BETTER SHIPS, BLUE OCEANS

ALERT JOINT INDUSTRY PROJECT

MARIN project No.	:	35098-1-PAS/MO
Date	:	2025-06-16
Version No.	:	4.1
MARIN project manager	:	Ir Willemijn Pauw and Dr Ir Fenneke Sterlini
MARIN technical lead	:	Captain Arjen van der Loo
MARIN department	:	Performance at Sea

MARIN
P.O. Box 28
6700 AA Wageningen
The Netherlands
T +31 317 49 39 11
E info@marin.nl
I www.marin.nl

CONTENTS PAGE

1 INTRODUCTION

1.1 Background

Fatigue due to irregular working and sleeping hours and monotonous (tiring) working conditions are negatively affecting watch standers in most navigation spaces across all oceans and seas. Combined with often excessive working hours when the ship is in port or when the ship transits busy shipping areas, fatigue is frequently the cause of (near) accidents and incidents.

Partly because of these working conditions, well-trained seafarers choose to leave their profession, and this again requires the continuous recruitment and training of new crew members to become part of the ship's operation. This situation causes an additional strain on the onboard operation and is a huge financial burden and an unfortunate waste of well-trained talent.

In an effort to address fatigue, the Horizon project (2012) and Martha Project (2013-2016)[1] focused on changing the watch schedules without reducing the total number of hours of watch standing. New watch schedules were implemented but did not significantly improve the conditions on board.

1.2 Goal of ALERT JIP

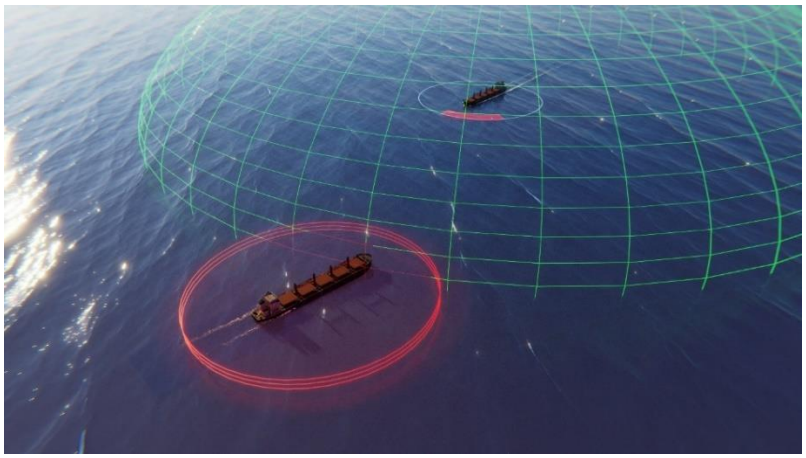

Figure 1.1: dome visualisation of risks, where the ship that 'enters' the dome will need (human) attention.

The ALERT Joint Industry Project (JIP) takes a different approach for navigation spaces. The goal is to improve overall safety, efficiency, and the work-life balance for the maritime crew by introducing periodically unattended navigation spaces.

For several decades, machinery spaces have benefitted from automation systems and 'unattended machinery spaces' designation, to allow machinery spaces to be unattended mostly during the 'dark hours' of the day. Automation systems monitor the technical operation to alert the engineer on duty, when necessary, to any issues needing immediate attention. The set-up of unattended machinery spaces allowed the engineers to dedicate their working hours to the necessary maintenance during the daylight hours and maintain a more favorable and healthier daylight/nighttime sleeping pattern.

The ALERT JIP will use a similar principle to allow the navigation space to be unattended for periods of time while not jeopardizing the safe operation. To be able to (temporary) leave the ships bridge unmanned, the bridge team's tasks, identified as established routines, are divided into 3 specific categories:

- Tasks that can safely be rescheduled,
- Tasks that safely can be absorbed by automated technology and systems
- Tasks that require human (re)action at all times.

[1] www.Solent.ac.uk/research-innovation-enterprise/research-at-solent/projects-and-awards/martha

For each task being performed and each risk which might occur during such a period a solution should be found in either a technological or procedural way.

