

DigLogs

Pilot project Plan PP4

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5.2.2 Mobile Safety/Security Pilot

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Introduction: Mobile Safety/Security

The mobile technology can help in reducing the time required for the ship evacuation and abandonment procedures. During an emergency, escape routes might be blocked due to fire or flooding, forcing persons who are following evacuation signs to turn back and search for alternative routes. A mobile application, guiding passengers through the proper direction in the current situation might reduce such problems while avoiding congestions. Such a technology shall be based on the localisation of passengers (smartphone, smartwatch, or other mobile devices) based on an infrastructure sustained by ship emergency grid and/or an independent source of power.

Localisation data can be useful also during normal operation. It can be used to early detect unauthorised access to restricted areas, allowing fast reaction of the onboard security team. Moreover, in case of onboard infections, the localisation records, normally not accessible in order to protect passengers' privacy, could be put at disposal of medical officers. The movements of infected passengers can be analysed to identify the passengers that came in contact with them. Then, through the adoption of test and quarantine, it will be easier to contain the infection growth onboard. Finally, localisation can be useful also for commercial purposes, such as allowing big data analysis, providing push notifications related to the passenger position and providing guidance onboard to reach desired destinations.

Before the development of this promising technology, the technical feasibility of a system based on Bluetooth beacons on a ship has to be proven. Besides, the effect on the evacuation time due to the usage of mobile technology should also be studied to prove the benefit of the system. Therefore, a test on a small test population is advisable to compare the standard evacuation time with the one related to the adoption of mobile technology. This will be the main objective of the pilot action carried out by UNITS within the framework of the DigLogs project. For this purpose, a tender procedure will be prepared to select the developer of the pilot system. The test environment will include an area covering 2 decks connected by multiple staircases on a RoRo pax vessel, which is currently under construction. The pilot system will be composed by a mobile application to be installed on mobile devices and a backend application to configure and monitor the system from the ship bridge. The APP will exploit a beacon net to enable mobile devices localisation.

1. Pilot project goals

The main **project goal** is to assess the effectiveness of the application of mobile technologies to enhance people safety/security on passenger vessels. The project will be mainly focused on ship evacuation, which is a very complex and critical operation during ship design (Figure 1) and even more in the operative environment, when it could be strongly affected by the emergency scenario [1]. In fact, as a consequence of a fire or flooding emergency, ship abandonment could be required.



Figure 1. Evacuation analysis during the design phase.

Passengers are currently trained for emergencies [2], but in a real emergency situation, some escape routes might not be available anymore (especially in case of fire). In such a case passengers could be obliged to come back and search for alternative escape routes, wasting time. Moreover, evacuation can be hindered by the panic occurrence, which might again increase the time required to evacuate the ship. In this context, the usage of mobile technology can enable a reduction of evacuation time, preventing passengers to go in the wrong direction and increasing their situational awareness to limit panic occurrence. The availability of clear guidance information, considering the current status of escape routes, has been already found useful [3].

However, the application of mobile technology to provide guidance onboard has not been tested yet and requires special attention due to the peculiarities of the onboard environment. Besides, the ship is also a challenging environment from a technical point of view. A mobile guidance system requires device localization as a prerequisite. Onboard a ship, localization cannot be carried out with standard methods, such as GPS. The ship is a non-fixed environment and the steelwork does not allow the application of several wireless technologies, due to shielding effect. Bluetooth technology has been already applied to design onshore localization services [4-5] and on passenger ships for commercial purposes [6]. However, up to now, it has not been applied in building positioning systems applicable during emergencies. Hence, the pilot will investigate also the best technical solution to develop an onboard localization service, which has to make information available to the crew, supporting their decisions and reducing reaction time.

The main **long term goal** is to foster the deployment of mobile technologies for onboard safety and security purposes. The achievement of a reduction of the evacuation time is essential to raise the interest of shipping companies and, thus, to enable further development of the technologies tested during the pilot action. Besides the experience gained during the pilot, from a technical point of view is expected to ease the development of onboard positioning systems and their scalability.

A reliable onboard localization service can enable the development of **more complex solutions** compared to the pilot one. Furthermore, additional tools are already foreseen to increase the ship safety and security, ranging from the access to restricted area control to the persons tracking in case of onboard infections, passing through the enhancement of crew situational awareness and the improvement of communication/data collection during an emergency. Besides, localization can be extremely useful for commercial purposes too. The development of combined systems including also commercial functionalities can, even more, encourage the application of mobile technologies for safety/security, fostering their development and widespread diffusion.

2. Pilot project functions and scope

The **main pilot function** is to develop and test a mobile guidance system capable to reduce the evacuation time on passenger vessels in a real emergency scenario. The system will be composed by an application (APP) to be installed on mobile devices and a backend program capable to

collect data from mobile devices for monitoring and analysis purposes. The APP will exploit Bluetooth beacon to locate the user inside ship public spaces and thus guide him to the ship muster stations through the shortest route while taking into account the available escape routes, which could be blocked due to fire, flooding or overcrowded.

As mentioned, the **pilot scope** is to measure the benefits coming from the adoption of mobile technologies to enhance ship safety in terms of reduction of the evacuation time. To this end, tests will be performed in a real environment (passenger vessel).

