



A holistic  
passenger  
ship  
evacuation  
and rescue  
ecosystem

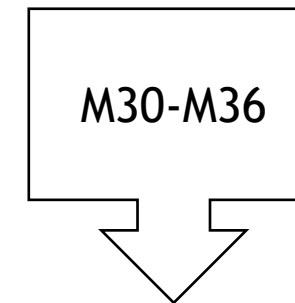
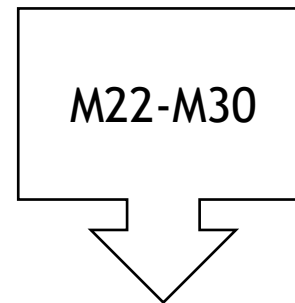
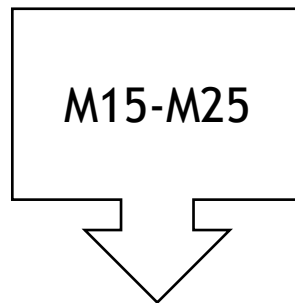
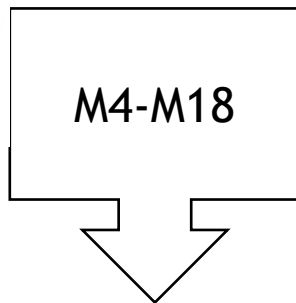
## WP6. PALAEMON Back-End Infrastructure Final Review 23.03.2023

Final Review and Report for WP6 Deliverable and tasks (KT, ITML, ESI)



## WP6 Main Objectives

- \* Support the on-board operations at operation and strategic levels via:
  - Merging incoming data from WP4, WP5, WP6 components
  - Implementing Warning, Alerting and Reponse Coordination
  - Develop virtual control room for first responders
  - Impelement the Ship Structural Monitoring Ecosystem
  - Develop the Interoperabilty Framework and PALAEMON APIs
  - Develop the Data Fusion Middleware for the communication Infrastructure
  - Perform test for ensuring the Platforms sustainability, in order to be used for the Pilot's Validation



Phase 1	Phase 2	Phase 3	Phase 4
Development of WP6 Components (Stand-alone)	Interaction of components considering the final Platform objectives	Final adaptation to the platform, testing and preparation for the pilots' validation	WP6 components were tested and validated on pilots + delivered the required KPIs



## WP6 interaction with other Work Packages

- \* WP3. PALAEMON Intelligence Framework - AI Services & Algorithms
- \* WP4. PALAEMON Mass Evacuation Vessel
- \* WP5. PALAEMON on-board mustering tools & services
- \* WP7. PALAEMON Integrated System & Technology Validation Trials
- \* WP8. PALAEMON Application Field Trials, Evaluation and Outcomes

## Overview of Deliverable and their assigned partner:

Task #	Title	Responsible Partner
Task 6.1	Ship Structural Monitoring Ecosystem	ESILimited
Task 6.2	PALAEMON data fusion middleware	ITML CY
Task 6.3	PALAEMON interfaces and HMIs toolkit	ITML CY
Task 6.4	Development of PALAEMON On-Board DSS	KT
Task 6.5	PALAEMON Incident Management Module (PIMM)	KT
D6.6	PALAEMON Communication Platform (V2)	ATOS
***	D6.6 is coming from "T7.1 PALAEMON Communication Platform"	***

Task 6.1	Ship Structural Monitoring Ecosystem	ESI
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**Duration:** M4-M20 & M24-M32 | **Partners:** ESI (Leader), ATOS, UTJ, AST, DNV GL, ADMES, ANEK, OELSR  
**Objectives**

In Task 6.1 a Ship Health Monitoring system (SHM) was developed relying on IMUs and developed software and AE. The SHM system was tested successfully on board a ship at the Port of Piraeus.

The communication with the PALAEMON core was also tested successfully at several instances (end of M18 and after M40 to M44) from Month.

