PROJECT DELIVERABLE REPORT

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

D3.1 PALAEMON Evacuation Methodologies & Models Analysis

A holistic passenger ship evacuation and rescue ecosystem

MG-2-2-2018

Marine Accident Response

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1.3	2020/11/23	JU	Release

Contents

Abbreviations

BRM	Bridge Team Resource Management
DB	Data Base
HMI	Human–Machine interface
IMO	International Maritime Organization
ISM	International Safety Management
MQTT	Message Queuing Telemetry
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea
SSS	Smart Safety System
STCW	Standards of Training, Certification and Watchkeeping for Seafarers

Executive Summary

The global cruise ship market offers travellers a wide choice of ships, a variety of interesting destinations and an exclusive range of services.

The trend towards ever larger cruise ships is an evidence of a rapidly increasing demand. More and more people are becoming enthusiastic about cruises.

But it is precisely this trend that poses an enormous challenge for people and technology. The situation of ever larger ships, with an ever-increasing number of passengers and crew members, requires an appropriate system for the safe and fast evacuation of these enormous numbers of people in case of an emergency.

Such a task has a huge impact on the Crew and Management level dealing with evacuation procedure. The stress, the communication and the management of such task have a huge impact on efficiency of the evacuation procedure and to keep track of such large amount of information, Jade University proposed to develop an assistance system to reflect the research and development work on the location of passengers and crew members on ships but also to manage the whole process of evacuation and reduce the amount of unnecessary communication to an efficient extent.

1 Introduction

1.1 Purpose & Scope

In an emergency, the master and his officers must evacuate all passengers and crew quickly and efficiently in accordance with the standard laid down in the SOLAS Convention[1] . Unfortunately, this standard is still not regularly observed. A study at the Jade University of Applied Sciences found that often "the deadlines for the installation and evacuation periods were exceeded by far, caused by several systematic errors and organizational restrictions"[2]. Over the course of time, passenger ships have become larger and larger and thus also more complex. This applies to both the construction and the evacuation processes. In addition, most passengers have no experience with evacuations, which makes the efficient evacuation of these ships a particular challenge. Not to be neglected is the fact that especially, but not only, in the case of large passenger ships, the human factor and thus the question of how such an organizational challenge can be mastered safely and successfully plays a major role

This document, named “PALAEMON Evacuation Methodologies & Models Analysis (V1)” part of WP3 - PALAEMON Intelligence Framework - AI Services and Algorithms, presents a detailed description of the SSS, its role and purpose in the context of the PALAEMON project and, finally, describes its actual implementation. The SSS should be adaptive as vessels with very different sizes, and numbers of persons on board will use it, according to the project’s scope.[3]

This document describes the procedure followed and the available sources used for the dataset creation. We also provide an outline of the proposed approach for the crew guiding during the evacuation considering the Smart Safety Assistance System. Furthermore, a demonstration of the actual functionality of the tool is a part of this deliverable. The second version of this document (D3.2 due to M36) will provide the finalized dataset, an empirical study for the proposed method and the actual implementation of the tool.

1.2 Relation to other WPs & Tasks

The T3.1 Smart Safety System and Evacuation is not directly related to other components within the WP3 Components but can be implemented in later stages as initiator for Incident when it comes to simulate the whole process of evacuation. The project WP3 (Fig.1) aims to investigate the need for different applications, but also for structural improvements. The aim is to achieve a successful and more time-efficient evacuation, using different assistance systems.

The regulations of the International Maritime Organization (IMO) and the flag states provide the legal framework for the evacuation of a passenger ship, ranging from construction to equipment and operation. As some of these rules cannot be implemented directly, the

[1] cf. International Maritime Organization 1997, pp. 2, 7-9, 2016, pp. 2, 4-5)
[2] Investigation of systematic errors and organizational limitations occurring by evacuation procedures on passenger vessel and elaborating feasible recommendations, Pit Awe B.Sc. Thesis @ Jade HS-2020
[3] PALAEMON Architecture D2.6

classification societies convert them into class rules in order to make them work in practice and meet the time frame set. The construction and equipment are a fixed value in the life of a passenger ship, but not the operation. Chapter IX of the Annex to the SOLAS Convention adopts a mandatory safety management system (SMS) under the International Safety Management (ISM) Code. The Jade University takes on two functions in the project: On the one hand, the management of the work package (PALAEMON Intelligence Framework - AI Services and Algorithms) and on the other hand, the development of two different assistance systems (Smart Safety System and Stability Toolkit). The Jade Hochschule team is advising other partners in the project, taking into account the maritime aspects and maritime personnel. It is also investigating structural measures and possibilities for implementing new assistance systems and their possible integration with the human factor.