The main **input** data for the APP will be the signals coming from a Bluetooth beacons net, while the **output** will be a user friendly and clear guidance information that will be provided to the user to speed up the ship's evacuation.

The main **pilot limitations** deal with the small scale of the pilot project. In detail, the experimental campaign involving a sample population will be carried out in a limited area of a passenger vessel. This is sufficient to reach the goal (check technical feasibility and measure the evacuation time) which is the most important prerequisite to enable widespread adoption of the tested technology. Due to the limited area and the limited number of user, the APP and the Backend could require to be scaled and applied in wider environments. During the pilot, the ship WiFi will be adopted to enable the communication between the APP and backend. In a real application, this solution would be viable provided that the WiFi is powered by the emergency grid. Otherwise, it would be necessary to adopt other connection means to assure the functionality during an emergency.

Project **assumptions** are:

1. Time frame dedicated for pilot execution will be adequate,
2. Financial means for pilot requisitioning will suffice,
3. The adoption of Bluetooth technology for localisation onboard will be feasible,
4. The measurements obtained during the pilot can be reasonably scaled,
5. The stakeholders will be interested in project outcomes.

3. Project methodology

Custom **project management methodology** will be used. Best practices and concepts from classic project management methodology will be adopted. It will cover the entire lifecycle of the pilot project implementation. The solution is considered the best choice for the fast track and relatively short project like this pilot.

Standard tools will be used to manage the project, like internal information systems, document management system SharePoint, e-mail and office tools (Microsoft Word, Excel and PowerPoint). Furthermore, a Gantt chart is used to track project execution.

The **project team** will communicate directly (peer to peer), in person and using remote presence tools (Microsoft Teams and Skype). Brief weekly coordination meetings are held to inform all project team members about project development and to solve ongoing issues.

Documents used in the project planning and implementation can be divided into several categories, based on the document type and ownership:

1. DigLogs set of documents, outlined in DigLogs Application Form (includes this pilot work plan),
2. Documents created by UNITS, and
3. Documents created by the service provides (developer).

Expected output documents that will be produced as a part of the pilot project are:

1. Pilot Work Plan (this document),
2. Functional – technical pilot specification (needed for tendering documentation),
3. Tendering documentation (used in the public procurement process),
4. Technical documents required to monitor the service providers work (development, installation, testing),
5. Invoicing documentation,
6. Communication archives (emails),
7. Pilot project evaluation report.

Monitoring of the pilot project execution will be performed using the following milestones, in sequence (checkpoints – check off milestones):

1. Compiled draft of the project work plan – approved by PP4,
2. Completed project work plan – validated by WP5 package leader (PP5) and the whole partnership,
3. Written draft of the technical-functional specification,
4. Completed rest of the public procurement (tendering) documentation,
5. Issued requests/invitations for quotations,
6. Received commercial offers,
7. Evaluation of offers completed and developer selection, CHECK OFF MILESTONE 1
8. Development of the APP and backend,
9. Installation and configuration of the system in the test environment,
10. Trial and system acceptance, CHECK OFF MILESTONE 2
11. Full system functional,
12. Experimental campaign carried out with sample population, CHECK OFF MILESTONE 3
13. Completion of data analysis to assess the findings of the experimental campaign.

4. Project preparation

This chapter describes the **phases** of the Pilot project preparation before the actual development and later phases.

4.1 Project functional requirements

Aiming to fulfill the pilot project objectives, it is necessary to design the technical specifications of the system that will be adopted during the experimental campaign. The technical specification will be the base for the tendering procedure devoted to developing services provider selection. In the following, the key points of the tender technical specification are summarised.

As mentioned, the system, which will be the durable output of the pilot project, will be composed of two applications: the APP and the backend. The APP will be developed for the Android environment and installed on 30 mobile devices (smartphones/smartwatches) and will perform

the device positioning based on a Bluetooth beacons net. In detail, based on the signal intensity of three or more beacons, the APP will triangulate the position of the device within the test environment. The backend application will be installed on a laptop (OS: Windows 10) and will show and record the localisation data and perform some basic analysis including import/export functionalities. The communication between backend and mobile devices equipped with the APP will be assured by the Ship WiFi, provided that the solution will be proved to be feasible in the test environment. Figure 2 shows a sketch of the arrangement that will be tested during the pilot project.

The pilot system will be required to work in two modes:

1. Standard: normal condition, the APP locates the user.
2. Emergency: the APP guides the user to the muster stations through the shortest escape route.



Figure 2. Schematic view of the pilot arrangement and communication between components.

In both modes, the APP transmits the device position to the backend, which shows the location of the connected devices on the ship general arrangement. Both the APP and Backend will record data in a log file. The function mode will be selected using the backend application and automatically transmitted to all connected devices.

In the selected test environment, multiple escape routes scenarios will be prepared. They will include design conditions (all escape routes available) and additional scenarios, where one or more paths are blocked. Using the backend, the active scenario will be selected to consider the actual condition of rooms, corridors or staircases that might be blocked by fire, water or smoke. The selection of the actual scenario will be automatically transmitted to the mobile devices where the APP is installed. This basic solution has been considered satisfactory to fulfil the pilot project objectives and can be easily improved adding an automatic generation of the escape routes scenario after pilot completion. Based on the active escape routes scenario, the APP shall provide guidance information to the user.

