D1.3 MID-TERM REVIEW AND PROGRESS REPORT

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Executive Summary

This document presents the project progress until the first intermediary review. It is based on the paragraph 1 of the first periodic report.

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List of Acronyms

Acronym	Meaning
EC	European Commission
GA	Grant Agreement
WP	Work Package

Table 1. List of acronyms.

1 Objectives

ISOLA' objectives are divided into 4 main categories: Scientific Objectives (SO), Technological Objectives (TO), user-oriented objectives (UO) and impact making objectives (IMO). Each one of these categories, are further divided into specific activities that were followed in order for the consortium to be able to achieve the associated objective.

Scientific Objectives (SO) and Scientific Activities (SA)

SO1. Data processing modules for threat detection

- SA1.1 Visual Analysis for Threat Detection: This goal of this activity is to perform identification of objects' presence anomalies (missing or stolen items or items suddenly appeared). It will also detect abnormal activities of individual passengers that possibly are a threat for security. The objects and actions that need to be detected were defined at the first version of user requirements. This module will receive input from different sensors (cameras on drones, cameras on-board etc.). During the first period, the first round of gathering visual content from publicly available datasets or from ZEUS was completed. The first version of object detection and abnormal behaviour tools are ready and the first results are produced. Further improvements and refinements will be added during the next periods and will be compared to the State Of the Art.
- SA1.2 Data processing at the edge from multiple sensors and sources: The goal of this activity is to develop a platform capable to receive and process data from different sources and process them for further usage and distribution. Two versions of the message bus have been deployed to receive data from all services and process them accordingly. The first version was just to test the connection of all services and the second version was a cloud instance, which includes the final structure of the message bus, which will also be installed locally on the main server. This cloud version was used to test the connection between different services. Six different integration scenarios were designed and a successful flow between the services achieved, using dummy data at this stage. Finally, this activity includes a visual analysis at the edge, which performs face detection and recognition of passengers and crew members. The performance of the face recognition algorithm is also tested on a device, which runs at the edge and compared to the classical solution.
- SA1.3 Crowd Monitoring from visual content: The goal of this activity is to detect the number of people and abnormal crowd behaviour. More specifically, after discussions with the end users and the production of the first version of the user requirements' deliverable, this module will have to detect the presence of people in a specific area, the number of people in a specific area and the abnormal behavior of a group of people in a specific area. The first round of gathering visual content for training the algorithms from ppublicly available datasets is also completed. The first version of the algorithm is ready and the initial results are produced. During the next period further development

will occur and the results of this module will be compared to the State Of the Art solutions.

- SA1.4 Passenger and crew identification and tracking system: The goal of this activity is to track and map movements on-board. Two different technologies of tracking movement are tested in a controlled environment. Both solutions managed to track people by using wireless sensors and both have advantages and disadvantages. The final solution will be selected during the next period according to the needs of the maritime environment, which has many restrictions and the successful implementation of the system in such conditions considered as a challenge.
- SA1.5 Hazard dispersion prediction and reporting: The goal of this activity is to predict how a hazardous substance (detected by the air quality monitoring system) will spread on-board. The development of the prediction models and the design of a GUI has started.

SO2. Multi-level semantic enrichment, reasoning and fusion methodologies for intelligent event detection

- SA2.1 Data harmonisation, semantic representation and ontology creation: The goal of this activity is to develop a flexible and modular ontology-based framework for semantically representing all information pertinent to ISOLA, such as multi-modal sensor observations and domain knowledge. The first version of the ontologies is created, which was also participated in the integration tests and many discussions have been made to conclude to the inputs and outputs of this module.
- SA2.2 Integration layer and Multimodal indexing of heterogeneous data: The goal of this activity is the creation of the appropriate indices to allow the querying and efficient retrieval of the stored multimodal data. The development of the first version of the multimodal indexing has begun, which was also participated in the integration tests and the inputs of the module have been defined.

SO3. Early Warning & Decision Support Systems

- SA3.1 3D-visualisation of early warnings: The goal of this activity is to comprise a set of interfaces and HMIs that allows the visualization of information to improve the understanding of the end - user and identify possible solutions in many different scenarios related to early warning signals. Until now, two graphical user interface proposals are completed and the first ship is modelled and textured in 3D. Finally, the first version of the Visualization module for Windows and Android is developed.
- SA3.2 Early Warning & Ship Crisis Assessment Algorithms for Decision Support: The goal of this activity is to develop an assessment and warning model that will form a component of the decision support system that will manage in real-time the ship's and passengers' security system. A solution for the software component based on requirements is designed, an architecture of internal component services are drawn and the development started of the main internal services for providing decision support interactions.
- SA3.3: Crisis classification: The goal of this task is to perform a real-tile threat and vulnerability analysis to assess the consequences of the potential and identified hazards and classify the crisis in the proper category. The architecture of this module and the

mapping of the type of variables and data that will be utilised from the other ISOLA services are defined and designed.

TO1: Tools and services to enhance ship security capacity

- TA1.1: Secure Boarding System: The goal of this activity is to enhance access control and embarkation monitoring measures. Two modules are designed for this activity. A mobile app and a boarding kiosk. For the mobile app the personal data capture and the Bluetooth data exchange for secure boarding are designed and implemented. The face recognition algorithm is integrated in the boarding kiosk.
- TA1.2: Data acquisition from UxVs: The goal of this activity is the deployment of a tethered Unmanned Aerial Vehicle (UAV) and an Underwater Unmanned Vehicle (UUV), which provide an overview of the situation outdoors of the ship. Concerning the UAVs, the development and configuration of the tethered drone has started and the final design is available. In addition, a mission drone will also be provided by ACCELI to ISOLA project in order to increase the level of security that is provided in this project and for research purposes in collaboration with CERTH and the visual analysis algorithms. Finally, considering the UUV, the multi-beam sensor and side scan sonar are installed on the UUV and the results of the first tests will be available during the next periods.
- TA1.3: Mobile apps monitoring (and crowdsourcing): The goal of this activity is the development of mobile applications that receive input in the form of reports from passengers and accepted disseminated output from the early warning messages module. The 3rd version of the interface, the role based login and the implementation of the interaction menu are being implemented. The feature of the 3D ship location viewer has also started.
- TA1.4: Monitoring system of water and air facilities: The goal of this activity is the robust monitoring system against possible chemical hazards by triggering alarms, thus raising a security issue to the occupants of the ship. In this context a handheld and a fixed chemical detector will be provided, which monitor the luggage and the air ventilation system respectively for Toxic Industrial Compounds (TICs), or other volatile organic compounds (VOCs) that can either be directly harmful to passengers or can act as indicators of illegal activity. The design and development of the 1st prototypes has started and is also tested in the integration tests and in close collaboration and bilateral remote tests with hazard dispersion prediction module (SA 1.5).
- TA1.5: High-level control of a swarm of UAVs used for monitoring: The goal of this activity is to configure, launch and monitor a swarm of UAVs to support situational overview of the ship. Autonomous path planning activities are also included. The design and implementation of automatic control of a swarm of drones has started.
- TA1.6: Data Acquisition from the ship's legacy systems: The goal of this activity is to collect information from a number of systems that are crucial for monitoring a ship's condition. The development of embedded code for acquisition of the selected sentences

and the development of relevant services and APIs needed for the communication link have started.

TO2: Smart interaction with the passengers and intelligent report system

- TA2.1: Security risk management modelling for enhanced preparedness: The goal of this activity is to create a comprehensive review of existing security procedures and models and facilitate decision support in close collaboration with ontologies. The design of the first version has already started.
- TA2.2: Warning (message) generation to the occupants: The goal of this activity is the development of natural language generation techniques to automatically create warning messages in the event of a crisis. The component to match the risk modelling user requirements is designed.
- TA2.3: Deployment of ship crew solutions and mitigation actions: The goal of this activity is to review and analyse the existing SOPs for deployment of ship crew in case of crisis and identify existing shortfalls and key processes and procedures that can be automated in order to decrease the reaction time and improve coordination among crew member. This activity started at the last month of first period.
- TA2.4: Generation of an intelligent reporting-logging system: The goal of this activity is the development of an adapted metadata based archive for the system. This activity stated at the last month of first period.