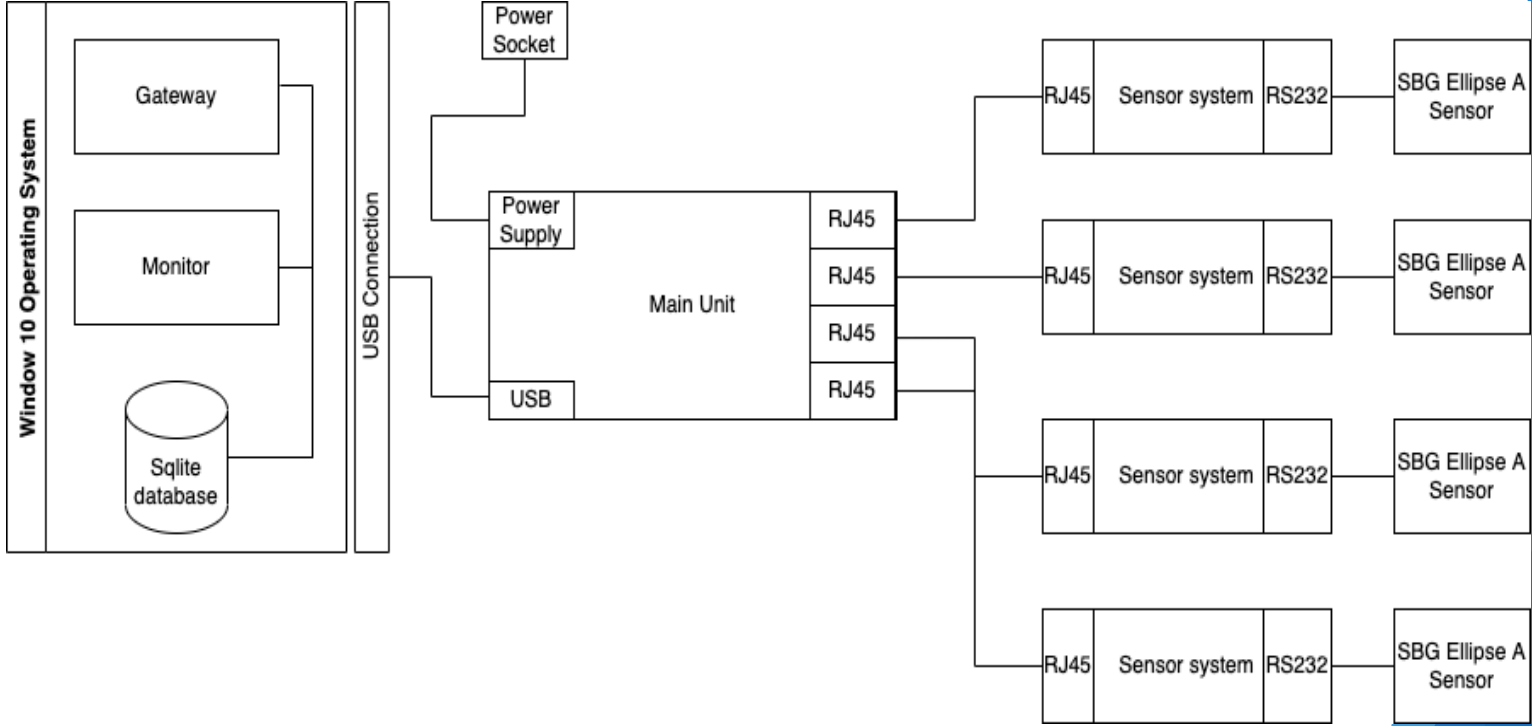
The developed SHM paired with IMUs provides status reports and alarms when the value of a particular parameter has gone over a designated limit

SHM with IMUs for monitoring Global Hull Strength and stability AE system for detection of local damage

### **Deliverable**

**D6.1 Ship Structural Monitoring Ecosystem (M32)**

Task 6.1	Ship Structural Monitoring Ecosystem	ESI
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Task 6.2	PALAEMON Data Fusion Middleware	ITML
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**Duration:** M4-M20 & M24-M32 | **Partners:** ITML (Leader) and ATOS, KT, ADSYS, THALIT, UAH

## Objectives

- [1] To customize and deploy a data fusion middleware able to handle complex critical events from multiple data streams
- [2] This (data fusion middleware) to deliver the pre-processing of data and to provide data to the modules deployed in WPs 3-5.