Pilot project **prerequisites** are:

1. Selection of a proper test environment (limited area of a passenger ship),
2. Selection of a developing service provider to design and develop the APP and the Backend,
3. Installation of a beacon net in the test environment to enable localisation,
4. Installation of the APP on test mobile devices,
5. Installation of the backend on a laptop.

4.2 Resource tendering

After the creation of the basic technical and functional specification describing pilot system functionalities and the additional services required to complete the pilot, a call for offers will be issued by UNITS. A single service provider will be selected. The tender will include the development of the system, the installation and testing in the test environment, and the provision of the necessary hardware and equipment, which will be at UNITS disposal for 6 months. It is expected to publish the tendering documents in early November 2020 and, due to statutory rules, they shall stay published for at least 15 days. It is expected to collect multiple

offers by the end of November. The evaluation and selection will be performed considering both technical and economical aspects, according to standard rules adopted by the organisation.

The selection of the developing service provider will mark the end of the tendering phase of the pilot execution.

4.3 Pilot solution design

The pilot **detailed design** will be performed by the developing service provider selected with the already described tendering procedure. The design shall satisfy the technical specification and it is subject to UNITS approval. In particular, the developing team will be in charge to define:

- The type of mobile devices (smartphone/smartwatch/both);
- The system architecture, including the applications breakdown into modules;
- The communication protocols between APP and backend;
- The data logging functionalities, including a dedicated database, if required;
- The localisation algorithm, which shall assure a 0.5 m maximum error;
- The guidance mode, which shall be as user friendly as possible considering the chosen device type and might be combined including video, audio and/or device vibration;
- The installation procedures;
- The procedures to optimise Bluetooth beacons position to enable accurate localisation within the test environment;
- The testing procedures.

5. Project development

The pilot project will be divided into four main tasks:

- T1 After the detailed design of the system has been agreed with the developer, the planning of the experimental campaign will be carried out.
- T2 System developer: in this phase, the system (APP and Backend) will be developed and tested in-house by the developer. The guidelines for the deployment of the beacon net will be also defined.

- T3 Configuration and testing: in this phase, the system will be installed and configured in the test environment. In particular, the location of the Bluetooth beacons will be optimised to assure accurate localization of mobile devices.
- T4 Experimental campaign: in this phase, the system will be tested with a small sample population. Then the experimental data will be analysed to finalise pilot project outcomes.

5.1 Preparation of the Pilot environment

The pilot application will be tested on a medium-size passenger ferry (e.g. Figure 3), which is currently under construction at Visentini shipyard in (Porto Viro). UNITS will sign an agreement with the shipyard, which will collaborate free of charge putting at disposal the ship and its WiFi network. The ship's main particulars are reported in Table 1.

Table 1. Main Particulars of test ship

Length overall	LOA	203.28 m
Length between perpendiculars	LBP	194.20 m
Moulded Breadth	B	25.60 m
Max Draught	T	6.50 m
Depth at DK 3 – Main deck	D	9.15 m
Depth at DK 4 – Weather deck	D	15.00 m
Deadweight	DWT	abt 8500 t
Sea trial speed	V	23.70 kn
Passenger cabins		151 x 4
VIP cabins		4 x 2
Disabled cabins		2 x 2
Crew cabins		32
Avion seats		189
Trailers lanes		abt 2566 lm
Cars capacity		abt 260
People onboard (long international voyages)		400
People onboard (short international voyages)		1000



Figure 3. Sample of medium size ROROPAX vessel

For the experimental campaign, an area within passenger accommodations including two decks has been selected:

- Deck 6 (Passenger deck), where the passengers' cabins are located;
- Deck 5 (Restaurant deck), where the vessel's common areas are fitted, as well as muster stations and lifeboats' embarkation.

The test environment (Figure 4) will be limited to the two main corridors on Deck 6, the ship main lounge on Deck 7 and the three staircases connecting the two decks. The area has been selected as a test environment since the presence of multiple staircases makes it easy to define alternative evacuation routes from cabins (start point) to the main lounge (assembly point). Hence, by blocking one or more staircases, it will be possible to test the effectiveness of mobile technology in guiding persons along available escape routes during evacuation.

All rooms within the selected test environment will be properly fitted with Bluetooth beacons to cover all the spaces with the signal of at least three devices. This should enable the localisation of mobile devices in the test area. The location of beacons will be optimised to ensure a good localisation accuracy (errors within 0.5 m). The connection between mobile devices and backend will be assured by the ship WiFi network.



Figure 4. Test environment for experimental campaign

During the experimental campaign, the backend program will run on the laptop connected to the ship WiFi network to monitor and record the mobile devices' positioning data, switch evacuation scenario and start/stop emergency mode. The APP will be installed on 30 mobile devices (smartphones or smartwatches) to carry out the experimental campaign. All the hardware (beacon net, mobile devices) will be provided by the developer and put at disposal of UNITS during the experimental campaign in order to test the system (APP and Backend), as specified in tendering process description.

After the experimental campaign, the system (APP and Backend) will be moved to UNITS and maintained in its facilities. If the pilot project will succeed, further development of the system is already envisaged and it might lead to the installation in all common spaces of several passenger vessels.