TO3: Platform development & System Integration

- TA3.1: Technical requirements and platform development roadmap: The technical requirements were defined based on the user requirements after several refinement iterations. Based on the technical requirements the inputs, outputs, programming languages, dependencies (soft and strong) and critical factors where defined for each task/service. The development roadmap has been designed and is clear for all partners of the consortium.
- TA3.2: System architecture development and security requirements: The platform's architecture was designed based on the technical requirements and dependencies of the technological solutions. Four different versions of architectures were designed and discussed before concluding to the final one. The connections between the services and their dependencies were defined by creating: (i) a general flow diagram, which depicts the flow of information in ISOLA platform, (ii) more specific flow diagrams, which depict the flow of information between major technological solutions and (iii) flow diagrams specifically for each use case. Finally, the physical components and how they will form the final ISOLA platform are defined.
- TA3.3: Dynamic Vulnerability Assessment and Testing Service (DVATS) (Cyber security): The goal of this activity is to reveal the presence of vulnerabilities in ICT systems and infrastructure at passengers' ships. The module is ready to participate in PUC5.
- TA3.4: System integration: The goal of this activity is to integrate a system with many different sensors and smart agents producing a huge heterogeneity of data, and using many data processing services to integrate and provide relevant information through an

advanced interactive user interface. All the services connected to the message bus and the majority of them successfully participated in the 6 different integration test scenarios namely:

- Scenario 1 : Piracy incident (Small boat detection)
- Scenario 2 : Cybersecurity
- Scenario 3 : Illegal Boarding
- Scenario 4 : Chemical Dispersion
- Scenario 5 : Face recognition during incident
- Scenario 6 : Search for an object under ship's hull

- TA3.5: Interactive User Interfaces: The goal of this activity is to design software applications for crisis response and management is a challenging task as it supports important work processes and decisions. The 3rd version of GUI is finished and the 3D modelling of the one vessel is almost finished.

UO1: User requirements

- UA1.1: Use case design, stakeholder engagement and user requirements: This activity demonstrates the achievement of the innovation objectives in ISOLA by implementing 5 pilot representative scenarios that target real case data coming from heterogeneous data sources and the resulting decision making and responses that occur that cover a broad range of security-related situations. The PUCs are designed and described after the appropriate research.
- UA1.2: Security requirements: Discussions have been made to ensure the highly demands of the ship security practitioners to enhance and augment the security of passengers' ships and protect them from different threats onboard. Those requirements are defined in the first version of the CONOPS and users' requirements deliverable.
- UA1.3: Ethics and legal framework: The goal of this activity is to ensure the ISOLA engages in responsible innovation practices, CENTRIC will develop a legal and ethical framework to scaffold design and conduct an ongoing impact assessment.

UO2: Pilot design, implementation and evaluation

- UA2.1: Development of the validation scenario and evaluation methodology: The work done during the first period, which is also applicable to all WP8 Tasks includes the following:
  - Work program methodology (Inputs / Processes / Outputs / Risks / Dependencies / Timeframes) analysis conducted from the WP Leader and explained to all partners to set the basis of a common understanding especially to those not familiar with the marine Environment
  - WP2 outcomes collection and exploitation
  - Focused questionnaires issued and addressed between End Users and technology providers. These questionnaires aimed to the mutual understanding of requirements, restrictions, and time frames limitations of both partners' categories:
    - End Users Questionnaires addressed to Technology Partners.

- Technology Partners Questionnaires addressed to End Users

All partners responded accordingly and provided each other with the requested information, documents etc.

- The research techniques utilized are institutional documentation and literature review, periodic meetings, desk workshops, P2P Discussions, interviews with subject matter experts etc.CY-MoD (AVERSA, CYBERLENS, CELESTYAL) Working Document (PUC5 Evaluation Methodology)
- Scheduling of vessels allocation by type, by name, drawings / plans and the provision of other information requested to End Users, site survey visits, PUCs rehearsals along with special requirements and logistic support to Technology providers.
- Project Management Functions

- UA2.2: Field demonstrations, testing and training: This task is being planned upon the ISOLA Software to be developed, according to the evaluation methodology and validation scenarios, providing for their distant training on the platform's functionalities and use, table-top exercises, dry-runs and rehearsals. Although the task starts on M12, segments for users training needs are highlighted through the system capabilities definition and PUC's demonstration roadmaps. ISOLA Software Package is designed to embody Users' Training needs.

IMO1: Dissemination and collaboration

- IMA1.1 Dissemination of project results: The goal of this activity is to disseminate the project to ship security authorities, travel agencies, security, medical, and cargo ship agencies, civil municipalities, governmental institutions and laboratories and other related to the maritime stakeholders in order to promote project's uptake. ISOLA project participated and presented its goals in Project to Policy Kick-Off Seminar (P2PKOS) that was organized virtually by Research Executive Agency (REA) on March 22 & 23, 2021 and also inthe Workshop - Horizon Border Security Projects, which was organized by FRONTEX on 20-21 May 2021.
- IMA1.2 Collaboration: The goal of this activity is to build networks and collaboration with other projects and stakeholders ensures a proper exchange information and ideas and enriches the project results and outcomes. ISOLA participated and discussed on topics for possible collaboration with H2020 project "PALAEMON – A holistic passenger ship evacuation and rescue ecosystem" in its 2nd Workshop on Evacuation, which was organized in 14 April 2021.

2 Explanation of the work carried per WP

2.1 Work Package 1

2.1.1 WP activity and outputs during the first 12 months

The objectives of this WP are to manage the project to time and budget, to co-ordinate the activities, to monitor and adjust the implementation plan if necessary and to monitor the data management and the ethics. In this context, online meetings occur every two weeks for the majority of WPs. A plenary meeting happened in M6 of the project to monitor the progress of all WPs and tasks. The achievements are that the project reached its goals for the 1st reporting period and the deliverables were submitted.

Task 1.1: "Project Management and Coordination"

During the first year of the project, this task was committed to the definition, implementation and monitoring of the appropriate procedures for quality assurance. More specifically, the goal was to coordinate activities between:

- The research and the technological development work packages
- The assessment of work and achievements of the deliverables
- The management of project risks and associated contingency planning
- The organization of the management and technical committee meetings and AB.

Task 1.2: "Project Administration, reporting and Financial Management"

Six months after the beginning of the project an internal financial reporting occurred to monitor the financial activities of the partners. In highest priority was also the management of:

- The intellectual property rights (IPR)
- The data protection and the generated knowledge
- Compliance with obligations under the EU Commission Grant Agreement
- The Project Management Board (PMB) and AB
- The resources use and financial expenditures
- The maintenance of records and financial accounts compliant with time frames
- The compilation of partner inputs to management and contractual reports
- The definition, implementation and monitoring of the appropriate procedures for quality assurance

Finally, the reporting to Commission for 1st year of the project will be delivered on time.

Task 1.3: "Quality Assurance and Risk Management"

During the first year of the project, the quality assurance guidelines for research and development carried out within the project were developed and described. Furthermore, reporting periods were established in order to detect risks and take corrective action if necessary. In this reporting documents, a shared risk log was created, containing descriptions, analysis and strategies for reducing risk in the project, which will be maintained by the PM team and regularly updated. These steps ensure that the project's developments are compliant with existing ethical standards and guidelines.

Task 1.4: "Scientific and Technical management"

During the first year of the project the goal of this task was to ensure that the project meets the requisite scientific and technical quality standards. This is why the technical manager participated in all meetings of the project to monitor the progress of each WP and have a general view of the project. Bi-weekly technical meetings are scheduled for all technical WPs, where

discussions are made on the technical and scientific progress of all the technical tasks, to report the progress of each WP and set new short-term goals until the next meeting. At the beginning technical remote meetings with all technical partners occurred every two weeks. After a few months, the technical remote meetings were integrated into WP7 remote meetings, because in this WP the roadmap, architecture, integration and prototypes are also discussed. There was a very close collaboration with WP2 to understand users' needs and extract the technical requirements based on the users' requirements. The platform's architecture was designed after four different versions, which were discussed and changes according to technical partners' suggestions. The participation of all services in each PUC is scheduled, so all the technical partners know where they are going to be tested. The major platform's development steps were also proposed and every technical partners agreed with this. Furthermore, each technical task was divided into subtasks with specific deadlines to organize the workload more efficiently. The technical manager designed and presented the 1st Integration Scenarios, to test the connectivity between the technical modules/services. Finally, the monitoring of all technical WPs and tasks was also achieved by gathering technical reports from all WPs every 3 months. Those reports included the progress, the risks and possible deviations or delays.

Task 1.5: "Data Management"

Research data management is a key element of ISOLA given the reliance of the proposed system on capturing information, processing it effectively and transforming it into outcomes that can lead to an improvement in the ship's security situation. In the first period, ISOLA has initiated the first version of the data management plan which set out the processes for data management within project and analyzed the actual and envisioned datasets that will be used within the project. This was delivered in D1.2 at M6. Each WP was reviewed, and each partner produced an analysis of the data that will be processed within their task(s). As the use of most data arises within components that reside in EU-RES deliverables a separate log of these actual and proposed datasets and their usage is being maintained separately to that which is included in the deliverable.