The dome visualisation explained:
Each emerging or evolving situation can be seen in time and space as a fast or slow approaching risk. This could be something newly appearing or becoming noticeable. An emerging situation is one that has just been identified or has just begun to manifest, like a ship that has just appeared on radar or a fire alarm that has just activated. On the other hand, something that is already present changes or develops over time. An evolving situation is one that continues to change in character, scope, or severity after initial detection, like weather conditions gradually worsening or an engine problem that is progressively deteriorating.
Another example is an observed object in front or aside the ship. In time it will come closer or move in another direction and disappear. In this case it is important to know when action might be needed. As another example sensor information might be outdated due to an error, in combination with other information this might be no problem, while in other cases there will be a time limit after which missing data becomes a dangerous risk. These risks together can be visualized as a 3-dimensional dome over the ship, representing the time and space within which the ship is safe without human intervention (Figure 1.1). The size of the virtual dome is the result of the combination of those risks, the larger the dome, the better. In this illustrative manner the dome visualises the risk interpretation that is currently build up by the crew/human factor in combination with the available technical tools and systems.

1.3 Status at IMO

International Maritime Organization (IMO) has executed a regulatory scoping exercise on Maritime Autonomous Surface Ship (MASS) to assess how existing IMO instruments might apply to ships that utilize varying degrees of automation.[2] The identified degrees of autonomy, are:

- *Degree one*: Ship with automated processes and decision support. Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.
- *Degree two*: Remotely controlled ship with seafarers on board. The ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions.
- *Degree three*: Remotely controlled ship without seafarers on board: The ship is controlled and operated from another location. There are no seafarers on board.
- *Degree four*: Fully autonomous ship: the operating system of the ship is able to make decisions and determine actions by itself.

The present IMO regulations give a guideline for alternative methods (Msc.1-Circ.1604 item 1.2.2):

> *"trails to evaluate alternative methods of performing specific functions or satisfying regulatory requirements prescribed by various IMO instruments should be conducted in such a manner that they provide at least the same degree of safety, security and protection of the environment as provided by those IMO instruments".*

In this project we aim to assess a prototype design onboard.

[2] MSC.1/Circ.1638 Outcome of the Regulatory Scoping Exercise for the Use of Maritime Autonomous Surface Ships (MASS) (2021). Retrieved 22 March 2024, from Netherlands Regulatory Framework (NeRF) – Maritime (overheid.nl)

1.4 Objectives

The periodically unattended navigation spaces envisaged by the ALERT JIP concerns *Degree one* of autonomy. The objectives of the ALERT JIP are to:

1. Create, demonstrate and evaluate a design of an automated watchkeeping concept and the outline of a human alerting system to address those tasks that require human action.

2. Establish approval for a MASS-trial (MSC.1-Circ.1604 item 1.2.2) in such a way that participants can subsequently successfully apply for trial under the current legal framework.

3. Set up a draft-amendment to IMO regulations, specifically to STCW Regulation VIII/2, in order to extend the trial period to permanent, and to extend the conditions for safe unattended navigation spaces.

The strength of the JIP is to tackle this process jointly, to structure it as a risk assessment, to properly document it and to conclusively test mitigating measures. In this JIP, we will not develop a new automated system and decision support (Degree one) instead we will make a prototype description that includes: :

- Flow chart/checklist
- Overview of required data/information such as: equipment status, environmental conditions, navigational challenges
- Overview of thresholds to define status
- Classification of follow-up action (is automated or human interaction required?)
- Guidelines for the HMI
- Recommendations for (adaptation of) system settings such as thresholds

This prototype will contain:

- Specifications for deployment of the ALERT operational concept for ship owners/operators
- Requirements for development of the ALERT system including variables and thresholds for system developers.

1.5 Proposal outline

In the next sections we start with a recap of regulatory back ground. Followed by detailing the scope of work, the planning, the cooperation between project participants and the budget.

2 REGULATORY BACKGROUND

2.1 Current legal situation

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) Regulation VIII/2 sets the requirements for watchkeeping arrangements and principles to be observed. STCW Regulation VIII/2 requires officers in charge of the navigation to be physically present on the navigating bridge or in a directly associated location such as the chartroom or bridge control room at all times. On the other hand it requires officers in charge of an engineering watch to be immediately available and on call to attend the machinery spaces and, when required, shall be physically present in the machinery space during their periods of responsibility.