5.2 Development of the Pilot application

As mentioned, the pilot system is composed of two main components: the APP and the Backend. The APP will be developed for the Android environment, whereas the Backend for windows 10. UNITS will select a development service provider through the already described tendering

procedure. The developer will be also in charge to put at UNITS disposal all the required hardware to carry out the experimental campaign in the test environment, including the beacons and the mobile devices where the APP will be installed. UNITS has allocated a € 30,000.00 budget for the tendering procedure and will consider multiple technical offers in order to select the developer.

The developer will be required to provide the following documents:

1. Project Implementation Plan: describing in detail development tasks and timing (updated during the project)
2. Requirements Specification: describing in detail the system functionalities
3. Software design description: describing the APP and Backend architecture and its decomposition into modules.
4. Database Logical model: describing the database structure adopted to fulfil system functional requirements

The developer will deliver the APP, the Backend and the related source code (with comments).

5.3 Pilot application testing and acceptance

The selected developing services provider will be in charge of installing and testing the system (APP and Backend) in the test environment. The testing activity has the main objective to check the accuracy of the localization of mobile devices performed by the APP. To this end, special attention will be due to the proper location of Bluetooth beacons within the test environment. The developer is in charge to define the testing procedures that shall be agreed with UNITS.

The developer will be required to provide the following documents:

1. Installation and operation manual: describing the procedures to install and manage the system.
2. User manual: describing the functionalities of the APP and backend.
3. Tests plan: describing the procedures adopted for testing the system functionality in the test environment.

After the installation and configuration in the test environment, a system trial will be carried out under the supervision of UNITS. During the trial, all the functionalities of the system will be

checked in agreement with the test procedures suggested by the developer. After trial success, UNITS will issue an acceptance document and the system will be considered ready for deployment. Then, the developer will be required to provide the following documents:

1. Errors report: describing the anomalies and their solution status.
2. Version document: describing the version of the deployed software and updating the documents issued during the deployment phase.
3. Installation report: including the version of the installed software and changings from the previous status.

5.4 Pilot deployment and documentation

The experimental campaign will include evacuation trials performed with a small sample population. The experimental campaign will be carried out in 1-2 days at Visentini shipyard (Porto Viro), where the ship is currently under construction or at Arsenale San Marco (Trieste), where the hull maintenance will be performed after launching. UNITS personnel will be flanked by the developer's personnel during the experimental tests to prevent/correct any possible technical issue.

Due to COVID-19 emergency, the number of persons involved in the experimental campaign has been limited to 30 as a precaution. Persons will be selected to be as far as possible representative of normal passengers' population [7] to be also comparable with computer simulations. Each person will be provided with a mobile device where the APP is installed.

The experimental campaign aims to prove the efficiency of the deployed technology in reducing the evacuation time. To this end, the sample population will first perform the standard safety training regarding evacuation procedures in the test environment [2]. Then, multiple evacuation trials will be performed and recorded starting from cabins' corridors (Deck 7) to the main lounge (Deck 6), which is the muster station for MVZ 3. The trials will include multiple scenarios, where one or more staircases are blocked and cannot be used by persons (e.g. Figure 5). Trials will be performed with and without the active mobile APP guidance in order to measure the evacuation time reduction obtained by deploying the mobile technology. The scenarios will be randomly scheduled to prevent persons from knowing available escape routes at the beginning of each evacuation trial.