Task 1.6- Research Ethics and Data Protection Monitoring

T1.6 is responsible for managing research ethics within the project and ensuring that any data collection activities are compliant with data protection and privacy laws. In this first stage, focus has been on support the delivery of the tasks within WP10 and identifying where there is crossover between ethical considerations in research ethics and those under review through T2.4 that will also include the ISOLA operational system. The next stage is ensuring that robust processes are in place that are customized to each piloting activity – that is updating all participant information sheets, consent forms, data processing consent, and identifying any specific ethics issues related to the actual implementation of the pilots.

2.1.2 Deliverables of WP1

- D1.1 : Project Management and quality assurance plan

- D1.2 : Self-assessment & data management plan v1
- D1.7 : Project collaboration tools

2.1.3 Deviations of the WP compared to DOA and justification

No deviations to be reported for 1st period

2.1.4 Publications for the WP

No publications to be reported for 1st period

2.1.5 Risks for the WP

No risks to be reported for 1st period

2.2 Work package 2

2.2.1 WP2 activity and outputs during the first 12 months

WP2 aims to engage the end-users in an effective process to do the following in dependency relationship between them and in hierarchical order:

- Examine the historical and statistical facts about security incidents on passenger ships
- Collect the fundamental legislative and regulatory documentation that structures the compliance framework of ships security
- Collect institutional documentation, regarding security Policies, Ship Security Risk Assessment (SSA), Ship Security Plan (SSP) and the related Standard Operational Procedures (SOP), Emergency Response Plans and Checklists, to prevent and respond to security incidents onboard
- Summarize the essentials of currently implemented procedures to define the currently implemented Concept of Operations (CONOPS), crosscheck compliance and correlate these CONOPS essentials with the prevailing legislative and regulatory framework
- Examine the efficiency of currently implemented CONOPS to extract possible Mission Needs or Users' Operational Capabilities' Gaps that need to be covered in order for crews and security personnel to fulfil their Mission effectively

- Define from the very beginning of the ISOLA Platform's development the Ethics and EU legal framework that the Platform must comply with to protect sensitive personal data
- Interpret these Users Capabilities' Gaps in general Users' Operational / Functional Requirements from the ISOLA System to enhance their capacities and security operations' efficiency
- Prescribe the five (5) attainable and realistic Pilot Use Cases Scenarios (PUC), which will include almost all potential security threats and upon which all relevant ISOLA System's capabilities will be tested
- Refine and finalize the ISOLA Platform's Ethics and EU legal framework that the Platform must comply with to protect sensitive personal data taking into consideration the Users' operational requirements and the representative PUCs prescription
- Define the final Users' Operational Requirements, including ISOLA System's functional specifications, by setting the threshold (minimum) and objective (desired) values for the Evaluation of the ISOLA System, taking into consideration individual offered technologies' TRL and capabilities that will be tested during the PUCs Demonstrations and Operational Tests
- Define the final Concept of Operations for security on-board with the utilization of the ISOLA System

The work done during the first period of the project, which is applicable to all WP2 Tasks includes the following:

- Work program methodology (Inputs / Processes / Outputs / Risks / Dependencies / Timeframes) analysis conducted from the WP Leader and explained to all partners to set the basis of a common understanding especially to those not familiar with the marine Environment
- Use Cases (D2.1) / CONOPS (D2.2) / User Requirements (D2.3) Development Methodologies essentials and work path explained from the WP Leader to all partners
- Fundamental documentation (legislative and regulatory framework, Ships' Policies, SSPs, SOPs, Check Lists, Maritime Security Company's SOPs) collected, crosschecked and correlated with each other to set the basis of the whole project and avoid roll-backs and undesired waste of time and effort
- Focused questionnaires issued and addressed between End Users and technology providers. These questionnaires aimed to the mutual understanding of requirements, restrictions, time frames limitations of both partners' categories:
    - End Users Questionnaires addressed to Technology Partners.
    - Technology Partners Questionnaires addressed to End Users

All partners responded accordingly and provided each other with the requested information, documents etc.

- The research techniques utilized are institutional documentation and literature review, periodic meetings, desk workshops, P2P Discussions, interviews with subject matter experts etc.
- NTUA (author), AVERSA and BDI cooperated to a Working Document, which includes historical and statistics data, legislation and regulatory framework summary, Users basic security functions, envisioned ISOLA System advantages/benefits to End Users etc.). This document was a working tool and input for all the deliverables of WP2.
- Vessels allocation, drawings / plans and information provided by End Users
- Project Management Functions

Task 2.1 "Use Cases Design"

Five (5) attainable and realistic Pilot Use Cases (PUC), according to the assessed security risks, scenarios were developed, including the most possible, as well as alternative steps flows and timelines of security trigger events, systems' alarms and suggestions to Users, Users interaction with the System and relevant updates depending on the situation evolvement. The scenarios refer to:

- PUC1: Passenger using or misplacing toxicant / illegal substance and demonstrating violent or provocative behaviour. Illegal substances boarding attempt.
- PUC2: Shoplifting incident in a vessel's shops and unattended, possible dangerous, item in ship's restricted access area.
- PUC3: Piracy Attack, Armed Robbery Attempt and Underwater Suspicious object attached on vessel's hull detection
- PUC4: Illegal Boarding attempt or Illegal access in restricted areas on-board
- PUC5: Cyber Security

Task 2.2 "CONOPS and Security Provisions"

Historical and statistical data, the legislative and regulatory framework, Company's Policies, SSA, SSP, ship crew's and security personnel's SOPs were studied and the essential information for the operational environment, all security threats and the currently implemented security functions on passenger ships described in a single document. This document is the currently implemented Concept of Operations (CONOPS v.1) on-board ships without the use of an innovative System like ISOLA.

CONOPS v.1 is structured relevantly to a "Use Case Scenario – per security threat" form, already prescribed in five (5) distinctive PUCs. It includes all possible security threats, according to current risk assessment on-board, and provides the stepping-stone of ISOLA

System's utilization for an applicable improvement of passenger ships' Security. It is the basis for the future work of an advanced CONOPS v.2, with the utilization of ISOLA System and its interactions with the End-Users.

Task 2.3 "Stakeholder Engagement and User Requirements"

The Users Requirements Table was prepared, which took into consideration in hierarchical order the historical and statistical data, prevailing legislation, SSA, SSP and the currently implemented SOPs to describe the Company's and Security Personnel's Mission, their Mission Needs or Capabilities Gaps that expect to be covered to fulfil this Mission and finally the Users' Operational Requirements from the ISOLA System to enhance their capacities and operations' efficiency towards their Mission fulfilment. This table was continuously updated to its interim and final version after iterative discussions.

The currently implemented Concept of Operations (CONOPS v.1) on-board ships set the basis of examination of the Company's, crew's and security personnel's Capabilities Gaps. These Capabilities Gaps were initially assessed with the use of Doctrine, Organization, Training, Materiel, Leadership (and Education), Personnel, Facilities (DOTMLPF) factor structure of the Capabilities Gaps Analysis) and defined the User's Operational Requirements from the ISOLA System.

The Capabilities Gaps and the consequent Users' Operational Requirements were structured in a relevant to the five prescribed PUCs form. Users' Operational Requirements are guiding Technology providers to develop their individual technologies and integrate them into a System that will enhance Users' capacities and will help them in the following distinctive domains:

- Situational Awareness (surveillance, detection, early warning)
- Decision Making Support & Suggestion for Action
- Communication & Reporting
- Protection of Evidence

Task 2.4 "Ethics and Legal Framework"

The prevailing Ethics, Legislative and Regulatory framework of the EU has been taken into consideration and initial general guidelines have been given to all partners from the beginning of the project. Specifically, it was examined:

- The legal environment relating to Maritime Operations and the security context of passenger ships
- The ISOLA context from the Ethics and Legal Framework perspective
- Possible legal implications relating to the five (5) selected PUCs
- Passenger's personal data management and data protection
- Further ethical considerations

2.2.2 Deliverables of WP2

The following Deliverables were delivered with no deviations:

- D2.1 : Use Cases Prescription
- D2.2 : CONOPS for Security Operations on Passenger Ships v1
- D2.3 : User Requirements and Security Environment Report v1

2.2.3 Publications for the WP

No publication to be reported for first period.

2.2.4 Risks for the WP

No risks to be reported for first period.

2.3 Work package 3

2.3.1 WP3 activity and outputs during the first 12 months

The primary aim of this WP is to customize and deliver existing commercial multiple sensor systems in key points in the ship infrastructure, providing continuous real-time monitoring of the ship. Also, in this task the control of different UxVs will be implemented. During this first period, the tasks have initiated their efforts in line with the definition of user requirements in WP2. Individually they have done a specific analysis for the use cases. Finally, the components have also been designed with the objective of ensuring efficient flow of messages and data as reflected in the system's architecture and first prototype.

Task 3.1 "Secure Boarding"

For this first period the development of two main systems are considered, which are the Kiosk Application and Mobile App.