Existing International Maritime Organization (IMO) regulations such as the International Convention for the Safety of Life at Sea (SOLAS) and STCW itself offer some room for experiments and innovation. According to SOLAS Regulation I/4 (b), the flag State may exempt any ship which embodies features of a novel kind from any of the provisions of chapters II-1, II-2 (construction), III (life-saving appliances) and IV (radiocommunications) under the condition that such ship shall comply with the flag State's safety requirements which are acceptable to the Governments of the States to be visited by the ship. SOLAS also contains a general provision of equivalents in Regulation I/5. A Flag State may allow a ship to be fitted with any other fitting, material, appliance, or apparatus, then prescribed by SOLAS, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance or apparatus, or type thereof, is at least as effective as that required by SOLAS.

STCW Convention Regulation I/13 offers Flag States the possibility to authorize ships entitled to fly its flag to participate in experiments. IMO has issued Guidelines for the approval of alternatives and equivalents as provided for SOLAS Chapter I regulation 4 (b) and various other IMO instruments (MSC.1/Circ.1455).

In 2019 IMO's Maritime Safety Committee adopted Interim Guidelines for trials of Maritime Autonomous Surface Ships (MASS) (MSC.1/Circ.1604). The term "trial" as used by these Guidelines means an experiment or series of experiments, conducted over a limited period, in order to evaluate alternative methods of performing specific functions or satisfying regulatory requirements prescribed by various IMO instruments, which would provide at least the same degree of safety, security and protection of the environment as provided by those instruments. Subsequently, the EU published EU Operational Guidelines for Safe, Secure and Sustainable Trials of MASS.[3] These Guidelines do not allow for deviations from existing regulations excessing the limited period for trials.

[3] EU Operational Guidelines for Safe, Secure and Sustainable Trials of MASS guidelines_for_safe_mass.pdf (europa.eu) (2020). Retrieved 22 March 2024, from https://transport.ec.europa.eu/

3 SCOPE OF WORK

3.1 Overview

Focused on the three objectives (as detailed in 1.4), the ALERT project is a thorough study divided into separate Work Packages (WP's), exploring three areas of expertise, namely: the human factors experience, the advanced technology and the maritime regulations, simultaneously. The focus will be especially on the human factors, where technology and regulations should be considered facilitating.

The ALERT JIP project is divided into work packages. Each with their own scope of work. The following diagram provides a chronological overview of the activities from start (left) to end (right).

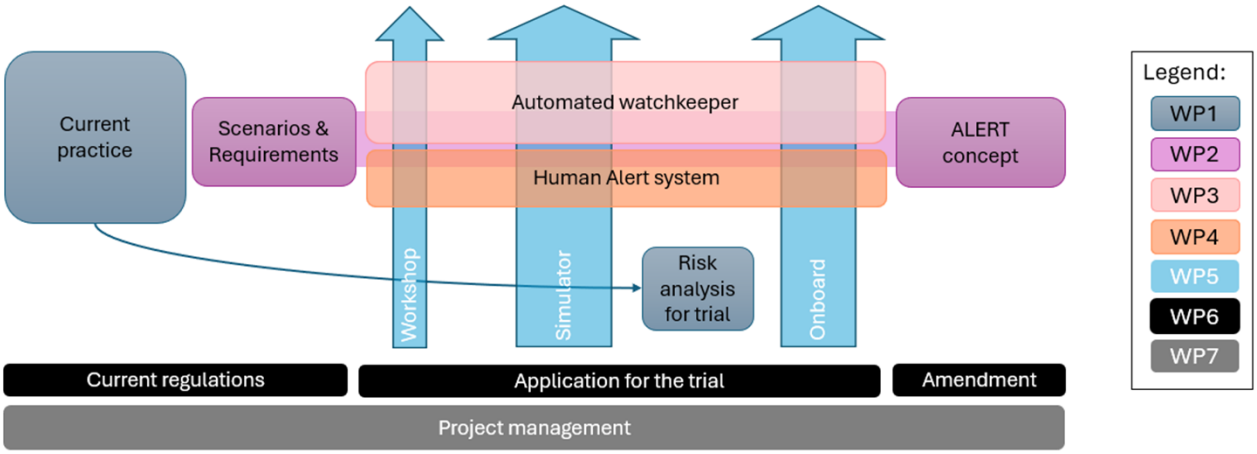

Figure 3.1: Overview of scope and responsible work package within the ALERT JIP. Note that timeline is from left to right and between the different WPs information needs to be exchanged.