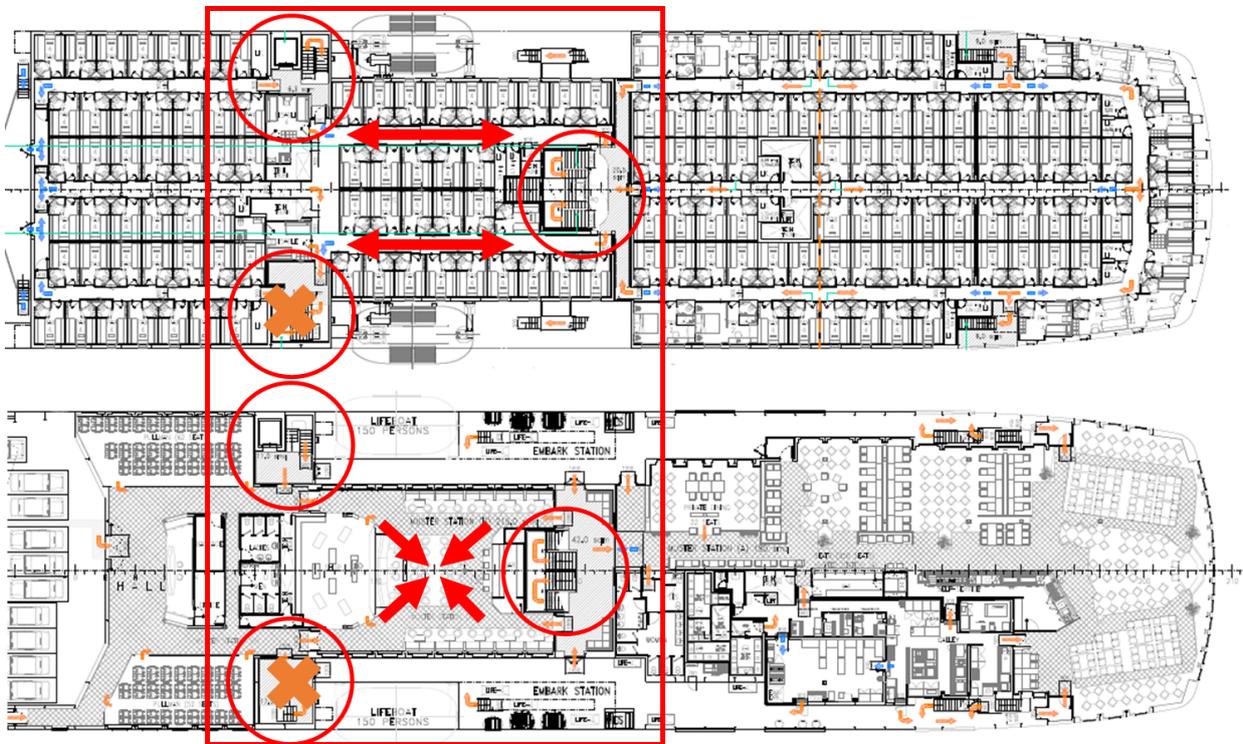


Figure 5. Sample of evacuation scenario with one blocked staircase.

In addition, evacuation simulations will be carried out with advanced commercial software (Figure 6) in order to select the experimental scenarios and effectively plan the experimental campaign (timing). The comparison of the simulations with the experimental data could also enrich the pilot results. The experimental campaign planning will be completed with the instructions to the sample population, which will aid them in the preliminary evacuation training and the usage of the mobile APP. Moreover, during planning, special attention will be paid due to the procedures related to COVID-19 emergency, in order to assure the safety of all the persons in the sample population, as well as UNITS and developer personnel.

After the experimental tests, collected data will be analysed in order to quantify the benefits of the tested solution. The conclusions, together with the findings from the net configuration phase, will be properly documented according to DigLogs application form. This will be the basis for subsequent dissemination activities and, in case of success of the pilot project, in proving the evacuation time reduction for possible further system development.

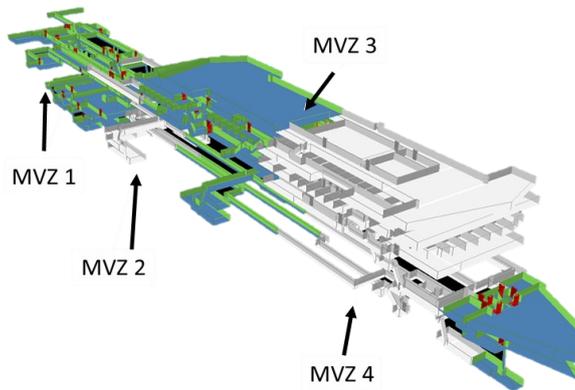


Figure 6. Ship 3D model adopted for evacuation simulations.

The system (APP and Backend) will anyway be maintained for 5 years in UNITS facilities, using proprietary hardware as required by Diglogs application form.

6. Project team

Core project team tasked with project execution is comprised of the following resources with identified roles and responsibilities:

1. **Alberto Marinò**, internal team member, job role: Associate Professor, project role: Scientific Supervisor, in charge of top-level project steering,
2. **Vittorio Bucci**, internal team member, job role: Researcher and Assistant Professor, project role: Project manager, responsible for overall project governance, and financial and organizational aspects of the project,
3. **Serena Bertagna**, internal team member, job role: Research Fellow, project role: Project Communication manager, responsible for communication and dissemination,
4. **Luca Braidotti**, internal team member, job role: Research Fellow and Appointed Professor, project role: Project Assistant, responsible for project technical aspects.

Extended project team includes members of the developers and DigLogs WP5 leader:

5. **Karmen Krivičić Spajić**, external team member, job role: Project manager for PP5 team involvement within DigLogs, project role: DigLogs WP5 package leader, in charge of WP5 steering, progress assurance and compliance assurance with the Application Form
6. Representatives of the selected **developing service provider**, external team members, project role: developers, tasked with the delivery of project required services.

7. Project Timeline

Figure 1 provides an overview of the expected timeline of the pilot project. The main milestones foreseen are:

- MS1 Selection of the system developer (expected within November 2020)
- MS2 Acceptance of the system installed in the test environment (expected within February 2021)
- MS3 Completion of the tests with persons and data analysis (expected within June 2021)