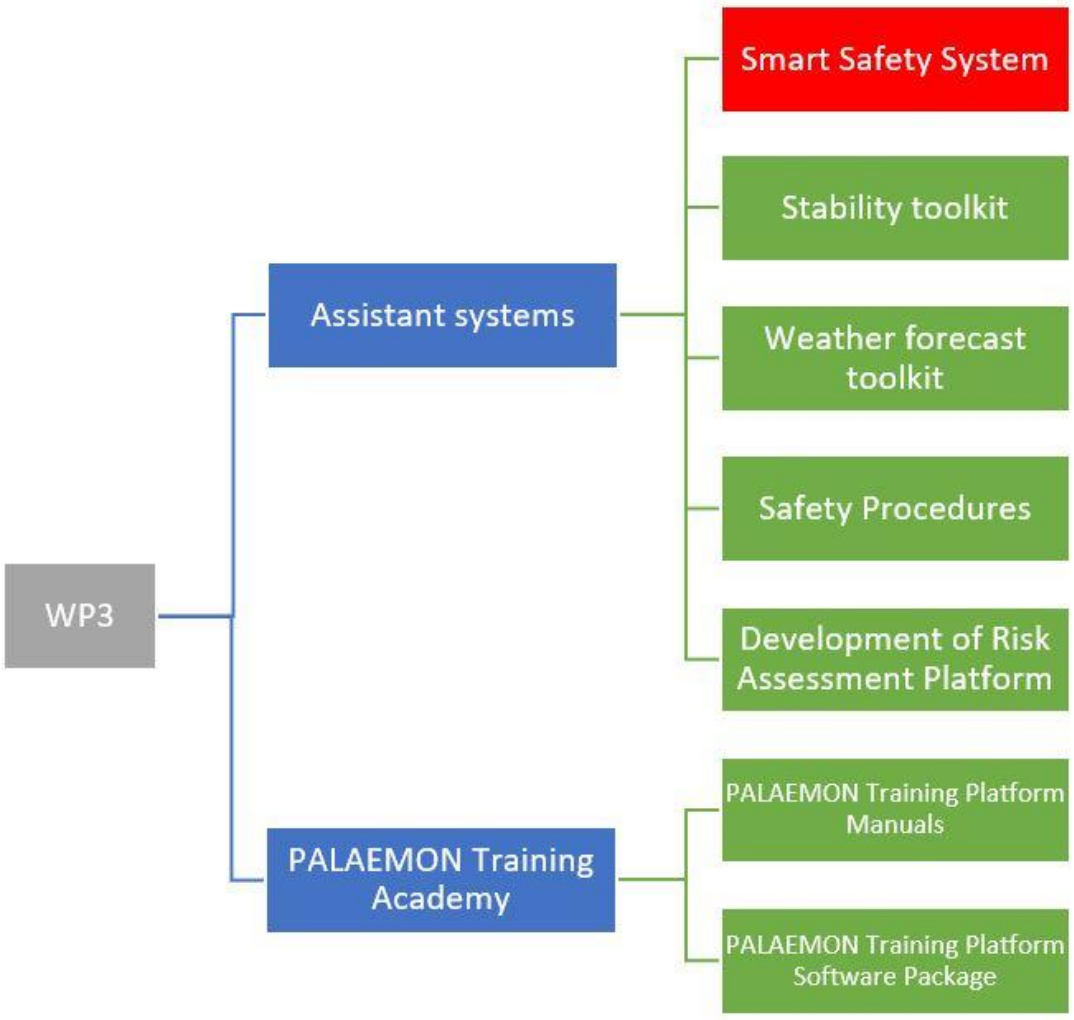

Figure 1 Work package 3 Content

2 Intelligent systems for evacuation processes

Since an emergency is obviously a very stressful situation, the ability to make rational decisions, to obtain and interpret information is often severely limited. A reduction of stress can be achieved in different ways, e.g. by providing sufficient information in good time and by leading the escape.

