926.060,00

It can be seen in Table 36 that in the first-year losses are expected, but in the following year the costs are covered and the solution starts to generate profits.

11.3 MEV Business Case

The Initial cost related to MEV manufacturing are mainly material and personnel. See Table 37.

Table 37 MEV Initial costs

Cost per project		
Cost Type	Time - PM	Cost (€)
Material	1	150.000
Engineer	14	70.000
Operators	16	56.000
Other yearly costs Platform		
TOTAL YEARLY COSTS		276.000

From the third year onwards, manufacturing will be done with a dedicated line, which implies an investment of 1.000.000. Certification costs are calculated in 20.000 €.

The marketing costs are foreseen annually with an increase in the last years.

The revenues are calculated using a price of 350.000 € as target price. See Table 38 and Table 39.

Table 38 Sales estimation

Constants					
%Sales increase	0,02				
Prices					
Price Product I	€ 350.000				
Price Product II					
Price Product III					
Price Product IV					
Sales (Units)					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Product I	3	4	5	6	7
Product II					
Product III					
Product IV					
Total	**3**	**4**	**5**	**6**	**7**

Table 39 Revenues estimation

Revenues					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Product I	€ 1.050.000,00	€ 1.407.000,00	€ 1.764.000,00	€ 2.121.000,00	€ 2.478.000,00
Product II	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00
Product III	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00
Product IV	€ 0,00	€ 0,00	€ 0,00	€ 0,00	€ 0,00
Total	**€ 1.050.000,00**	**€ 1.407.000,00**	**€ 1.764.000,00**	**€ 2.121.000,00**	**€ 2.478.000,00**

The calculated benefit as shown below, taking into account the costs and revenues. See Table 40.

Table 40 Cost and Revenues

	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Sales	€ 1.050.000	€ 1.407.000	€ 1.764.000	€ 2.121.000	€ 2.478.000
TOTAL Revenues	€ 1.050.000	€ 1.407.000	€ 1.764.000	€ 2.121.000	€ 2.478.000
Annual cost	€ 60.000	€ 60.000	€ 60.000	€ 70.000	€ 75.000
Production			€ 1.000.000		
Certification	€ 20.000				
Yearly costs	€ 828.000	€ 1.109.520	€ 1.391.040	€ 1.672.560	€ 1.954.080
Total Operating Expenses	€ 908.000	€ 1.169.520	€ 2.451.040	€ 1.742.560	€ 2.029.080
EBITDA	€ 142.000	€ 237.480,00	-€ 687.040,00	€ 378.440,00	€ 448.920,00

12 Conclusions

The current deliverable summarizes the results of the following tasks:

- T9.2 Exploitation Strategy & PALAEMON Business Plan led by ATOS
- T9.3 Assessment of equivalence of PALAEMON solutions with existing standards and potential barriers led by DNV
- T9.4 Project solutions LCA and LCC analysis Led by DANAOS

Therefore, the deliverable is the result of collaboration between the three (3) tasks.

The main results reported in the deliverable are:

- Assessment of equivalence of PALAEMON solutions, in this section the assessment of the PALAEMON solutions' compliancy with the existing statutory regulations (SOLAS, LSA Code, etc.) and Class rules and standards is provided.
- Life cycle assessment: this assessment includes both tiers of the evaluation. Concerning the feasibility of the interpretation of PALAEMON in the shipping industry indicates that the PALAEMON ecosystem generates value to the safety system of a maritime company in an end-to-end perspective of the incident management (safety management, incident assessment and management, post-incident analysis stages). The industry, based on the answers received through questionnaires, accepts the digital transformation of safety administration and innovation in the management of evacuation that the PALAEMON ecosystem offers. The validity of the system will be further assessed in practice.
- Exploitation activities:
    - In section 5, a PESTEL analysis was conducted, as this was a recommendation formulated in the PALAEMON review report:" to have a better overview of the current situation". The analysis concludes that despite the destabilizing external factors (Inflation, Ukrainian War, etc.), the benefits that the PALAEMON ecosystem can bring to passenger ships could counteract the negative effects of the current situation.
    - After this, in Section 6, the "List of Asset and results" were collected and thoroughly presented. The main PALAEMON results are described there, and a detailed information of each asset is provided. For each asset, the following information is presented:
        - Problems solved by the asset
        - Value proposition
        - Customers
        - Challenges
        - Unfair advantage
    - In Section 7 (Individual Exploitation Plans) the majority of the PALAEMON partners have updated their individual exploitation plan from the previous version of this deliverable. In the section partners has presented their business plans for their components.
    - Further on in the document, the Intellectual Property Rights of the PALAEMON results are presented in Section 8, as well as the TRLs achieved and the contributions to the standards. It is worth mentioning that most of the selected