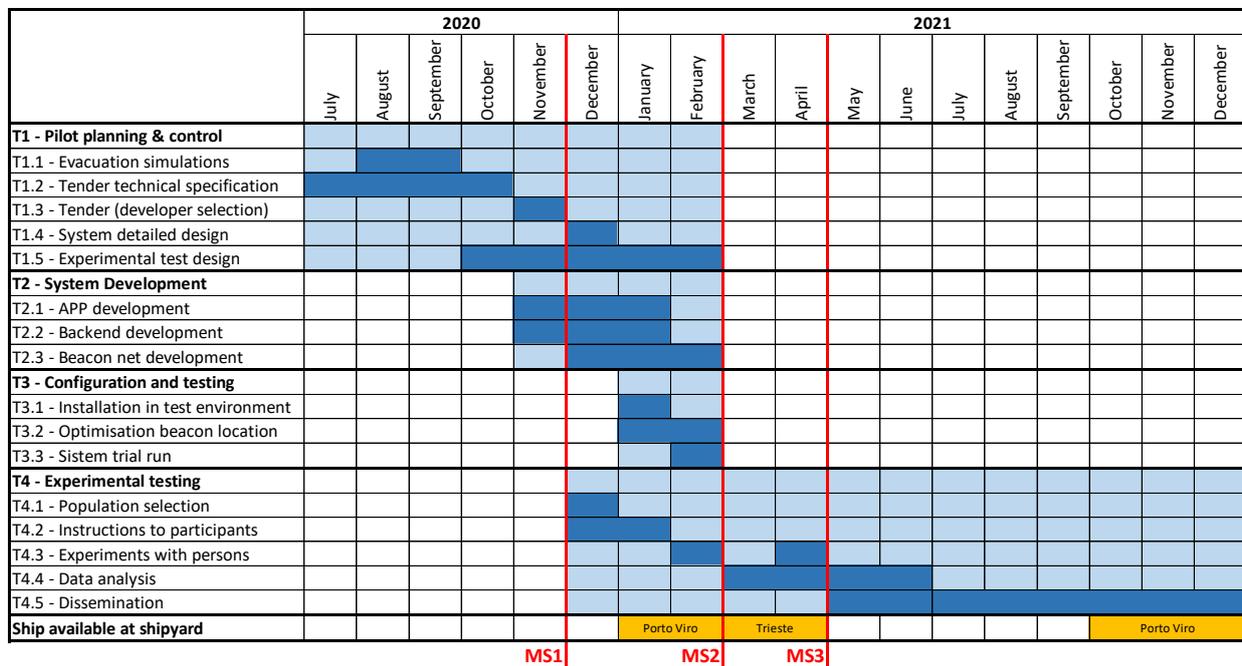


Figure 1. Pilot project Gantt chart

8. Project risk management

Common risk register methodology was developed by the LP of the WP4, in earlier stages of the project, and it will be used to identify and mitigate risks that might arise from the pilot execution.

The main goal of the risk management of the pilot project is to address all foreseen risks from various aspects:

- Use preventive measures and risk avoidance, where possible, to avoid risk occurrence (most favourable),
- Use mitigation measures, where possible, to lessen the risk impact (less favourable),
- Use risk transfer (to third parties), to lessen the risk impact, and
- Establish a clear list of actions and contingencies including escalation path towards WP5 leader and LP and have informed opinion on residual risk.

However, the project will be relatively short (pilot execution), hence, logically, this fact will help significantly in its successful completion.

No higher levels of technical risks are anticipated, thus mostly common project risks may reasonably be expected.

No higher risk of delay due to tendering procedures is envisaged since a single tender will include the complete system development (APP and backend), installation, testing including the hardware for the experimental campaign, which will be provided by the developer and put at disposal of UNITS during the experimental campaign. Hence, there is a lower risk connected to multiple tendering procedures devoted to acquiring the hardware from different vendors.

The main risk is the uncertainty of the availability period of the test environment. As mentioned, the test ship is currently under construction. Hence the shipyard activities and planning can influence the planned installation, testing and experimental campaign. However, the experimental campaign might be carried out in two different timeframes: at the shipyard (when the ship accommodation is finalized) or during the hull maintenance, which is planned in Trieste after ship launching. Hence a quite large window for carrying out the tests is expected, covering a period from January to April 2021. As soon as more details about timing will be available, a

more realistic schedule of the installation and experimental campaign will be issued. In the worst case scenario, the development of the system may not be completed in time to meet the availability window. The occurrence risk for this scenario is considered low, however, a mitigation strategy has been already put in place: the experimental campaign would be delayed and the system would be installed on the next sister ship built by the Visentini shipyard, which is expected by the end of the project.

Another relevant risk is connected to current COVID-19 emergency, which might lead to limitation of the number of persons involved in the experimental campaign. The likelihood of such a scenario is unknown. A possible mitigation strategy would be to carry out the tests with UNITS, developer or shipyard personnel.

The used risk register is shown in Table 2.

Table 2. Adopted risk register.

ID	Date raised	Risk description	Likelihood of the risk occurring	Impact if the risk occurs	Severity	Owner	Mitigating action applicable to pilot project action	Contingent pilot project action	Progress on pilot project actions	Status of the registered pilot project risk
1	[risk identification date]	Pilot project purpose and need is not well-defined	Medium	High	High	LP/SC	Complete a business case for the harmonization pilot if not already completed and ensure purpose is well defined according to project plan	Escalate to the LP/SC and inform WP5 leader with an assessment of the risk of runaway costs/never-ending project.	Business case re-written with clear deliverables and submitted to the LP/SC for acknowledgment	[Open/Closed]
2	[risk identification date]	Project design and deliverable definition is incomplete.	Low	High	High	LP/SC	Define the scope in detail via design details, workshops and meetings with PP/LP and input from subject	Document assumptions made and associated risks. Request high risk items that are ill-defined are removed from scope.	Design workshops and meetings scheduled.	[Open/Closed]