The captain and the crew have to make important decisions, as they bear the ultimate responsibility for the whole time on board. This includes, for example, the decision whether passengers have to leave the ship or not. It is a decision where many lives are at stake. In order to facilitate this type of decision, the master on a passenger ship should have a decision support system consisting of emergency plans with various foreseeable scenarios[4] . In addition, tis system should be able to operate even when some vital functions of the ship are damaged or destroyed (energy, communications). SOLAS has also established guidelines for the safety crew to be followed and practical exercises to be carried out to be better prepared for an emergency. However, current assistance systems still lack a rapid exchange of information, clarity and timeliness in order to make such decisions safely and efficiently. The aim of this work package is to enable the captain to make and evaluate such decisions and their follow-up decisions quickly and clearly in order to be able to carry out a rapid and efficient evacuation.

3 Software architecture and functionality

One of the important aspects is information about the condition and development during an evacuation. This information exchange is nowadays done by means of VHF and on-board communication media such as on-board telephones or loudspeakers (Push to Talk System). These means of communication are generally well suited, but they require clear communication, a calm way of speaking and enough time to exchange all relevant information. When using these tools, the mental condition of the crew members involved in the communication plays a major role. During an emergency, fast communication and the exclusion of misunderstandings are of high relevance. The captain and his officers, especially at management level, need all information about the current state of the evacuation and its possible development, if foreseeable.

On the basis of the SOLAS and STCW Conventions in support of directives focusing on fire prevention, navigational safety, training and emergency planning, a study will be carried out to analyses existing on-board safety systems and to plan the introduction of new improved technology to support simpler and faster communication between safety systems in accordance with SOLAS Chapters II-1 and II-2. The changes also provide regulatory flexibility to enable ship designers to meet all future safety challenges. This implies the possibility for PALAEMON to develop a new internal system that will bring together all safety matters in a clear and unambiguous user-friendly interface (alarm management system, both mobile and centralized solution). The core of this system is the diversity of information, but also its clarity and accuracy.

[4] see: SOLAS, 2009, Chapter III Lifesaving appliances and arrangements

The "Smart Safety System (SSS)" component of the PALAEMON project is intended to create an assisting safety system during evacuation. The aim of the system is to improve the safety evacuation system on board passenger ships and to provide information on the condition and all relevant information during the evacuation process. All crew members on board should have access to this information. This also reduces the burden on VHF communication and provides a detailed overview of the situation on board

The various assistance systems created in the project are stored by an internal central system and integrated into the on-board network. Furthermore, the system is presented as a gadget so that the user can select only the information he needs. The entire information network communicates with the DSS central system and calculates a corresponding recommendation for action for the management level. The component uses a "Message Queuing Telemetry Transport" (MQTT) protocol for communication between all devices on board, from standard PCs to smartphones and tablets. This type of "Machine-to-Machine" (M2M) communication offers the advantage of being able to communicate with a "library" even if different programming languages are used.

4 Specifications for SSS architecture components

The general model is developed in an arranged test system, which allows the examination of the ship design. The test system will be based on a simulated ship design and the training system will be based on the analysis of various past ship emergencies to come as close as possible to reality. This will support the project with various data collected through testing, analysis and evaluation to provide one of the latest and safest innovations in the field of maritime passenger transport.

This Model of the SSS was build on the adapted on similar System which is used at coordinating Firefighter, when they are proceeding with building evacuation. The needs and systematic changes are done and adapted within the system to meet the objective of T3.1 and the whole process of WP3.

4.1 Functionality of SSS

This module gives an overview of the evacuation status and the current status of the evacuation progress. It also provides an interface for the connection between the master and the evacuation team. The information is provided as a gadget in the (DSS) decision support system.