- **WP 1:**
  Creates a comprehensive analysis of the present actions and routines on a navigation space, including aspects such as ship and/or cargo type, geographical location, traffic intensity and human experience. This work package results in a risk assessment for the original set up and for the unmanned navigation space. The risk assessment leads to the approval for real life experiments on board ships at sea.
- **WP 2:**
  In the first stage of this work package the scenario definition and requirements are sketched. This is iteratively worked out further during the design in WP3 and WP4, leading to the final ALERT concept.
- **WP 3:**
  Iterative development of the conceptual design and user requirements of the Automated watch keeper.
- **WP 4:**
  Iterative development of the conceptual design of the Human Alert system
- **WP 5:**
  Assessment and validation of the developed concept of the automated watchkeeper and the alert system, in three iterative steps.
- **WP 6:**
  Regulatory assessment of present regulations, the application for the MASS trial and creating proposals for amendments and initiating the process to submit these proposals into the IMO process.
- **WP 7:**
  Project management including the organisation of project steering group meetings.

3.2 Project items in detail

3.2.1 WP 1 – Current practice and risk assessment

The ALERT project will start with a comprehensive review of established routines on the navigation spaces. This overview will be created by literature review, onboard observations, questionnaires, and interviews. Observations will preferably take place on a number of different ships to ensure a good overview in type of operation, type of ship and geographical locations.

The focus will be on those periods of the day (and/or voyage) which are regarded as (very) low workload and limited added value to spend time on watch on the bridge. A task analysis will be conducted describing the various tasks as performed by the bridge watch standing crew during these relevant periods.
A risk analysis will be setup to gain insight into the risks which exist during these periods and which crew actions are taken in the current operation to mitigate these risks. In the later stage of the project the risk analysis will be carried out for the changed procedure including unmanned periods on the bridge, following the present IMO regulations (see section 1.3).This risk assessment leads to the approval for real life experiments on board ships at sea.

3.2.2 WP 2 – Scenarios and requirements

Based on the crew tasks and risks, scenarios can be developed on which the bridge can be unattended for a certain period of time. For each task being performed and each risk which might occur during such a period a solution should be found on either a technological or procedural way. This also includes the actual (i.e. not just ‘scheduled’) work and rest times of the crew.
From these scenarios user requirements and task allocation can be defined.

In a second stage of this work package the scenarios and requirements will be iteratively adapted during the design in WP3 and WP4, leading to the final ALERT concept design, consisting of e.g. :

- Scenario definition for unattended bridge periods
- User requirements
- Prototype of the ALERT concept

This prototype is iteratively developed under WP3 and WP4 and is a description including:

- Flow chart/checklist
- Overview of required data/information such as: equipment status, environmental conditions, navigational challenges
- Overview of thresholds to define status
- Classification of follow-up action (is automated or human interaction required?)
- Guidelines for the HMI
- Recommendations for (adaptation of) system settings such as thresholds

This prototype will contain specifications for deployment of the ALERT operational concept (ship owners/operators) and requirements for development of the ALERT system including variables and thresholds (system developers).

3.2.3 WP 3 – Conceptual design and user requirements of automated watchkeeper

The aim of this work package is to create a conceptual design and user requirements of the Automated watch keeper. Building on the current practice routines an assessment will determine the different values of the operational safety limitations. These operational safety limitations are depending on environmental conditions, ship type, locations and perhaps even experience, among others to be determined during this study. The combined values of the Operational Safety Limitations, can be visualized as a 3-dimensional dome over the ship (Figure 3.2). The determination of the virtual size of the Operational Safety Limitations - dome plays an important role in whether and how tasks will be handled without human involvement.