licences used are of the permissive type (MIT, Apache2.0). Permissive licences allow users to use, modify and distribute software freely, while providing some protection to the copyright holder. In addition, no problems with the use of commercial/proprietary licences are foreseen.

- To introduce the exploitation pathways in Section 10, the previous section, Section 9, “Business model canvas” provides a copy of the business model canvas to help the reader a better understanding.
- In Section 10 “Exploitation pathways”, the consortium has identified several pathways for exploitation. The alternatives are not unique, and they can occur simultaneously. The consortium has agreed to explore and realise every type of business opportunity that is identified.
- To conclude, in Section 11, “Business Cases”, 3 examples of business cases are presented:
  - The academy business Case
  - The ICT business case
  - The MEV business case

  The purpose of these business cases is to outline the potential revenues and, costs associated with each proposed project. They serve to justify the allocation of resources and to gain support and approval from stakeholders. Also, the business cases support the demonstration that the proposed projects are sound and viable solutions.

In conclusion, the consortium considered that the work undertaken in the project provides value to the ship industry and it will be extended and used in other projects (research and commercial projects) and it is willing to support each other in the business opportunities that may arise.

Annex I Questionnaire

This section of the deliverable contains the questionnaire utilized for the LCA development described in Section 4.

QUESTIONNAIRE

Besides the demographics, the questions of this questionnaire are divided in 3 different sections, each one representing one stage of the analysis method.

Specifically:

- The **safety management stage** is referring to all the safety procedures held in order to be prepared in case of an incident, such as maintenance, training, drills, preparation of files for regulatory compliance, etc.
- The **incident assessment and management stage** starts after the occurrence of an incident, it contains the assessment of the bridge team whether to sound the General Alarm (GA) or not, the mustering process, the embarkation to the lifesaving appliances and the ship abandonment.
- The final stage is referring to the **analysis of the incident** as a whole and its consequences after it has ended.

Demographics

1. Are you a member of the PALAEMON consortium?
    - Yes
    - No

Answer:

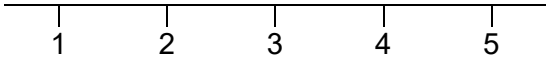
2. In which stakeholder group do you belong?
    - Flag state
    - ICT
    - Training academy
    - Shipping company
    - Classification society
    - Other

Answer:

Stage 1- Safety management

3. How do you think that the utilization of the PALAEMON ecosystem would affect the ***safety management cost*** of your company (compared to the current safety management cost)?

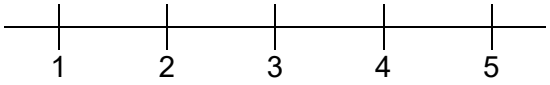
   (1=It would increase it a lot, 2=It would slightly increase it, 3= It would not affect it, 4=It would slightly decrease it, 5= It would decrease it a lot)



Answer:

4. How do you think the fact that the MEV's construction will be mainly based on bio materials would affect the ***environmental footprint***, compared to a scenario in which typical lifeboats are used?