4.2 Input Connections & Interfaces

Officers and crew members provide information and can rely on sensors (e.g. wristbands) and also on communication devices (e.g. tablet or Bluetooth receiver). (see figure 2)

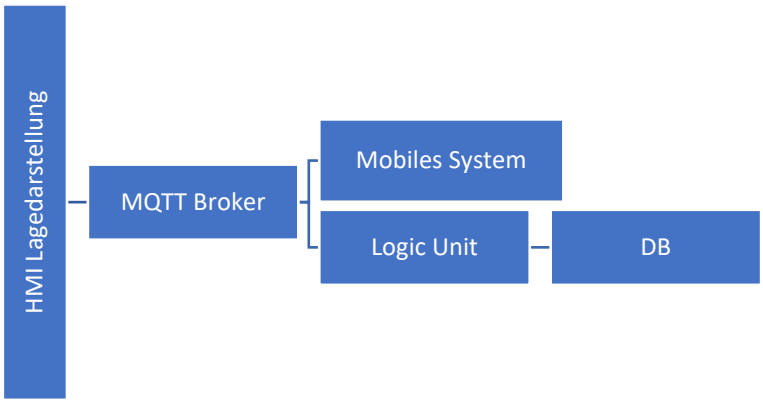

Figure 2 Architect of the Smart Safety System

5 Human Factor and testing for Applicability

When working with the information flow provided by the new technology supported by the project, information must be filtered and adapted to human behaviour and flexibility. This means that the way the user behaves and handles the new technologies should also be taken into account. The aspect to be studied is the relationship between human behaviour in interaction with multiple assistive systems and artificial intelligence provided by the project partners. Therefore, once the new system has been created, Jade University plans to test it in a BRM (Bridge Team Resource Management) with external users to see to what extent information can be processed in stress situations. These results will be analysed and passed on to the EU Commission as a recommendation. In addition, two cruise lines intend to test the system on board during the project. This is also of great importance for the developers, as it will allow for quick improvements and adjustments within the project time.

Therefore, a study is planned within the second stage of the Project to test the developed SSS with end users and see how applicable and useful such assistance systems provide.

6 Data output

The Captain, the management and the operation level will have the access for the SSS System which it allows communication paths, information exchange and be able to have access to all relevant information that may assist the evacuation procedure. In this sense it was utterly important to have a friendly and stable interface for the end users. The following Screen shots are from the actual V1.1.0 of the SSS system

6.1 Main Interface

In this area the user will have the possibility to assign teams and propose tasks to be carried out by the crew. Also, this give the possibility to share the information about coordinating between the teams involved in evacuation, fire fighting or search rescue procedure. All messages and communication paths are listed and saved withing the log on the left side and will be visible to every crew member.