First, the Mobile App will be an application in the hand of passenger with the objective of collection all personal data including picture and will allow its owner to embark on board. The collection of Personal data associated with picture will populate a database required by other devices. The secure boarding task includes also the control of passengers' identification. That's the reason why a library will be included in the app that can read information on an ID card or a passport (reading of MRZ Machine Readable Zone or embedded chip if any) and will be able

to compare the picture on the ID document with the picture capture by the app. The Biometric Data remain in the smartphone.

The Kiosk is an application for a workstation connected to a camera. The workstation connects with smartphone in its neighborhood. The Kiosk uses the set of Biometric data of connected smartphone to identify passengers in the flow. Non identification of a passenger generates an alert. Until now Face recognition algorithm has been included and the generation of alert has been implemented and tested with ISOLA message bus. As the usage of Biometric Data is considered as sensitive data, a Privacy Impact Analysis (DPIA) is considered in accordance with GDPR rules. The CNIL's template for this objective was used.

In second year the development of the modules will be pursued. Particular efforts will be given to deliver outputs that can be handled by ships' personnel. It is very important to adapt the Kiosk behavior considering data flow, conditions of use and duties of security officers.

Task 3.2 "Data acquisition from UxVs"

ACCELI provided a fully customized Mission UAV, able to accommodate the various hardware components (e.g., height/distance sensors, cameras) in order to execute smart algorithms (e.g., visual object detection and collision avoidance services, algorithms for swarming), and generally to be easily adapted to the current operation by the user. ISOLA Mission UAV will be capable to perform on-board image processing, making use of machine learning-based techniques (in collaboration with visual analysis module) obtained from the various aforementioned sensory inputs. The computations will be executed on the on-board supercomputer, which delivers improved AI performance at a small size, making it ideal for mobile robotic applications.

The status of this subtask is:

- Configuration and adaptation of ACCELI mission UAV on ISOLA use case scenarios
- Configuration of embedded GPU for edge processing scenarios
- Hybrid operation depending on the availability of ISOLA control center or not

Further to this, ACCELI developed and configured a fully customized tethered UAV, able to accommodate the various hardware components (e.g., height/distance sensors, cameras) and to provide video and images in a 24/7 mode. The proposed tethered drone will be able to provided surveillance operations from high heights (40 m from the tallest part of the ship) and it will be able to be easily adapted to the current operation by the user.

The status of this subtask is:

- Development and configuration of ACCELI tethered drone. Final design of ISOLA Tethered UAV is available

MST provides an Autonomous Underwater Vehicle (AUV) able to autonomously inspect the underwater environment around the ship and port for any suspicious underwater AUVs or divers that may sabotage the ship, during the embarking and disembarking stages. The multi-beam sensor and side scan sonar are installed on the UUV.

Task 3.3 "Crowdsourcing and mobile apps monitoring"

The implementation of the third version of the interface is started and now emphasis is given on role based login. Furthermore, on the implementation of the interaction menu is in progress. The development of the 3D ship location viewer has also started and successfully initiated the communication with message bus. Finally, the mobile communication with the message bus and the relevant OS has started.

Task 3.4 "Monitoring system of air facilities"

The performance requirements in PUC4 have been specified regarding the use of fixed/handheld chemical detector (contribution to deliverable D2.1). The target compounds have been defined and studied of their physicochemical properties for selecting the appropriate detection technology together with sampling and analysis methodology. We have defined vapor sampling rate based on PUC requirements. We have designed and developed first prototypes of the handheld (T4i X-Machina) and fixed chemical detectors (T4i ATMOS) serving Milestone 2 – 1st ISOLA prototype. The chemical detector message structure has also been defined (in collaboration with PRO) for integration with ISOLA message bus. We have prepared and executed preliminary field tests and measurements using the handheld and fixed chemical detectors that have given feedback for optimization and further improvements.

We have done the assembly of calibrator (T4i FemtoMachine) for supporting the validation of T4i ATMOS and T4i X-Machina, whilst serving ISOLA objectives we have developed a communication module development and tested T4i message post service on IBM message bus and consumption by other ISOLA stakeholders. We have delivered the first version of the chemical detectors' UI for control and data acquisition.

Task 3.5 "High-level control of a swarm of UAVs used for monitoring"

This task focuses on the design, development, and deployment of a platform for operating various kinds of automated drone flights. The main focus within it is to develop capabilities to automatically execute not only single-drone missions, but rather missions involving a swarm of drones. The developed capabilities are generic such that they enable the deployment of different kinds of missions using the same infrastructure. Capabilities will be demonstrated in the ship safety / security domain within the ISOLA project, nevertheless its applicability goes beyond this single field.

This task interacts mostly with two additional ISOLA components, namely the path planning as an input and the image analysis at the output. The path planning tool devises the waypoints to be followed by a specific mission and sends that information as an input to the drones' platform for the creation of orchestrated swarm missions. The main artifact of a drone mission is the imagery and associated metadata collected during the flight, which is to be sent to the image analysis component. The support for both of these interactions was designed and implemented in this reporting period. Agreement was reached with the path planning team as to the structure of the message constructed by the path planners and transmitted to the drones' platform. In essence the message represents an array of arrays of waypoints, representing the

flight paths of a drones swarm. On the output side, the drones' platform shall store the imagery in an appropriate data store and shall send a message containing the link from which the image analysis team can retrieve the data. We did conduct discussions with the visual analysis team to align capabilities and clarify requirements, and data sets.

An additional line of progress was performed for the design and development of basic capabilities for the integration test. That thread of work constitutes developing a stand-alone server that communicates with the message bus as a consumer and as a producer, independently from the drone's platform server, thus, a message bus producer and consumer, to interact with additional components, was developed and deployed. This server receives input messages from the path planning team, and interacts with the main drones' platform server via its REST API, initiating a swarm of drones' mission. On the output side this communication server shall be used for sending information about imagery to the image analysis component (via a drones platform server component named analysis plugin). Overall communication in both directions has been established.

Progress towards the main goal, namely, design and development of a server component to enable orchestration control, is at the center of the task progress. The higher level focused on design and initial development of the major component, namely, server component to support swarms, orchestrator to implement the swarm support within the server, web app extensions to configure and monitor swarm missions, and mobile app extensions to support participation in swarm missions. At a first stage an initial implementation of the orchestrator server component to control and supervise swarm mission was developed. This component added support in the server for swarm in addition to single drone missions. That was followed by the design (programmatic and UI) and development of extensions required to the web dashboard component to configure, monitor and present orchestrations (swarm missions). In addition, design and development of extensions to the mobile app as a part of the swarm control mechanism was established.

Once an initial version of the swarm capabilities has been achieved, simulated tests of an orchestrator controlling a swarm of drones were performed. Tests exercised the different components using drone simulators for debugging and safety purposes, rather than immediately deploying and testing on real drones.

This task provided requirements / requests from end-users for the demonstrations, for a successful deployment and exercising of developed capabilities in the relevant use cases. This task is expected to participate in pilots - PUC3, and PUC4.

Task 3.6 "Connection with the ship's legacy systems"

The progress of the Task 3.6 in the 1st year of ISOLA project is referenced below. In-depth discussions between partners were held, to define system specifications based on specific sentences from indicative systems normally found onboard. Then, embedded code was developed for acquisition of the selected sentences. Also, development of relevant services and APIs needed for the communication link. Investigation was conducted on alternative architectures for the installation (with and without onboard server). The prototype testing was successfully performed, based mainly on simulated data and focusing on system interconnection. Furthermore, based on refined requirements system development on an

embedded and hardware basis was further progressed. Finally, preliminary design an alternative hardware.

2.3.2 Deliverables of WP3

No deliverables for first period

2.3.3 Deviations compared to DOA and justification

We add a control of Passengers identity to fulfil user requirement which was not scheduled by the original DoA. IDEMIA has succeed to mobilize enough resources to have no impact on deliveries of Secure Boarding. Extra expenses has been reported to coordinator.

2.3.4 Publications for the WP

No publication to be reported for first period.

2.3.5 Risks for the WP

No risks to be reported for first period.

2.4 Work package 4

2.4.1 WP4 activity and outputs during the first 12 months

The objectives of this Work Package are receive input data from many different sources and perform processing and analysis algorithms on then either on the main server or at the edge. More specifically, WP4 consists of the tasks:

(i) Data collection and processing at the edge from multiple sensors and sources,
(ii) Visual analysis for threat assessment
(iii) Crowd monitoring from visual content
(iv) Passenger and crew monitoring system
(v) Hazard dispersion prediction and reporting from sensor data.