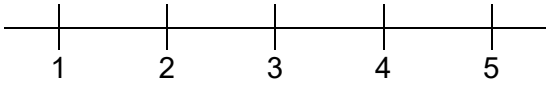
   (1=It would increase it a lot, 2=It would slightly increase it, 3= It would not affect it, 4=It would slightly decrease it, 5= It would decrease it a lot)



Answer:

5. To what extent you think the digitalization of safety management as offered in PALAEMON ecosystem would affect ***safety awareness*** and ***safety administration*** compared to the existing modern available tools?

   (1=It would decrease them a lot, 2=It would slightly decrease them 3= It would not affect them, 4=It would slightly enhance them, 5= It would enhance them a lot)

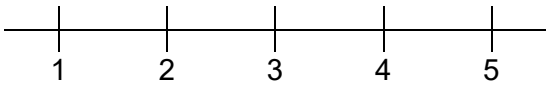


Answer:

Stage 2- Incident assessment and management

6. How do you think that the PALAEMON ecosystem would affect the ***safety level***, compared to a scenario in which it is not used?

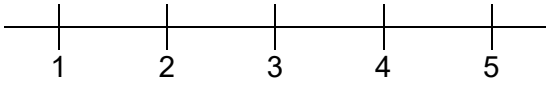
   (1=It would decrease it a lot, 2=It would slightly decrease it, 3= It would not affect it, 4=It would slightly increase it, 5= It would increase it a lot)



Answer:

7. How do you think that the PALAEMON ecosystem would affect the ***performance of crew members*** (decision making, management of dangerous situations etc.), compared to a scenario in which it is not used?

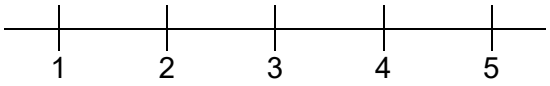
   (1=It would decrease it a lot, 2=It would slightly decrease it, 3= It would not affect it, 4=It would slightly improve it, 5= It would improve it a lot)



Answer:

8. How do you think that the PALAEMON ecosystem would affect the ***performance of passengers*** (reduced stress and panic will result to better behavior during an emergency), compared to a scenario in which it is not used?

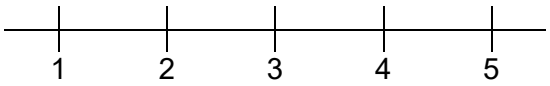
   (1=It would decrease it a lot, 2=It would slightly decrease it, 3= It would not affect it, 4=It would slightly improve it, 5= It would improve it a lot)



Answer:

9. How do you think that the PALAEMON ecosystem would affect the ***risk exposure***, to possible hazards during voyage, compared to a scenario in which it is not used? (This question is based on the fact that PALAEMON components might re-assess the risks against hazards, e.g. become a mitigation control measure to reduce risk).

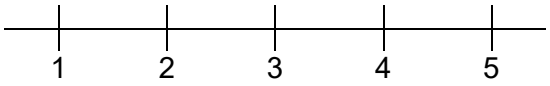
   (1=It would increase it a lot, 2=It would slightly increase it, 3= It would not affect it, 4=It would slightly decrease it, 5= It would decrease it a lot)



Answer:

10. How do you think that the PALAEMON ecosystem would affect the ***time needed*** for a ship to be evacuated, compared to a scenario in which it is not used?

    (1=It would increase it a lot, 2=It would slightly increase it, 3= It would not affect it, 4=It would slightly decrease it, 5= It would decrease it a lot)

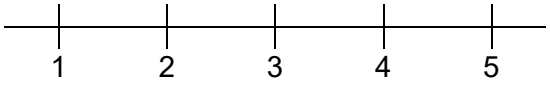


Answer:

Stage 3- Post incident analysis

11. Do you think that the PALAEMON reporting system could enhance the ***post incident analysis*** procedure and provide better results compared to the current conditions?

    (1=It would give significantly worse results, 2= It would give slightly worse results, 3= It would not affect the post incident analysis procedure, 4=It would slightly enhance the results, 5= It would significantly enhance the results)



Answer:

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