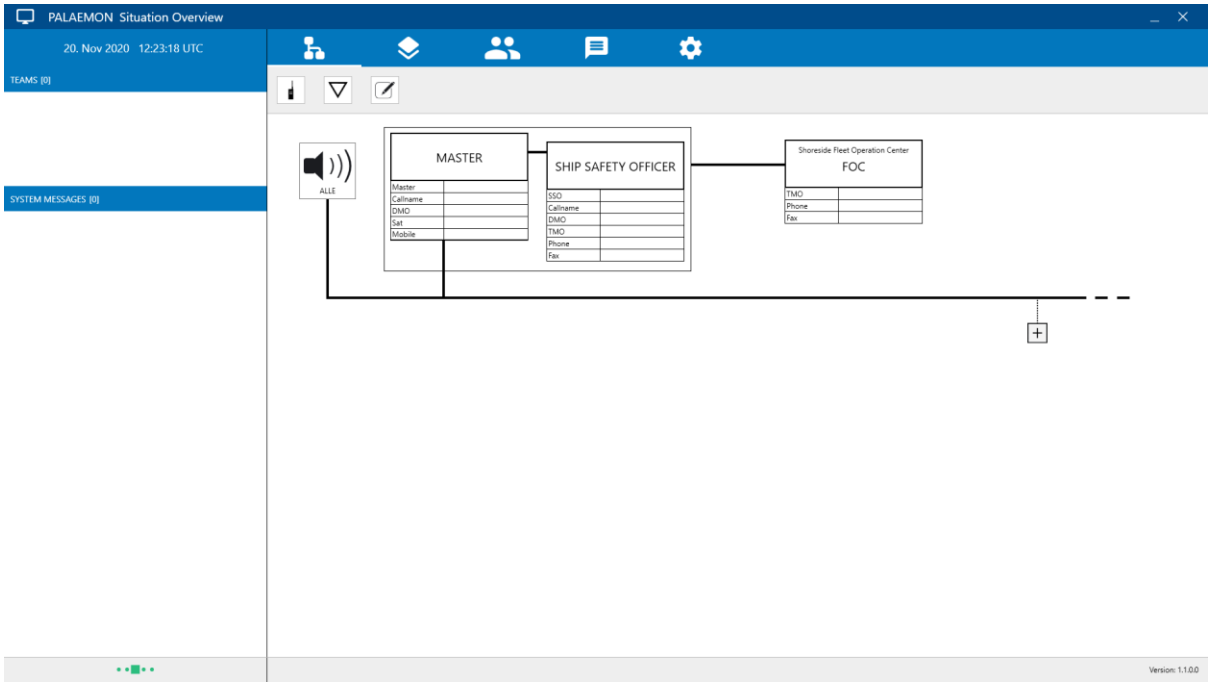

Figure 3 Main Interface Page of SSS

6.2 Ship and information management

Within this layout the crew will have the possibility to address dangerous, processes and location either manually or through censoring system. All information assigned in the software will be saved and registered within a log file that will be then provided to the DSS and can be handled accordingly. Depended on the test that will be done in the next step modification will be added or disclosed as their need's stats