Task 4.1 "Data collection and processing at the edge from multiple sensors and sources"

This task started off by contributing towards a refined platform view of the architecture, with specific focus on designating the proper role for the message bus in the overall architecture; along with determining the necessary capabilities provided by this service. A second focus was towards fine tuning the proposed architecture concerning information exchange and flow among components. A description of intended service and interactions was presented at the architectural level to reach understanding on capabilities provided and interactions with additional components. Along with the architectural aspects, practical decisions were determined, by reaching agreement on base technologies to be used (specific technology for the message bus backbone with the data-interchange format as the generic technology for the

messages payload). A common message structure was created and agreed upon with all component owners (common header with the decided data-interchange format based body payload). Focus shifted towards establishing all the individual message formats to be used by different components. First, a better understanding of the data flow in the system was necessary to identify which components need to be interacting. Thus, information flows among components was clarified. With that understanding all components required to receive a specific message type along with the components required to produce these messages needed to reach agreement on the exact message format for them to be able to semantically interpret and parse a message received on a specific topic. This way this task helped establishing clear communication protocols between information producers and consumers. Consolidation of individual message formats (body) was encouraged, based on specific interaction needs between communicating components (acting as consumers and producers).

To start exercising the establishment of connections between components and the platform back-end and support initial integration among components, by enabling the flow of messages across different components, early on in the project lifetime a sample cloud based deployment of a message bus instance was deployed and made available to project partners. Along with the message bus deployment, a sample implementation of message bus client usage was made available for several programming languages in preparation for the integration test. This sample served as an example for all components, including those written in other programming languages.

In preparation for the integration test, and laying the ground-work for future demonstrations and platform usage in general, a deployment of a full-blown cloud based message bus was carried out, supporting all agreed upon topics. This deployment served as the corner stone of information flow among components in all integration scenarios carried out.

This component shall participate in all planned pilots, and specific support for PUC5 was already discussed and put in place.

Furthermore, this task includes the face visual analytics on an edge device, to search in real time for specific people in case of emergency. During the first period, the code transfer from the x86-64 architecture to the edge device architecture was performed. The transfer includes the program workflow, detectors for face and pedestrian and the recognition algorithms for face. After code transfer, full test cycles were realized to compare the detection and recognition results on both architectures. In summary, the results for the face and pedestrian detections and the face matching were the same. In a second step, the processing speed of the implementation was optimized. Hereby, the throughput of the device was increased from two stream channels to three ones for high object density streams and to five stream channels in case of low object density streams.

A further development step was to implement a synchronization interface between the machines with x86-64 architecture and edge architecture machines. It was decided that synchronization could only be performed from a master to one or more clients. This means that the master is always a machine with x86-64 architecture. The clients can be machines with x86-64 architecture or edge architecture. Only the watch-lists are synchronized on the machines. The interface is designed so that the machines do not have to be based on the same algorithm version. Finally, this visual analytics module was connected with the ISOLA message bus. First tests with other partners were successfully passed.

Task 4.2 "Visual analysis for threat assessment"

The main objective of this task is to use all the available information from visual content (cameras on board, CCTVs, cameras on drones) to perform analysis via deep learning algorithms and detect potential threats to the ship's and passengers' security. The main subtasks of this task are:

- The detection of objects that may be threat to the ship and its passengers such as boats that are approaching the ship with potential pirate intentions or detection of missing objects during a theft incident etc. Object detection has been witnessing a rapid revolutionary change in the field of computer vision. The goal of this technique is to determine where objects are located in a given image or video.
- The early detection of abnormal people's behaviors, that may also be threat for the rest of the passengers such as people under intoxicated conditions or people that have consumed alcohol. These people will have strange behaviors such as staggering or stumbling. Another example are people that during the boarding procedure want to bypass the security control and run towards the entrance.

At first stage a lot of discussion have been made with partners from WP2 to clarify the types of objects and behaviours that have to be detected by visual analysis module. After the determination of the conditions and the Pilot Use Cases, the critical step was to find the appropriate and available datasets to train the algorithms accordingly to take the required outcome.

This was and remains a hard process for this task because there are not many available datasets that can be used to detect for example small boats that can act as pirate vessels.

Due to the fact that in a real-world surveillance environment most of the images/videos are at a distance, blurred or in small resolution this makes this process of finding the proper dataset very difficult. A crucial part in the achievement of this task's goals played our partner ZEUS, which provided two types of datasets that include small boats. The first one was samples of photos and videos, which they have acquired from their years of experience in the ship's security domain, and which were provided to the visual analysis team for the needs of the project. The second one was photos and videos that they have planned and retrieved from the field also for the needs of the project. Those datasets are very important also for the Technology Readiness Level of this module, which is trained on real data received from the field. Based on this input and all the other available data that were received from publicly available sources, the first version of the object detection module for small boats was trained and the first results are very promising. The module achieves to detect small boats in an image or video with very satisfactory accuracy for the time being. An algorithm that can be used either from powerful workstations or autonomous embedded systems is being developed. The next immediate goals for the object detection module is to populate the datasets with more content and improve further the accuracy and performance of the algorithms.

The detection of abnormal behaviour module also faced the same problem with the availability of datasets. There are several datasets but those that are from surveillance cameras are few and

even then, contain a few samples for each action. So the first challenging problem is that in real-world surveillance environments most activities occur at a distance with a small resolution and hence recognizing such activities is difficult due to scale problems. The second problem is that, while there are ready-made data sets with common actions such as running, it is much more difficult to find datasets for abnormal actions such as staggering or stumbling. There are not many available visual data that include the specific behaviours that the end-users asked for and there are even less with the appropriate conditions that the project demands. For example, during the boarding procedure the visual sources will be the drones that will scan the area for abnormal behaviours using their cameras. The available visual data from cameras in these distances or in that height are extremely rare and the training of the algorithms is a very difficult task. Nevertheless, the first version of this module is capable to detect with a sufficient accuracy some types of abnormal behaviours such as staggering or stubbing from cameras that are not from drones. This is very important for the detection of strange actions in case of intoxicated people inside the ship. The next step is to search and find more data that will also help in the detection of abnormal behaviour from drones.

Both object detection and abnormal behaviour modules were connected to the message bus and participated successfully in the simplified scenarios of the integration tests.

This task also includes the face detection and recognition module, which goal is to combine post-event processing with real-time processing. This was necessary to hand-over identified subjects from the post-event analysis to real-time searches. Hereby, interfaces had to be designed, implemented and tested to connect the post-event processing pipeline and real time processing. The development of the interfaces is finished. Furthermore, the design of a CNN architecture for human attributes started to be designed. First results regarding error rates were promising; however, further reductions of the error rates are anticipated.

Task 4.3 “Crowd monitoring from visual content”

This module has the goal to detect the presence of people in a specific area, the number of people in a specific area and the abnormal behavior of a group of people in a specific area. For example, in case of the boarding procedure. People are getting in line to check their tickets from the ship’s personnel. When they pass the check, they are moving to their cabins, to the lobby or other ship’s areas. The captain needs to know how many people are still waiting to get on board and how many there are in the lobby at this moment. This service will provide that information. An illegal passenger is also hidden in an area where no one can stay after the ship’s departure (i.e. the garage). This service will detect his presence and inform the next service for further actions. The end users also asked to provide information about the number of humans on board a small boat that is approaching the cruise vessel and perhaps is a piracy threat. The input of this module is either cameras on board, CCTVs or cameras from drones. The visual content is analysed by deep learning algorithms, which are capable to monitor an area, detect the presence of people and determine their number. The first version of this module is ready and with very promising results in terms of accuracy. This version was tested to detect people on board small boats, from a given dataset and to detect abnormal behaviour of a group of people (crowd). Further refinement of the algorithm’s parameters will improve both accuracy and performance and of course the enrichment of the already used datasets to train the model. This first version of the module was also successfully connected to the message bus.

Task 4.4 "Passenger and crew monitoring system"

The progress accomplished over the first 12 months of the project for T4.4 are as follows. The technical and user requirements of the monitoring system were defined create a smooth technical implementation plan. The monitoring system was named the Passenger & Crew Tracking system or PCT system for short. The development of the PCT was initiated in month 7 and is currently under way. Testing of the proposed technologies has started.

Task 4.5 "Hazard dispersion prediction and reporting from sensor data"

In the first 12 months of the project we have made progress on T4.5 in multiple aspects. In the development of the product, we have defined the user and technical requirements. We have also named the product 'HAVAC model'. Regarding development of the HAVAC model we have determined the necessary components and made a plan for their development. We have already accomplished creating the agent library to be used by the model. The connector and floorplan interpreter have been developed. The first version of the airflow and agent models have been developed to a stage ready for testing. This development progress has been continuously recorded through documentation. Progress of the server architecture and integration testing has been achieved. We have successfully received messages from the T4i sensor to the HAVAC model. The HAVAC model architecture and internal communication systems have been planned.

2.4.2 Deliverables of WP4

No deliverables for first period

2.4.3 Deviations compared to DOA and justification

No deviations to be reported for first period.

2.4.4 Publications for the WP

No publication to be reported for first period.