							matter experts.			
3	[risk identificati on date]	Project schedule is not clearly defined or understood	Low	Medium	Medium	PP	Hold scheduling workshops with the project team (internal and external providers) so they understand the plan and likelihood of missed tasks is reduced.	Share the plan and go through upcoming tasks at each weekly project progress meeting.	Workshops scheduled.	[Open/Closed]
4	[risk identificati on date]	No control over staff priorities	Medium	Medium	Medium	PP	PP should brief internal team managers on the importance of the project. Soft book resources as early as possible and then communicate final booking dates ASAP after the scheduling workshops and meetings. Identify back ups for each project team member engaged on the project.	Escalate to the PP's top management and bring in back up resource, inform LP/PSC and inform WP5 leader	PP's top management has to agree to hold briefings. Identification of suitable arrangements (meeting room, teleconferencing tools)	[Open/Closed]

5	[risk identificati on date]	Consultant or subcontractor delays	Medium	High	High	PP	<p>Include late penalties in pilot project contracts.</p> <p>Build in and protect lead time in the schedule.</p> <p>Communicate schedule early.</p> <p>Check in with supplier's progress regularly.</p> <p>Query statements like '90% done'. Ask again and again if the supplier or consultant requires additional information.</p>	<p>Escalate to LP, SC and top management of the supplier and inform WP5 leader. Implement late clauses.</p>	<p>Lead time from each contractor built into the project schedule.</p> <p>Late penalties agreed to and contracts signed.</p>	[Open/Closed]
6	[risk identificati on date]	Estimating and/or scheduling errors	Medium	High	High	PP	<p>Break this risk into two parts: 'cost estimating' and 'scheduling errors'.</p> <p>Use two methods of cost estimation, and carefully track costs and forecast cost at completion making adjustments as necessary.</p> <p>Build in 10% contingency on cost and</p>	<p>Escalate to LP and SC and inform WP5 leader. Raise change request for change to budget or schedule. Pull down contingency.</p>	<p>Contingency agreed by the top management of the PP; LP informed.</p>	[Open/Closed]

							<p>scheduling.</p> <p>Track schedules daily and include schedule review as an agenda item in every project team meeting.</p> <p>Flag forecast errors and/or delays to the Project Board early.</p>			
7	[risk identificati on date]	Unplanned work that must be accommodated	Low	High	Medium	PP	<p>Attend project scheduling workshops.</p> <p>Check previous projects, for actual work and costs.</p> <p>Check with peer companies for actual events during similar projects.</p> <p>Check all plans and quantity surveys. Document all assumptions made in planning and communicate to the vendor's project manager before</p>	<p>Escalate to the vendor's project manager with plan of action, including impact on time, cost and quality.</p>	PP's team attending scheduling workshops.	[Open/Closed]

							project kick off.			
8	[risk identificati on date]	Lack of communication, causing lack of clarity and confusion.	Medium	Medium	Medium	LP/SC/PP	<p>Write and discuss a communication plan which includes frequency, goal, and audience of each communication.</p> <p>Identify stakeholders early and make sure they are considered in the communication plan.</p> <p>Use most appropriate channel of communication for audience e.g. don't send 3 paragraph email to developers,</p>	Correct misunderstandings immediately. Clarify areas that are not clear swiftly using assistance from Project Sponsor if needed.	Communication plan in progress.	[Open/Closed]

							have a call instead.			
9	[risk identificati on date]	Pressure to arbitrarily reduce task durations and or run tasks in parallel which would increase risk of errors.	Low	High	Medium	PP	<p>Share the schedule with key stakeholders to reduce the risk of this happening.</p> <p>Patently explain that schedule was built using the expertise of subject matter experts.</p> <p>Explain the risks of the changes.</p> <p>Insist on contractual obligations towards pilot project vendors.</p>	<p>Escalate to LP and SC with assessment of risk and impact of the change and inform WP5 leader.</p> <p>Hold emergency risk management call with decision makers & source of pressure and lay out risk and impact.</p>	Awaiting completion of the schedule.	[Open/Closed]

10	[risk identificati on date]	Scope creep	Medium	High	High	PP	<p>Document the pilot project scope in a Project Initiation Document or Project Charter and get it authorised by the PP.</p> <p>Include the full scope in the contract.</p> <p>Refer to it throughout the project and assess all changes against it also ensuring alignment of any changes with the business case of the pilot project.</p>	<p>Document each and every example of scope creep NO MATTER HOW SMALL in a change order and get authorisation from the project board BEFORE STARTING WORK.</p> <p>This includes ZERO COST changes.</p>	Scope clearly defined in the contract.	[Open/Closed]
11	[risk identificati on date]	Unresolved project conflicts not escalated in a timely manner	Low	Medium	Medium	PP	<p>Hold regular project team meetings and look out for conflicts.</p> <p>Review the pilot project plan and stakeholder engagement plan for potential areas of conflict.</p>	<p>When aware immediately escalate to LP and PSC and gain assistance from LP to resolve the conflict. Inform WP5 leader</p>	Project team meetings scheduled.	[Open/Closed]
12	[risk identificati on date]	Proposed pilot action becomes obsolete or is undermined by external or internal changes.	Low	High	High	PP	<p>No ability to reduce likelihood, but make sure early warning is given by reviewing pilot action on regular</p>	<p>Initiate escalation and project close down procedure.</p>	Project close down procedure confirmed with Project Board.	[Open/Closed]