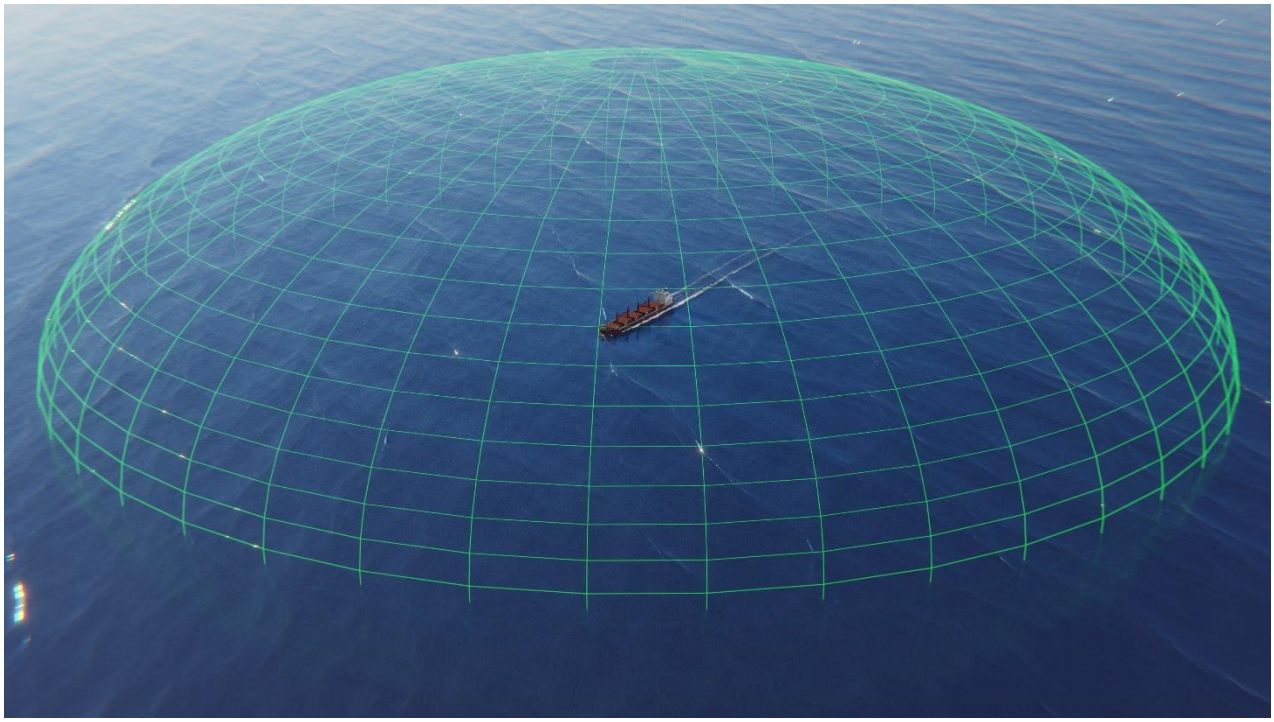

Figure 3.2: visualisation of the Operational Safety Limitations Dome

Tasks will be categorized, e.g. in “Action Levels” that allow deferred human interaction or reaction, tasks that allow (or require) automatic technical/equipment response and those tasks that require a human interaction. Functional requirements for the automated watch keeper will be defined.

In the project we will focus on developing the user requirements. Although the ALERT-project will include a description of functional requirements, the technical development will be left to commercial parties.

The conceptual design will be iteratively developed and tested together with the human alert system during 3 evaluation moments (WP5).

The results of the work package are:

- Operational Safety Limitations overview & Functional requirements
- Conceptual design of watch system (input for WP2)
- Input for the evaluations in WP5

3.2.4 WP 4 – Conceptual design of Human Alerting system

Even though several tasks may be rescheduled or automated, there will be situations where the operator onboard needs to be involved. The stand-by watchkeeper will need to be alerted. It is important that the human watchkeeping has enough time to assess the situation, understand the problem, make a decision, and take action. In WP4 a concept design will be developed in collaboration with the end-users onboard, using a user-centered design approach.

The alerting system could be envisioned to be a mobile device that can be carried with the watch stander on call while the watch stander is away from the bridge (Figure 3.3).