2.4.5 Risks for the WP

No risks to be reported for first period.

2.5 Work package 5

2.5.1 WP5 activity and outputs during the first 12 months

The objectives of this work package are firstly to deliver knowledge management, representation and linking of the collected data, to support interoperability and semantic reasoning for decision-making in all use case scenarios; secondly, to describe the framework of the integration (middleware) layer and multimodal indexing of heterogeneous data; thirdly, to consolidate methods and techniques enable to visualise data obtained for heterogeneous

sources, to assess and classify ship security events and to enhance decision making processes in a unified framework.

A system will integrate functionalities which are serving both the pre-emergency and emergency crisis phase. During the first period, the following have been achieved:

- The first iteration of the ontology has been conducted and thus the first stable version is capable of representing the relevant data and information at this stage of the system's development
- The first prototype of the adapter has been developed and tested against the database.
- Communication between modules has been successfully tested in specific PUC integration tests.
- A module for indexing and retrieval of heterogeneous ISOLA data has been implemented.
- Second version of the interface, GUI v0.2, was completed
- 3D model of the Hellenic Spirit ship was completed with basic functionalities
- Created the data models for providing event incidents structure, followed by key services for producing and interacting with the data models.
- Final architecture of the Crisis Classification module.
- Development of Use Case Diagrams for each PUC, which are being utilised for the development of the module's models.

Task 5.1 "Data harmonisation, semantic representation and ISOLA ontology"

The primary objective of T5.1 in overall is to provide the semantic infrastructure that will enable interoperability within the ISOLA system among the various sources at data level, enrich them with contextual information, discover inferred additional relationships that will improve the overall semantic and situational awareness and make this data accessible to the system as per the other modules' requirements.

Addressing the aforementioned objective of the task requires the aspects of it to be accomplished, the ISOLA ontology and knowledge base, a service for population and reasoning referred as Knowledge Base Service (KBS) and a query endpoint for semantically annotated information requests.

The ontology refers to a model that aims at semantically representing all notions relevant to the incidents, resources and tasks that are reported and handled within the ISOLA system. The ISOLA ontology is generally built in iterations and includes the total of the necessary classes to represent the related concepts from sensors and services. Additionally it is reusing resources from other ontologies when necessary to ensure the quality and exploit the advantage of reusability for cost-effective implementation and development of a complete knowledge base.

After analysis of the requirements from users and technical partners, the first iteration of the ontology has been conducted and thus the first stable version is capable of representing the relevant data and information at this stage of the system's development. Additionally the semantic models that will be used to fill the knowledge graph have been defined.

The Knowledge Base Service consists of algorithms that populate the ontology with the appropriate concepts and enriching the involved content with contextual information, which is saved in a graph database. The algorithms are for parsing, storing, inferencing and querying over the semantically enriched data with the connected endpoints. The knowledge graph along with the populating instances is hosted in a graph database which will perform semantic reasoning techniques.

The query endpoint will provide semantically enriched data to the system when it is necessary as per request from other components of the system. It consists of the graph triple store and an adapter which translates the requests into actual queries. This approach ensures security and efficiency when the information retrieval takes place. The first prototype of the adapter has been developed and tested against the database.

The communication and message exchange with the rest of the platform takes place through a message broker which is responsible for delivering the outputs and inputs among the various components of the systems. Intercommunication of T5.1 subtasks with the relevant system's modules has been successfully tested in specific PUC integration tests.

Task 5.2 "Integration layer and Multimodal indexing of heterogeneous data"

A service/module for indexing and retrieval of heterogeneous ISOLA data has been implemented. A database is used for storing, indexing and retrieval processes. Until know, the connection with the message bus for reading/posting messages and with another module through the message bus for sharing messages has achieved.

The first version for integration test has been implemented. It takes as input a message file, selects the Integration Scenario (Scenario 1, Scenario 2, Scenario 5 and Scenario 6) in which it belongs to, based on specific fields and file attributes, and outputs a message file for being available to another module.

A novel image retrieval method for indexing and retrieval has designed based on deep learning for feature extraction and unimodal hashing. Some open available datasets have been found for training this module. Some first results have been gathered compared with some state-of-the-art methods.

Task 5.3 "3D-visualisation of early warnings and the early warning module"

The purpose of this task is to develop a 3D visualisation module for displaying information from the ISOLA system and an early warning module for sorting, placement and representation of messages based on their content.

The 3D visualization module comprise of a set of interfaces that allows datasets to be processed and displayed graphically. Depending on each scenario the datasets received from the Message Bus improves the understanding of the end-user. The module assists the user by displaying real time data and location of a warning or hazard within the ship. This helps crewmembers identify faster possible solutions for each of the situations.

The 3D model of the Hellenic Spirit ship has been developed and implemented in the visualisation module. We have provided tools for rotating, zooming and panning the 3D model.

Additional functionalities have been developed to enhance the visualisation module's user experience. Floor selector has been added not to overcrowd the interface, see-thru functionalities have been added, colour coding for warnings, alerts and hazards are on the roadmap also.

The graphical interface has been developed and implemented. We consider the interface a work in progress since further message types will be defined and implemented in the near future. The module has a log in system for different user roles. We have finished integrating the guest role. The captain and crewmember's role is under development.

We have done communication tests with the Message Bus and we have successfully connected with the other partners in the designated scenarios. The module was tested on a Windows device, tests will be made after the implementation on Android platform and a multithread solution is considered to be added.

The communication with the Message Bus is done using message files format and the information received from the message bus is processed by the graphical interface. The displayed information can be system or crewmembers' messages, alerts and warnings and hazards. The implementation of this process is under development.

Task 5.4 "Early Warning & Ship Crisis Assessment Algorithms for Decision Support"

The task at aiming to provide the security officer with a platform for receiving support decisions and reasoning during an incident. The progress of this task began with taking the user requirements produced for the functional uses of the system and having a solution based on a combination of results from research outcomes and the set of technical requirements related to the task. Using the outcomes, the system component for the task was designed, including an architecture diagram of the components internal process. Development began by creating the data models for providing event incidents structure, followed by key services for producing and interacting with the data models. The configuration UI subtask involved creating navigation and pages for the decision support component of the common configuration UI, this included a page for creating and editing decision support event formats, along with a graph tool for creating and structuring the decision tree structure for security incidents. Other progress in the component involves the integration of the risk modelling component for triggering new security events (30% complete), and integration with the warning message component to trigger message generation tasks, and feeding information and context around incidents (60% complete).

Task 5.5 "Crisis classification"

The purpose of Task 5.5 is to develop a Crisis Classification module to be utilized during a crisis. This module will enhance the overall crisis management procedure through the module by adding to the DSS an evidence-based approach and inform the early warning module about the crisis level.

To this end, the effort on this task during this reporting period was focused on establishing the prerequisites for the development of the module, as planned in the Task 5.5 KoM. Different

methods for conducting the threat and vulnerability analysis were thoroughly examined, namely Bayesian Networks, Neural Networks, and Bayesian-Neural Networks to identify the methodology which the module will based on, and considering the several types of potential threats presented in the use cases.

In addition, meetings were scheduled with all partners in WP5 to clearly define the dependencies among the modules as well as a common framework regarding the types of variables and datasets that will be used for the crisis classification – the discussions ultimately led to the final architecture of the module to be integrated to the ISOLA system. The outcome of meetings assisted to the development of Use Case Diagrams for each PUC, which are being utilized for the development of the module's models.

In parallel, connection with the Message Bus and with other ISOLA modules was established, via the production and consumption of message files. This led to the successful participation in the ISOLA Integration Tests 1, 3, 4, and 5).

2.5.2 Deliverables of WP4

No deliverables for first period

2.5.3 Deviations compared to DOA and justification

No deviations to be reported for first period.

2.5.4 Publications for the WP

No publication to be reported for first period.

2.5.5 Risks for the WP

No risks to be reported for first period.

2.6 Work package 6

2.6.1 WP6 activity and outputs during the first 12 months

The development on technical service components of the main system started, having outputs for the security risk management and warning message generation tasks, with the beginning of the ship crew solutions and mitigation actions task taking on comprehension from the aims defined within the user requirements tasks.

Task 6.1 "Security risk management modelling for enhanced preparedness"

With the aim of creating a component for the detection and monitoring of security risk factors,

This task began with building upon the initial user requirements produce by the outputs of WP2, producing objectives for the task to perform research and investigation to solutions, then later producing a set of technical requirements related to how the risk modelling task is applied regarding each potential use case.

Based on the research outcomes and targets of the technical requirements, a plan of the risk modelling system component was formed. This included the development of relevant internal architecture diagrams, including data inputs, system processes, and outputs. This was followed by an assessment and confirmation of the required technology stack to build the component including database, server, and user interface outfits.

Development started with creating the core risk modelling data models and services to manage the process of receive inputs, scheduling and executing workflows, and collecting outputs.