							basis with the LP/PSC prior to stipulating the contract.			
13	[risk identification on date]	Delay in earlier project phases jeopardizes ability to meet fixed date. For example delivery of just in time materials, for conference or launch date.	Medium	High	High	PP	Ensure the project plan is as accurate as possible using scheduling workshops and work breakdown structure. Use Tracking Gantt and Baseline to identify schedule slippage early.	Consider insurance to cover costs and alternative supplier as a back up, if possible.	Awaiting completion of the schedule.	[Open/Closed]
14	[risk identification on date]	Added workload or time requirements because of new direction, policy, or DigLogs project changes	Low	Medium	Medium	PP	No ability to reduce likelihood.	Acquire advanced notice from PSC/LP if possible. Inform WP5 leader	Pilot project management reviewing options.	[Open/Closed]
15	[risk identification on date]	Inadequate testing by the project team or involved (aimed) stakeholders leads to large post go live snag list.	High	High	High	PP	Ensure that test cases/quality checks are timely prepared and testing/quality assurance window is protected.	Raise risk immediately and raise issue if it is clear that UAT testing is inadequate. Stakeholders could extend testing & bring in additional resource.	Stakeholders preparing test cases.	[Open/Closed]
16	[risk identification on date]	Legal action delays or pauses project.	Low	Medium	Medium	SC/LP/PP	Ensure all contracts signed before starting the pilot project. Follow all regulatory requirement	Escalate to the PP's management who will notify legal department. Follow instructions from legal	Contracts issued.	[Open/Closed]

							s and complete stakeholder management plan.	department and inform LP/PSC and inform WP5 leader		
17	[risk identificati on date]	Stakeholder or PP refuses to approve deliverables/milestones or delays approval, putting pressure on project manager to 'work at risk'.	Medium	Medium	Medium	PP	Ensure that PP's decision maker with budgetary authority is identified before project start and is part of the project board. Communicate dates for sign-off points up front.	Escalate to PP's management and LP and recommend action e.g. - to stop the project. and inform WP5 leader	Pilot project manager is confirming their sponsor / top management of the supplier.	[Open/Closed]
18	[risk identificati on date]	Theft of materials, intellectual property or equipment.	Low	High	High	PP	Follow security procedures, ensure Non-Disclosure Agreements (NDAs), & compliance certificates are in place along with required confidentiality clauses. Verify all physical security measures in place. Secure insurance, if applicable.	Notify appropriate authorities e.g. police, legal department, LP, PSC and initiate internal investigations. Inform WP5 leader	NDAs issued. Security certificates confirmed for contractors/suppliers working on the pilot project.	[Open/Closed]

19	[risk identification date]	Acts of God for example, extreme weather, leads to loss of resources, materials, premises etc.	Low	High	High	PP	<p>Ensure insurance in place and valid.</p> <p>Familiarise project team with emergency procedures. Where cost effective put back up systems in place, if applicable.</p>	<p>Notify appropriate authorities.</p> <p>Follow health and safety procedures.</p> <p>Notify stakeholders, LP and PSC. Inform WP5 leader</p>	Public Liability Insurance confirmed along with additional premises insurance at site / for the pilot project.	[Open/Closed]
20	[risk identification date]	Pilot project stakeholder's action (or lack of) delays project.	Low	High	High	PP	<p>Identify interested and dedicated stakeholders before start of the pilot project, analyze power and influence and create a stakeholder engagement plan.</p> <p>LP/PSC to check and if applicable, authorise the plan.</p> <p>Revisit the plan at regular intervals during pilot project execution to check all external stakeholders are managed.</p> <p>Consider getting additional insurance.</p>	<p>Notify appropriate authorities and follow internal procedures e.g. for activist demonstrations. Inform WP5 leader</p>	Stakeholder involvement analysis in progress.	[Open/Closed]

2 1	[risk identification date]	Due to delays in system development, the test ship is not available for the experimental campaign	Low	High	High	PP	<p>Monitor development status</p> <p>Update schedule on the base of shipyard scheduled operations.</p> <p>Postpone the experimental campaign to the next sister ship.</p>	Escalate to LP, SC and top management of the supplier and inform WP5 leader. Implement late clauses.	PP's team attending scheduling workshops.	[Open/Closed]
2 2	[risk identification date]	COVID 19 limit the number of persons during the experimental campaign	Medium	Medium	Medium	PP	<p>Consider in experimental campaign planning a reduced number of persons</p> <p>Follow the guidelines issued by public health authorities</p> <p>Carry out the experimental campaign with UNITS or Shipyard personnel</p>	Adopt alternative procedures during the experimental campaign.	Define alternative procedures for sample selection.	[Open/Closed]

Legend:

- LP = Lead Partner
- PSC = Project Steering Committee
- SC = Steering Committee (same as PSC)
- PP = Project Partner (PP4 in this case)

References and attachments

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- [7] IMO. 2016. MSC.1/Circ.1533 ANNEX 3 Guidelines for an advanced evacuation analysis of new and existing passenger ships. International Maritime Organisation. London, UK.