Remark: Tech activities are related to the customization of ITML's Data Fusion Bus

## Deliverable

**D6.2 PALAEMON data fusion middleware (M32)**

**Status:** **Submitted** 07 Feb 2022



Task 6.2	PALAEMON Data Fusion Middleware	ITML
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## Achievements & Technical Results

As reported in D6.2, D7.5

- [1] definition of the **data fusion overview**, which include the scope of the data fusion middleware in Palaemon and the main functional requirements / design principles
- [2] definition the **technical specifications** of the DFB Middleware, the platform core, the data access in Palaemon Architecture and the integration with PALAEMON Communications Platform
- [3] **Deployment:** The core DFB components (i.e., Kafka Broker [3] + Elasticsearch + DFB Data Endpoint) leaned a Kubernetes deployment, around which all the services interacted with each other. All the rest were basically executed in independent devices (e.g., partners laptops, smart cameras, etc.).

In the PALAEMON architecture (Figure @ next slide), DFB is part of:

- **Data access:** DFB provides an event-driven unified way of intercommunication between components
- **Platform Core:** DFB is responsible for storing and providing data



Task 6.3	Design and development of Interfaces and HMIs	ITML
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**Duration:** M4-M20 & M24-M32 | **Partners:** ITML (Leader) and KT, SIVECO, DSB, DANAOS, THALIT, UAH, UAEG, ANEK, OELSR

## Objectives

[1] To develop the interoperability framework between the various PALAEMON components by designing common interfaces (APIs) and providing adapters for modules to connect to DFB

[2] To develop Human-Machine Interfaces (HMI) and a virtual control room between the field crew and the bridge, using AR. HMIs are essential resources for crew members, who use them to review and monitor different processes, diagnose problems, and visualize data. HMIs can be used to (i) visually display data, (ii) track evacuation time, crew force, evacuation area, (iii) oversee KPIs and (iv) monitor sensors inputs and outputs.

## Deliverable

**D6.3** PALAEMON interfaces and HMIs toolkit

Status: **Submitted** 21 Feb 2022



Task 6.3	Design and development of Interfaces and HMIs	ITML
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## Achievements & Technical Results

As reported in D6.3, D7.5

[1] definition of the **PALAEMON Interfaces**,

the human interaction with the platform and DFB Access and its further deployment details

[2] definition of **technical specifications** of the HMI Interfaces

and their core intentions and contributions to the project

[3] **visualization** aspects per PALAEMON component (Figures @ next slide)

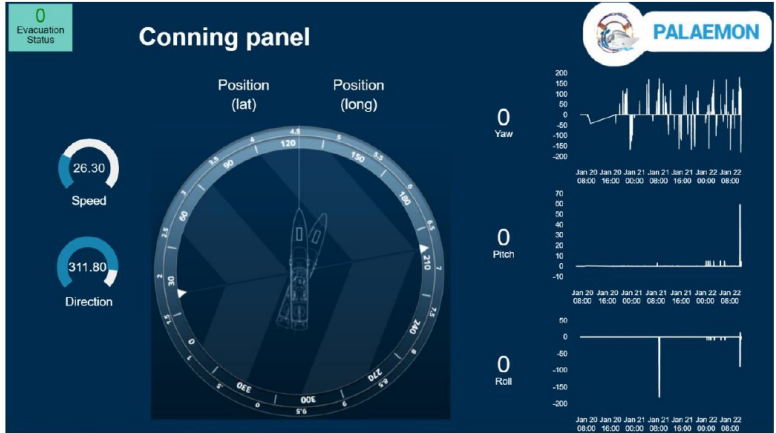
*PALAEMON CORE Monitoring / PALAEMON Incident Management Module / PaMEAS / Smart Camera /*