An identified element of the service was the management style of risk model execution strategy, the resulting progress includes an error correction and resilience layer managing the execution of each risk model.

A sub-task of the risk modelling comprises a risk modelling configuration UI with progress on configuration views for the creating, editing, and tuning of various elements of each risk model's design. UI development progress includes setting up a frontend web interface, first creating an admin login system with user and password management at 85% completion.

Next, creating the navigation interfaces (90% complete), for navigating between different viewing, editing, and tuning pages of the risk models, with an overview page with model activation/deactivation functionalities, a data graph editor for editing the data flows in the risk models processing pipeline (70% complete), and a data input source management page (95% complete).

Other progress includes model cloning functionalities for use in faster model prototyping and A/B testing strategies together with mapping model outputs to the decision support context (35% complete).

Wider progress involves adapting the component's internal data models and services to interact with the message bus, along with integration with the data inputs from the cyber vulnerability components and crisis classification outputs (20% complete) followed finally by validation tests.

Task 6.2 "Warning (message) generation to the occupants"

Filling the gap between intelligence data and actionable information for security officers, the warning message task began after building upon the initial user WP2 user requirements. The main objectives of the tasks technical component were composed into a warning message build-up document, to describe the expected communication per potential use case of the system, including when they should be generated, and the information that should be included.

Using this document along with the proposed technical requirements, further research was conducted to develop the technical solution. This involved planning, by creating an internal architecture diagram of the service and decide the appropriate technology stack for managing and generating warning messages.

Initial development began with creating the core services and data model formats for holding warning message data. Where data models including message templates and context data items related to the associated decision support event were created.

The sub-task for creating a configuration UI for creating and editing the template messages made progress including joining a common web UI, along with the risk modelling and decision support components and creating navigation for view and editing elements of the message generation and template configurations. The warning message configurations options consist of creating and editing new message templates, matching the relevant decision support events, and editing the audience scope of messages between ship passengers and staff members.

The progress for the machine translation of message sub-task consists of a processing queue for message translations, which schedules the loading of the required translation models to generate language inferences, and the integration of the language models themselves including Spanish, German, Italian, Chinese, Japanese, and Russian.

Progress in the message generation template processing starts with the message template processing with the decision support event data injection stage (40% complete) then the message sentence correction model stage (35% complete).

Overall other progress focused on the integration with the message bus where connections to the decision support and 3D visualization components were made, then tested in the integration tests.

Task 6.3 "Deployment of ship crew solutions and mitigation actions"

Started on M12. Discussion have been initialized with other partners and WP2 to define the goals and actions of this task.

Task 6.4 "Passenger and crew monitoring system"

Started on M12 with the study of current ISOLA software architecture.

2.6.2 Deliverables of WP6

No deliverables for first period

2.6.3 Deviations compared to DOA and justification

No deviations to be reported for first period

2.6.4 Publications for the WP

No publication to be reported for first period

2.6.5 Risks for the WP

No risks to be reported for first period

2.7 Work package 7

2.7.1 WP7 activity and outputs during the first 12 months

The objectives of this task are to plan the technological roadmap; to specify the entire architecture of the platform; to define and implement the security framework, especially to face potential cyber-attacks; to proceed with the integration of the utilities, mechanisms and tools comprising the overall ISOLA platform; and to specify and develop really interactive user interfaces following a User-Centered approach. During first 12 months, the technological roadmap has been planned, the architecture of the platform has been specified, the 1st ISOLA prototype is designed and described, the cyber-security framework has been defined and the majority of features are implemented. Finally, the interactive user interface has specified the majority of the users' needs, the development has started and the first results are presented.

Task 7.1 "Technical requirements and platform development roadmap"

The technological background of each technical partner was identified at the beginning of the project. Then, in collaboration with WP2 the needs of the project were analyzed. Questionnaires were delivered to the end users to understand their needs and interpret them for the technological solutions. During the first year of the project, there was a close collaboration with end-users on the description of PUCs, CONOPS and user requirements.

The technical requirements were defined based on the user requirements (after several refinement iterations). Based on the technical requirements the inputs, outputs, programming languages, dependencies (soft and strong) and critical factors where defined for each task/service. The tasks were split into subtasks in every WP to better organize the workload. A schedule of the working period for each task/subtask during the project's duration was proposed. Then the services' participation and role in each PUC at the demonstrations was discussed and decided. Furthermore, in this task the needs of each technical service/module for the preparation of pilots was defined and finally a plan for the platform's testing (prototypes, integration tests, pilots) was proposed.

Task 7.2 "System architecture development and security requirements"

The platform's architecture was designed based on the technical requirements and dependencies of the technological solutions. During the first year of the project and after many discussions with technical partners and the end users, four different versions of architectures were proposed before the final one to comply with the requirements. The high level architecture is divided into five layers namely:

- Data Ingestion layer
- Data Analysis layer
- Internal Communication and Storage layer
- Information Processing layer
- External layer

The physical components of all the tools and how they will form the final ISOLA platform was defined along with the internal architecture of each service/module and what is their role in the general architecture (connections with other services/databases etc.). There was a close collaboration with Task 4.1 to conclude to the schema and structure of the message bus and how the services will communicate between each other. Furthermore, the connections between the services and their dependencies were defined by creating:

- A general flow diagram, which depicts the flow of information in ISOLA platform
- More specific flow diagrams, which depict the flow of information between major technological solutions
- Information flow diagrams specific for each use case

Task 7.3 "System security (Cyber security)"

During the reporting period, the activities of T7.3 were focused on the development of the Dynamic Vulnerability Assessment and Testing Service (DVATS). As part of the initial specification activities of the project, the functionalities of DVATS were described using service-level templates to provide descriptions, inputs, outputs, requirements and dependencies. Visual representations of the DVATS's proposed architecture was also created during the development of the overall ISOLA architecture, while user requirements, gathered as a result of WP2 tasks, were consulted in order to refine the technological offerings of DVATS to satisfy the needs of the end-users.

After the completion of the first round of specification activities, the initial steps of the DVATS components took place. The types of data necessary for the analysis performed by DVATS were identified and its internal database structure was defined accordingly. Moreover, the vulnerability extraction process was tested and the architecture of the sensors necessary for the collection of input data for DVATS was finalized. Finally, the structure of the output messages produced by DVATS was defined and communicated to relevant partners.

Once the inputs and outputs of the DVATS were finalized and agreed upon, the development of the service's core functionalities was prioritized. A preliminary version of the algorithms for the identification of vulnerability indicators and their matching to known vulnerabilities were implemented. Finally, a first DVATS prototype was tested concerning its connection with the ISOLA message bus and it was able to provide output files and forward them to other relevant modules of ISOLA. During M13-M14, the same prototype will be featured in the operational testing of PUC5 using real network traffic data collected from a passenger vessel.

Task 7.4 "System integration"

When the technical requirements were defined, the inputs and outputs between different services of all WPs were discussed and we concluded to a scheme. It was very critical to conclude to an integration solution that would ensure that the integration approach will offer:

- Scalability
- High performance
- Durability

- Reliability

The connections between services via the message bus were decided. It was necessary to better understand the flow of messages to create general flow diagrams and diagrams for each case. All the partners concluded to a common message format and defined the initial parameters for each service.

Three steps of integration process were followed:

- All services established a connection with the message bus provided by Task 4.1
- Establish a connection and exchanges dummy messages with at least another service according to flow diagram
- Successfully participate in the six simplified integration scenarios

The Integration Scenarios were the following:

- Scenario 1 : Piracy incident (Small boat detection)
- Scenario 2 : Cybersecurity
- Scenario 3 : Illegal Boarding
- Scenario 4 : Chemical Dispersion
- Scenario 5 : Face recognition during incident
- Scenario 6 : Search for an object under ship's hull

Finally, having the development status of all the modules/ services and having established the connection between different services via the message bus, the 1st ISOLA prototype was described in deliverable D7.3.

Task 7.5 ": Interactive User Interfaces"

During the first period, as part of task 7.5, we have developed 3 versions of the GUI (Graphical User Interface) and uploaded proposals on Wiki. The implementation of the GUI is now work in progress, with a completion percentage of 30%.

We have started the 3D modelling of the Hellenic Spirit ship and advanced in the vessel 3D modelling. The percentage of completion is 95%, because further optimization regarding the rendering must be done to achieve the target frame rate – 30fps+.

Also, we have discussed with PROMETECH and agreed on the ship mapping and positioning system, we have provided ship DWG files with the outlines for the ship mapping and positioning system and also 3D ship model in FBX format to all relevant partners.

We have discussed with partners and agreed on the login module for different user roles and started the implementation of the login module. The percentage of completion is 50% (done for guests, WIP for crewmembers and captain).

We managed to finalise the encryption of credentials on local system.