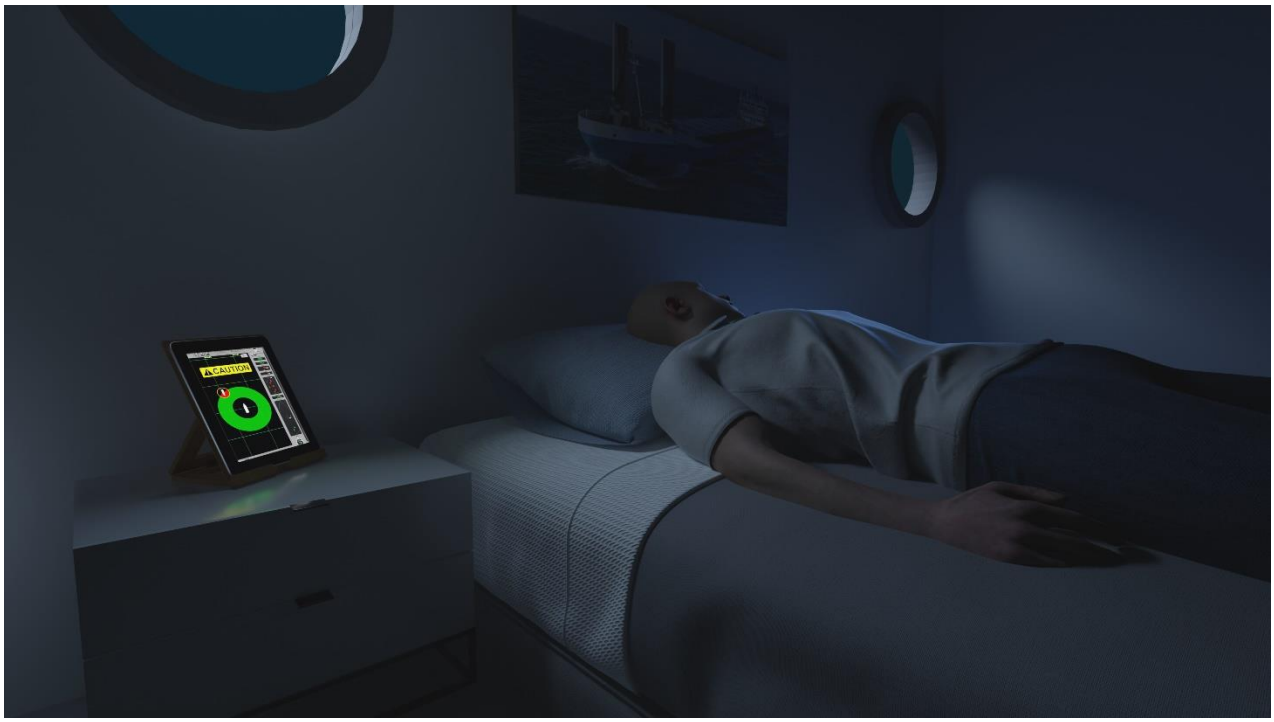

Figure 3.3: artist impression of the human alert system

Similar to WP3 this work package will consist of defining the critical limiting conditions and functional requirements. Next the conceptual design for the human alert system will be iteratively developed and tested during 3 evaluation moments (WP5).

For the human alert system, timing of the alert is crucial. This is depending both on the time until action is needed and on the time needed by the human to react and (re-)gain situational awareness.

The results of the work package are:

- Critical Safety Limits for the alerting system & Functional requirements
- Conceptual design of human alerting system (input for WP2)
- Input for the evaluations in WP5

3.2.5 WP 5 – Assessment and validation

For the purpose of this ALERT project and the planned request for the experiments, keeping the safety of the crew and the ship paramount, the conceptual design of the Alerting system could be tested in simulators and ultimately assessed on board a participating vessel in a human-manually operated format, allowing the further development of the actual ALERT system to be done by commercial parties. In WP 5 the developed designs will be tested during 3 evaluation moments, based on the defined tasks.

I. In the first iteration the evaluation will be done using a workshop with end users of the automated watchkeeper & Human alert concept.

II. In the second phase voyage simulations will be carried out and a simulator workshop will be set up. By means of these simulations, we will evaluate how long and often the periods of unattended bridge are feasible for specific ship types. The results will provide insight if certain ships, geographical locations and/or routes provide better initial conditions for testing the results of this project.

III. In final evaluation we will assess and validate the new procedures in an onboard reality assessment. Feedback from the watch stander and observations during this assessment will be used to optimize the system and gain trust from the crew. The application for MASS trial (WP6) and the risk analysis (WP1) will ensure that the onboard assessment falls within the current regulations.

The results of the work package are:

- Iterative illustration and demonstration of the conceptual designs
- Report with results and recommendations for further development after each assessment

3.2.6 WP 6 – Regulatory

This work package will encompass the assessment of present regulations and the regulatory aspects for the application for the MASS trial.

Furthermore WP6 will set up a proposal for draft-amendments to IMO regulations, including new technology standards, to allow periodically unattended navigation spaces.

The present IMO regulations will be reviewed in combination with the results of the bridge operation review. A full overview will be generated to list the different regulations that need to be addressed. Finally, draft legislative proposals will be generated for the regulatory authorities, such as (but not limited to) flag state and IMO. The process for submission will be initiated after consultation.