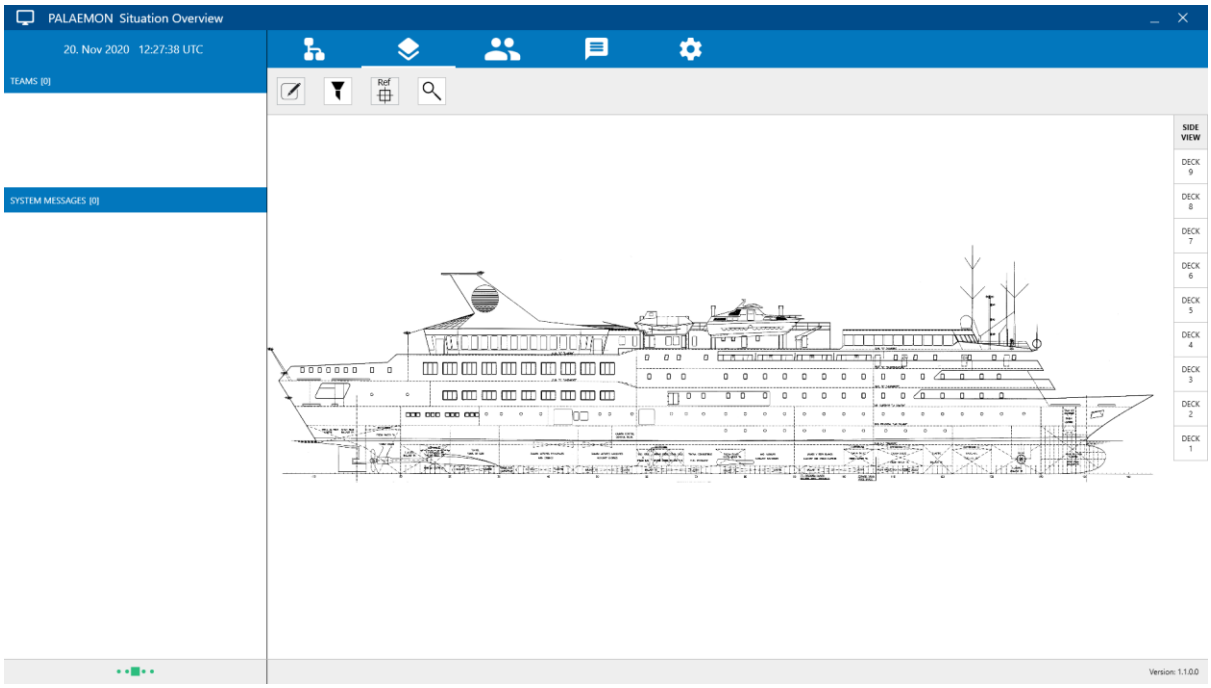

Figure 4 Ship Level and information management no 1

All information added will be registered and can be assigned to specific team leader or Crew Group/member. Also, restriction or assigning a new Muster station in case of deficiency or obstacles can be assign in matter of second and the easiness of drag and drop method. (See figure 5)

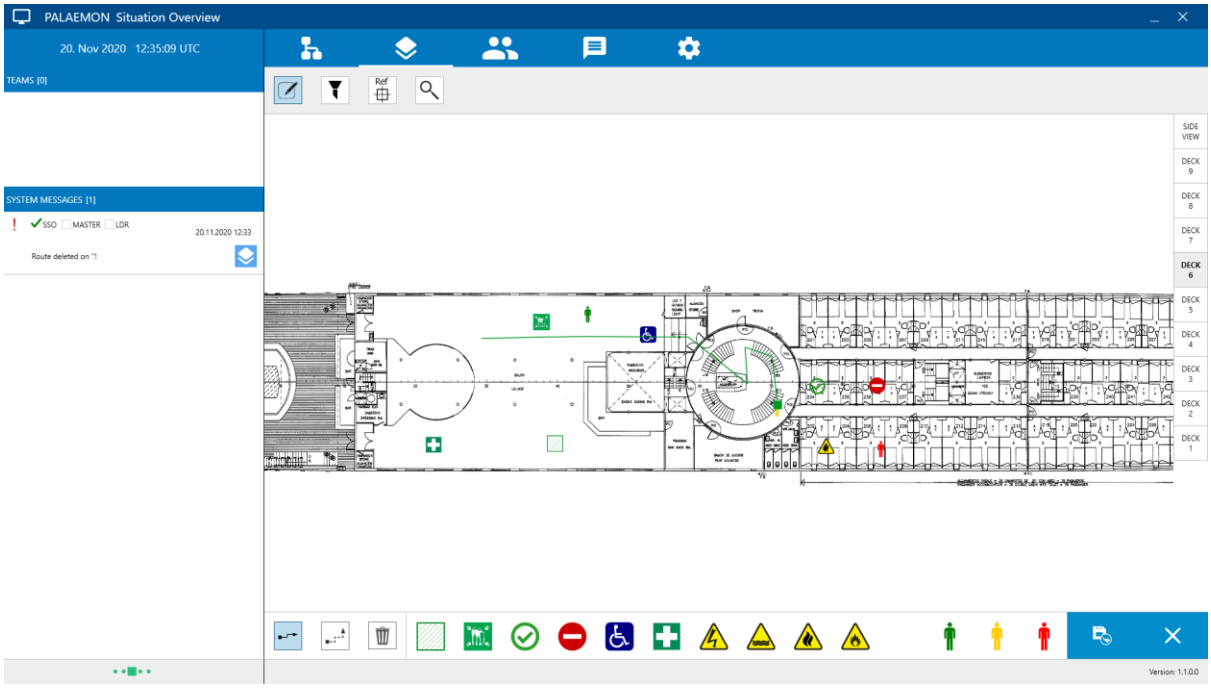

Figure 5 Ship Level and information management no 2

7 Conclusions

7.1 Conclusions

This document provides the initial approach of the specifications of the SSS. The functionalities of the SSS and a first version of the dataset are described, highlighting their contribution to PALAEMON project.

7.2 Future plans

The second version of this deliverable (D3.3 due to M36) will provide all the agreed functionalities and the developing specifications. Also, the second version will try to identify the performance of machine learning/information retrieval techniques to provide effective and ineffective crew's actions. Furthermore, the second version of this deliverable will provide the final version of the dataset and a detailed demonstration of the component.