We are currently working on the implementation of interaction module for Security Officer's role. – 60%, and on the data format for interaction with external modules. – 30%.

2.7.2 Deliverables of WP7

- D7.1 : Technical requirements and platform development roadmap
- D7.2 : ISOLA system architecture definition
- D7.3 : 1st Prototype of ISOLA System

2.7.3 Deviations compared to DOA and justification

No deviations to be reported for first period

2.7.4 Publications for the WP

No publication to be reported for first period.

2.7.5 Risks for the WP

No risks to be reported for first period.

2.8 Work package 8

2.8.1 WP8 activity and outputs during the first 12 months

WP8 aims to achieve the following objectives in hierarchical order:

- Collect and exploit the outcomes of WP2, which are its inputs and closely related to WP8. Specifically:
  - Five (5) PUCs Prescription
  - CONOPS v.2 including the ISOLA System's utilization
  - Users' Operational Requirements
  - Ethics and Legal Framework, taking into account the specificities of the Maritime Environment

- Develop the Evaluation Methodology, providing for the conditions under which the System's Functional Requirements, will be tested, including the threshold values (must) and possible objective values (should or could)

- Develop the Validation Scenario per PUC, following the already prescribed PUCs and elaborating detailed basic and alternative steps flows, detailed actions' timelines and users/system interactions per Role Player. The scenario must be coherent and easily implemented, as the main purpose of the PUCs Demonstration and Testing is not the evaluation of the Users competence but the evaluation of System's capabilities.

- ISOLA Software Package development where Users will provide their support and feedback for a tailored, user friendly and user oriented interface

- Users Training upon the ISOLA Software and practically on-board, according to the evaluation methodology and validation scenarios, providing for their distant training on the platform's functionalities and use, table-top exercises, dry-runs and rehearsals.

- Pilots Implementation per prototype evaluation report
- Field Demonstrations and final System's evaluation, following the evaluation methodology and validation scenarios and according to the DoA time schedule.
  - PUC5 on M13
  - PUC3-4 on M23
  - PUC1-2 on M33

The work done during the first 12 months of the work programme and is applicable to all WP8 Tasks includes the following:

- Work program methodology (Inputs / Processes / Outputs / Risks / Dependencies / Timeframes) analysis conducted from the WP Leader and explained to all partners to set the basis of a common understanding especially to those not familiar with the marine Environment
- WP2 outcomes collection and exploitation
- Focused questionnaires issued and addressed between End Users and technology providers. These questionnaires aimed to the mutual understanding of requirements, restrictions, time frames limitations of both partners' categories:
  - End Users Questionnaires addressed to Technology Partners.
  - Technology Partners Questionnaires addressed to End Users

All partners responded accordingly and provided each other with the requested information, documents etc.

- The research techniques utilized are institutional documentation and literature review, periodic meetings, desk workshops, P2P Discussions, interviews with subject matter experts etc.CY-MoD (AVERSA, CYBERLENS, CELESTYAL) Working Document (PUC5 Evaluation Methodology)
- Scheduling of vessels allocation by type, by name, drawings / plans and the provision of other information requested to End Users, site survey visits, PUCs rehearsals along with special requirements and logistic support to Technology providers.
- Project Management Functions

Task 8.1 "Development of the Validation Scenario and Evaluation Methodology"

CY-MoD (author) AVERSA, CYBERLENS and CELESTYAL cooperated to provide a basis for discussion through a Working Document, which defines the first in the row Operational Test the PUC5, Evaluation Methodology. Legislation and regulatory framework, as well as CYBERLENS' DVATS capabilities have been taken into consideration in this document. It will also be a working input for the whole System's Evaluation methodology, which is under development. Furthermore, several methodologies concerning the development and the implementation of the trials have been explored. Among others, the Trial Guidance Methodology (sourcing from Driver project), the Technical Guide for Union Civil Protection Mechanism (UCPM: Technical guide for UCPM full-scale exercises, Design, implementation and utilization of a UCPM full-scale exercise project), and Joint exercise planning doctrines

were reviewed to grasp the most suitable and structured method and tools during the three phases: Preparation – Execution - Evaluation.

Task 8.2 "Field Demonstrations, Testing"

PUC5 (Cyber security) Operational Test roadmap is almost finalized and specific dates for the Operational Test are yet to be defined. The rest of the PUCs' Demonstrations roadmaps are under development starting from the information acquisition (minimum required resources and assets capabilities, requirements and restrictions, safety and security limitations, scenario sequence, assets allocation etc.) and will be finalized timely enough and according to the DoA's schedule of the demonstrations.

Task 8.3 "User Training"

This task is being planned upon the ISOLA Software to be developed, according to the evaluation methodology and validation scenarios, providing for their distant training on the platform's functionalities and use, table-top exercises, dry-runs and rehearsals. Although the task starts on M12, segments for users training needs are highlighted through the system capabilities definition and PUC's demonstration roadmaps. ISOLA Software Package is designed to embody Users' Training needs.

2.8.2 Deliverables of WP8

No deliverables for first period

2.8.3 Deviations compared to DOA and justification

No deviations to be reported for first period

2.8.4 Publications for the WP

No publication to be reported for first period.

2.8.5 Risks for the WP

No risks to be reported for first period

2.9 Work package 9

2.9.1 WP9 activity and outputs during the first 12 months

The objective of this WP is the communication and dissemination of ISOLA project.

Task 9.1 "Communication and Dissemination actions"

The project internal file repository was developed and is hosted for each partner to use. The corporate identity of the project and the related materials (logo, templates and style guide) are

completed. The public facing website hosting the project information is published. The social media accounts (Linkedin, Facebook, Youtube and Twitter) accounts were made to advertise events related to the project. These social media accounts were kept up to date with the projects' activities. Finally, a social media post submission methodology was created and shared with the project partners.

Task 9.2 "Standardization, strategy and policy-making"

This task deals with surveying the standardization landscape in the target community in maritime security, relevant to ISOLA project scope and objectives, whilst promoting standardization in this market. In collaboration with WP2, user needs and opportunities have been identified and potential technical solutions have been proposed by technology providers.

A survey of the relevant security standards has been initiated, in an attempt to map existing standards, ongoing activities and potential gaps as future standardization work. A work plan for engaging all ISOLA partners in this activity has been put in place and an internal workshop is planned for the last quarter of 2021. During this online meeting, the consortium will be informed about standards, what they are and how they are developed, their benefits and how an expert or professional could contribute in future standards. The outcome of this workshop will feed back to the survey and will enable the interaction with relevant EU projects and CEN TC 391 (or other relevant TC), whilst contributing to deliverable D9.9.

Task 9.3 "Market analysis, industrial requirements and business model"

ISOLA had to analyse, investigate and describe four pillars.

- Industry Description and Outlook: Detailed statistics that define the industry including size, growth rate, trends, and outlook.
- Target Market: Who is our ideal client/customer? Include data on the size of the target market, the purchase potential and motivations of the audience, and how we intend to reach the market.
- Market Test Results: The results of the market research we conducted as part of our initial investigation into the market.
- Competitive Analysis: Who is our competition? What are the strengths and weaknesses of the competition? What are the potential roadblocks preventing you from entering the market?

ISOLA, in order to retrieve useful information, make targeted investigation and research, considering the above pillars, each partner provided with a specific questionnaire regarding its business, provided technology and component. After all contributions and suggestions from partner's deliverable D9.3 was successfully prepared and includes detailed information regarding:

- Conducted PESTEL Analysis (Political, Economic, Sociological, Technological, and Environmental & Legal) to consider macro-environmental factors that may affect the industry.

- Porter's Five Forces (competition, suppliers, buyers, substitutes, new entrants) – to assist in defining our positioning in the industry & assess & determine whether there is scope for development & high profitability potential.
- Customer research – to identify the market & target ideal clientele.
- SWOT Analysis – Essential to utilize SWOT analysis to design strategy plan for way forward.
- ISOLA System Analysis (holistic approach) – emphasize key characteristics that define the system as a novel technology collectively (with all components) rather than analysis on an individual component basis.

Task 9.4 "Exploitation plan and Intellectual Property (IP) protection for the proposed solutions"

Working to establish a detailed and efficient business plan that will ensure the commercialization and sustainability of ISOLA products and services during and beyond the project lifetime. This plan includes:

- The exploitable assets
- The detailed marketing strategies
- The pricing estimations
- The sales projections for the exploitation of the project results within the pilot countries and domains for the business models that will be promoted

2.9.2 Deliverables of WP9

- D9.1 : Plan for communication and dissemination
- D9.2 : Visual identity, website and social media presence
- D9.3 : Market Analysis Report v1

2.9.3 Deviations compared to DOA and justification

No deviations to be reported for first period

2.9.4 Publications for the WP

No publication to be reported for first period

2.9.5 Risks for the WP

No risks to be reported for first period.