The results of this work package are:

- A overview of the current regulations relevant for the ALERT JIP
- Application for the onboard MASS trial and reusable template (WP5)
- Proposal for draft-amendments to IMO regulations

3.2.7 WP 7 – Project Management

This task concerns the overall organization of the ALERT Joint Industry Project. This includes the communication with all participating organizations, JIP administration, finance, subcontracting of tasks, organization of the work, Steering Group meetings, JIP website and dissemination of results where appropriate.

3.3 Deliverables

The following deliverables are foreseen:

- Proof of concept of ALERT and how this improves overall safety, efficiency, and the work-life balance for the bridge watchkeeper.
- Description of the ALERT concept including specifications for deployment of the ALERT operational concept and requirements for development of the ALERT system including variables and thresholds.
- Established approval for a trial under umbrella of MASS regulation (MSC.1-Circ.1604 item 1.2.2) in such a way that participants can subsequently successfully apply for trial under the current legal framework.
- Draft-amendment to IMO regulations, specifically to STCW Regulation VIII/2, in order to extend the trial period to permanent, and to extend the conditions for safe unattended navigation spaces.

4 TIME SCHEDULE AND COOPERATION

4.1 Time Schedule

The ALERT JIP will run over a period of 3 years.

A tentative overview of the timeline is indicated in the activities overview below.

Intermediate progress meetings will be organized every 6 months. In between a progress report will be provided to all participants.

A first consultation meeting was held in March 2024. That meeting together with additional explorations form the foundation for this outline proposal. This outline proposal and standard draft Participation Agreement are circulated to prospective parties in Q2 2025, after which (online) meetings will be held with interested parties to further discuss objectives and scope of work.

The full proposal and participation agreement will be distributed Q2/Q3 2025 for participating parties to formally sign. The kick-of meeting for the ALERT JIP is foreseen during the Vessel Operating Forum (VOF), which will be held November, 2025.

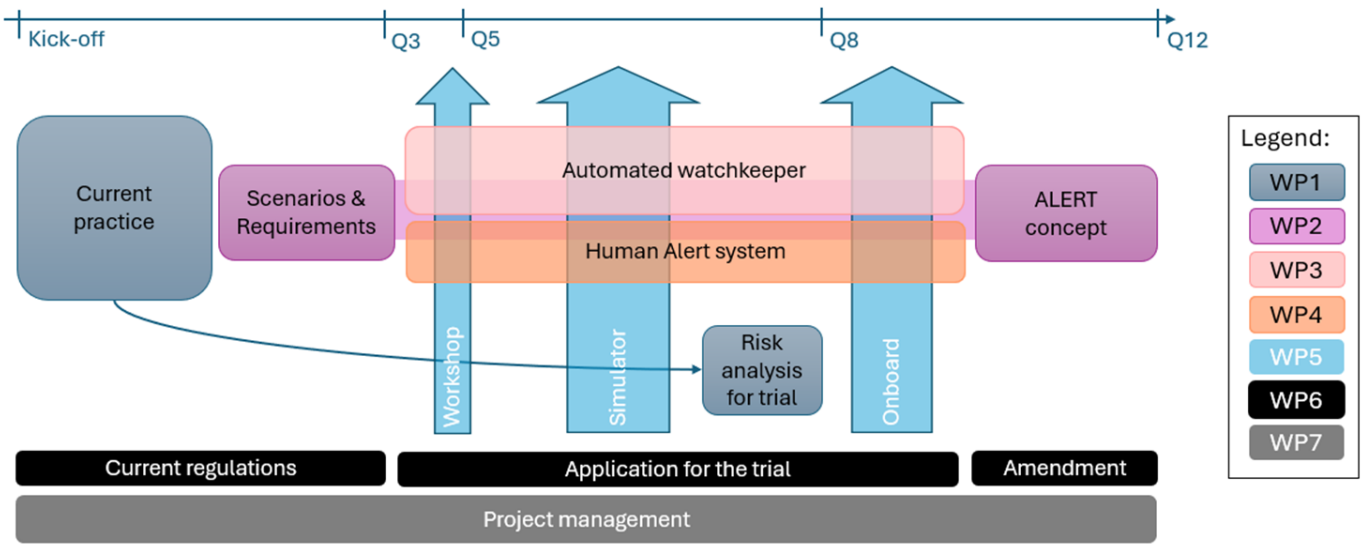

Figure 4.1: project timeline with time in quarters

4.2 Cooperation and progress

The ALERT JIP will be a joint industry project, which is thriving on the cooperation of the variety of participants, such as classification societies, shipowners and operators, equipment and system developers/manufacturers, and (inter)national regulatory authorities.