*PALAEMON Voyage Report Generator*

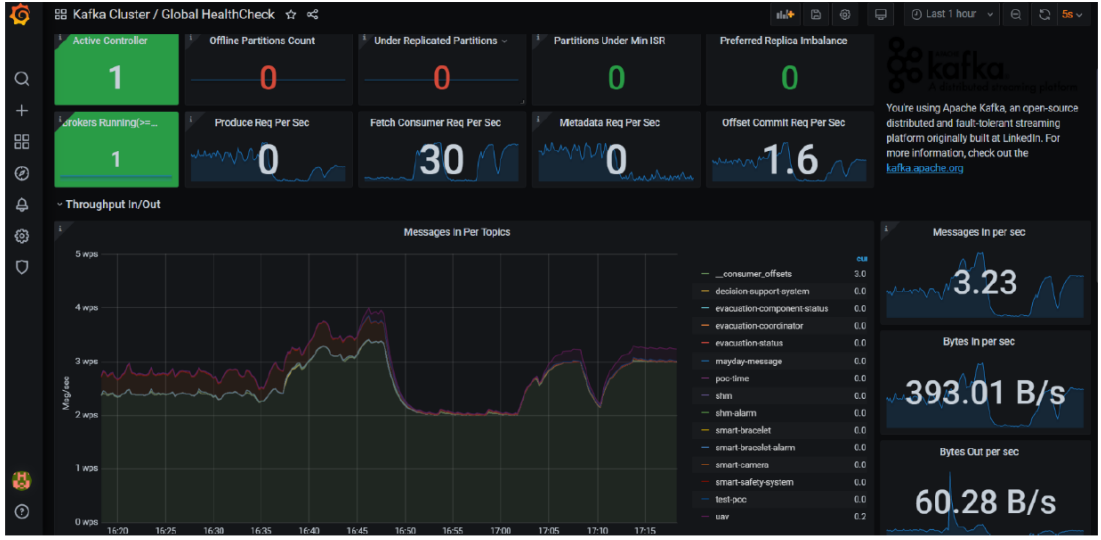
Task 6.3

Design and development of Interfaces and HMIs

ITML



Kibana canvas AIS (Automatic Identification System) layout sample



KAFKA (Grafana) Monitoring GUI - Messages per topic



Kafka (Grafana) Monitoring GUI - Resource utilisation



Task 6.3	Design and development of Interfaces and HMIs	ITML
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**Incident Type: Fire** Raised at: 2021-07-07 T 09:46:25  
Operational Level: 1

**Diagram of Danger in Ship**

● Extreme Danger ● High Danger ● Moderate Danger ○ No Danger

Engine Room 1 Risk: **90% Fire** - Evacuate this room immediately  
Engine Room 2 Risk: **70% Fire** - Start evacuation process

**PaMEAS**  
Passengers Mustering and Evacuation Process Automation System

Master Station	Status	Total	Passengers currently in MEVs	Passengers not in MEVs	Located	Missing
Master Station A	Evacuated	100	100	0	15	10
Master Station B	In Progress	100	75	25	15	10
Master Station C	In Progress	100	75	25	15	10
Master Station D	In Progress	100	75	25	15	10
Master Station E	Evacuated	100	75	0	15	10
Master Station F	In Progress	100	75	25	15	10

[Go to PaMEAS Dashboard](#)

**PALAEMON Situation Overview**  
08. Dec. 2021 21:22:15 UTC

PALAEMON Smart Safety System main window layout

PALAEMON Incident Management Module - Incident Assessment Screen



Task 6.4	Development of PALAEMON On-Board Decision Support System	KT
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**Duration:** M4-M20 & M24-M32 | **Partners:** KT (Leader), ATOS, ITML, SIVECO, DANAOS, DNV GL, THALIT, UAH, ANEK, OELSR

### Achievements

DSS implementation provided to the project the following key objectives:

- Generation of alerts in use case scenarios of the project
- Real-time decision making during the operation
- Warn and indicate the crews next moves
- Prioritize the severity of unfolding events
- Define of intervention strategies
- Captures multiple situations and incident types
- DSS increased accuracy of suggestions using data from the Shipboard Legacy Systems and the ship's ISM and SOPEP Manual
- Integrated with PIMM, Weather Forecast Tool, among other components
- Publish recommendation to the data fusion bus, in order to be used to other components
- Tested during the UC scenarios by the captain and the field crew

### Deliverable

**D6.4** - Development of PALAEMON On-Board DSS (M32)



Task 6.4	Development of PALAEMON On-Board Decision Support System	KT
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## Decision Support System

Which is the point of the fire or explosion that broke out? **FIRE AT THE ENGINE ROOM** **FIRE/EXPLOSION ON THE SHIP**  
**FIRE IN THE KITCHEN** **FIRE AT THE GARAGE** **FIRE IN THE ACCOMMODATION AREAS**