In this JIP project, MARIN will manage the administration and general project management. The regulatory aspects will be researched and managed by a dedicated project partner. While MARIN is expected to be involved in the majority of the research, other participants will be invited to share their expertise and research opportunities.

We expect the participants to contribute to the project by:

- Participating in the project steering group (Live meeting every 6 months)

- Facilitating onboard observations (WP1) to establish baseline
- Participating in evaluation workshop and simulator (WP5)
- Facilitating onboard reality assessment (WP5)
- Providing a financial contribution

Setting up this project as a JIP gives participants the opportunity to participate in this research and development of the ALERT system and impact the scope and direction. Both the costs and the knowledge development are shared and during the participants will be able to build on their network with other companies/clients. Project results will contain both specifications for deployment of the ALERT operational concept for ship owners/operators and requirements for development of the ALERT system including variables and thresholds for system developers.

5 FINANCE

Based on the outline proposal, the budget estimates are listed in the table below (including 15% contingency). This is based on the following assumptions:

a) observations (WP1) will be carried out on about 5 ships

b) onboard reality assessment (WP5) will be carried out on about 1 ship

At the initial conclusion of the work in WP 1, the detailed specification of the requirements in WP2, WP3 and WP4 will be reviewed and where needed updated. A possible re-allocation of funds may be decided by the Project Steering group.

	Total (EUR)
WP1 – Current practice and risk assessment	195k
WP2 – Scenarios and requirements	80k
WP3 – Conceptual design of automated watch stander	100k
WP4 – Conceptual design of Human Alerting system	65k
WP5 – Assessment and validation	255k
WP6 – Regulatory	60k
WP7 – Project Management	105k
Contingency	130k
TOTAL	**990k**

Based on participation of interested parties, the expected financial contribution is listed below.

	#	**Annual contribution:**	**Total in EUR**	**Total (EUR)**
Ship owners/operators, class societies, equipment manufacturers	8	25k	75k	540k
Small Medium Enterprise[4]	7	15k	45 k	360k
MARIN	1	25k	75 k	75k
				990k

Notes:

- The project will require a minimum of 16 participants
- The annual contribution will be invoiced in November 2025, November 2026 and November 2027
- The terms of payment is within 90 days of receipt of the invoice.
- The participation contributions are fixed lump sum contributions. If necessary, the scope of work can be adjusted by the participants steering group to meet the available budget.
- All quoted prices are excluding VAT and/or other taxes.
- The rates contain a contribution to MARIN's knowledge development for the maritime sector.

[4] SME definition: https://single-market-economy.ec.europa.eu/smes/sme-fundamentals/sme-definition_en with Staff <50, turnover or balancesheet ≤ €10 million

6 CONDITIONS AND TERMS OF PAYMENT

See attached MARIN JIP standard agreement v.10

Organisations confirm their participation by signing the TopTier JIP Participation Agreement with MARIN and will be represented in the JIP Steering Group. Meetings of the Steering Group with all participating organisations will be held every 6 months preferably in conjunction with the Vessel Operator Forum (www.vesseloperatorforum.com).

Data and results will be treated confidentially in the project and will only be shared outside the project after approval of the JIP Steering Group

Invoices:

- Annually in November. The first invoice will be November 2025
- 2nd invoice will be in November 2026
- Final invoice will be in November 2027

Payment

The following terms of payment apply:

- First invoice: payment upon receipt of invoice
- Others: within 90 days

7 CONTACT

For any further information please contact:

Fenneke Sterlini
Senior Project Manager
Phone + 31 6 187 27 102
Email F.Sterlini@marin.nl

Willemijn Pauw
Senior Project Manager
Phone + 31 317 49 33 15
Email W.Pauw@marin.nl

Arjen van der Loo
Project Manager
Phone + 31 6 41 04 24 26
Email A.v.d.Loo@marin.nl

Approved by:

Christian Veldhuis
Manager Performance at Sea
Phone +31 6 25 30 79 15
E-mail c.veldhuis@marin.nl

Hugo Ammerlaan
Manager Maritime Operations
Phone +31 634 08 72 98
E-mail h.l.j.ammerlaan@marin.nl