## Decision Support System

Go Back

- To cover in addition the two zones, connect the FIRE LINE to the network (not only DRENCHER).  
**First Mate**
- If the zones in the lower garages are activated, start operating water pumps.  
**First Engineer**
- Concentrate the fire crew. Preparation entrance of firefighters with full dependence.  
**First Mate** **OAK**
- Treatment of fire by fire crew if it is possible. Check of oxygen bottles before the entrance of firefighters and entry time recording.  
**First Mate** **OAK**
- Crew check for deaths and injuries.  
**First Mate** **OAK**
- Use of FIRE PLAN/LIFE SAVING PLAN.  
**Master**
- Full deck lighting.  
**Bridge Officer**
- If possible and safe, anchoring preparation or arrival at the nearest port.  
**Master**
- ON FIREFIGHT: Control for threat of pollution - treatment of pollution if existing. Call trailers if required.  
**Master** **First Engineer** **First Mate**
- Control and cooling of the upper decks and outside from trailer if required.  
**Master** **First Mate**
- AT THE PORT: Contact With Port Authority, Agent, Firefighting Service, Passenger debarkation, Ship Evacuation. Preparation for Hose Connection From Land (INTERNATIONAL SHORE CONNECTION).  
**Master** **First Mate**

Did you do all of the above? **Yes**





Task 6.5	PALAEMON Incident Management Module (PIMM)	KT
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**Duration:** M4-M20 & M24-M32 | **Partners:** KT (Leader), THALIT, UAH

### Achievements

- Creation of GUI for the bridge crew
- Incident Management module was used by the end-users to orchestrate the UC operation
- Integrated with DSS, Weather Forecast Tool and Smart Cameras Modules
- Publish incident data to other components

### Deliverable

**D6.5** PALAEMON Incident Management Module (PIMM) (M32)



- PALAEMON
- Decision Support Center
- Video Streaming Center
- Incident Assessment

Incident type: Fire Raised at: 2023-03-14T16:08:37.675134  
Operational Level: 1

Passenger Issues
Start Voyage
Smoke Detectors
LOGOUT

### Ship Stability Toolkit

Content of the Ship Stability Toolkit

- Heave: 5.6295m
- Sway: 9.536m
- Pitch: 15.9844m
- Yaw: 7.7809°
- Surge: 19.6153°
- Roll: 15.5877°

### Situation Assessment Recommendation

Sound GA: Abandon: **Stay Check**

### Decision Support System

Which is the point of the fire or explosion that broke out?

FIRE AT THE ENGINE ROOM
FIRE/EXPLOSION ON THE SHIP
FIRE IN THE KITCHEN

FIRE AT THE GARAGE
FIRE IN THE ACCOMMODATION AREAS

### Weather Forecast Toolkit

#### Current Weather

Sig wave height	Wind Direction	Wind Speed	Air Temperature
1.00 ft	169.00 deg	4.00 kt	5.00 F

#### Suggested Actions

•The crew's actions to extinguish of the fire were effective

Similar case: Gunde Maersk  
Similarity: 100%

#### Risks

•The fire was spreading quickly

Similar case: Aframax River  
Similarity: 99%

#### Possible outcomes

Distribution of deaths and injuries regarding the wind speed conditions

Category	Frequency
Deaths	93
Injuries	572

Distribution of deaths and injuries regarding the visibility conditions

Category	Frequency
Deaths	43
Injuries	175

**Evacuation Manager:**  
(Click the following buttons to change the EM's Operational Level)

<b>Normal Operation</b>  <small>No incident has occurred and all of the ship's functions run smoothly.</small>	<b>Situation Assessment</b> <span style="background-color: yellow; padding: 2px;">Active</span>  <small>The decision of evacuation has been confirmed and the summoning of all</small>	<b>Activation of Evacuation Protocol</b>  <small>The decision of evacuation has been confirmed and the summoning of all</small>	<b>Alert Passengers</b>  <small>The decision of evacuation has been confirmed and the summoning of all</small>	<b>Passenger Mustering</b>  <small>The decision of evacuation has been confirmed and the summoning of all</small>	<b>Mustering Completed</b>  <small>The Mustering phase has been</small>	<b>Embarkation</b>  <small>The embarkation of people into the MEV's is taking place.</small>	<b>Ship Abandonment</b>  <small>The ship has been successfully evacuated.</small>
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# Thank you

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