MONALISA 2.0 – Activity 3

Report on Pilot application: usability and crew acceptance issues

Document No: MONALISA 2.0_D3.1.6

Co-financed by the European Union
Trans-European Transport Network (TEN-T)
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<th>Version</th>
<th>Date</th>
<th>Author</th>
<th>Comments</th>
</tr>
</thead>
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1 Introduction

In the document D.3.1.3 the maritime scenarios for the marine application are defined. The aim of this document is to describe the carrying out of B-BS pilot applications in the defined marine scenarios and explain the progress of these, under the point of view of Behavioral Analysis, in order to reduce marine causalities.

The current Deliverable 3.1.6 describes the activities conducted during the pilot applications and the usability and crew acceptance observed during those activities.

In next Deliverable 3.1.7 will describe the feedbacks from pilot results and the proposed operations to be improved.

2 The selected marine scenarios for pilot application

<table>
<thead>
<tr>
<th>MARINE SCENARIOS</th>
<th>SHIPOWNER</th>
<th>FAMILY OF PILOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 Roll-on/Roll-off passenger</td>
<td>Moby Lines</td>
<td>1) D. Lgs. 271/99</td>
</tr>
<tr>
<td>A2 Ro-Ro Pax ship</td>
<td>Transmediterranea</td>
<td>2) MLC</td>
</tr>
<tr>
<td></td>
<td>Balearia</td>
<td></td>
</tr>
<tr>
<td>B Cruise ship</td>
<td>Costa Crociere</td>
<td></td>
</tr>
<tr>
<td>C Offshore Plant installation</td>
<td>OLT Offshore LNG</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toscana</td>
<td></td>
</tr>
</tbody>
</table>

Scenario A: Ro-Ro Pax

The scenario of Roll-on/Roll-off covers all vessels designed to carry wheeled cargo, such as automobiles, trucks, semi-trailer trucks, trailers, and railroad cars that are driven on and off the ship on their own wheels or using a platform vehicle. Types of Ro-Ro vessels include ferries, cruise ferries, cargo ships and barges.

In particular, the selected scenario regards the Ro-Ro pax. The acronym describes a roll-on/roll-off vessel built for freight vehicle transport along with passenger accommodation. Technically this encompasses all ferries with both a roll-on/roll-off car deck and passenger-carrying capacities.
Deciding to do the pilot application on a Ro-Ro Pax vessel, we privileged:

- The activities on board (with particular emphasis on the activities defined as "dangerous");
- The crew on board (with particular emphasis to the training and professional required certifications);
- The workplace on board (defined as a place where the seafarers carried out the tasks assigned and the places for the rest/refreshment and hygiene/health).

Scenario B: Cruise ship
This scenario covers all passenger ships used for pleasure voyages, where the voyage itself and the ship’s amenities are a part of the experience, as well as the different destinations along the way.

Deciding to do the pilot application on a Cruise ship, we privileged:

- The Injuries (with particular emphasis on the activities of reporting, statistics, detection of all events);
- The activities on board (in particular, the seafarers’ work and rest hour).

Scenario C: Offshore Plant
This scenario covers a particular floating regasification terminal, which transforms the liquefied natural gas (LNG) back to its normal gaseous. The terminal is a workplace at high risk from the point of view of Safety (safety of workers at the workplace) and Environment (environmental impact in case of serious accident). The main hazards are classified by the presence of high risk factors that are closely linked, as well as:

- the type of job, activities, used materials
- the features of the workplace (offshore platform)
- the proximity to the coast.

Deciding to do the pilot application on Offshore Plant installation, we privileged:

- The jobs (with particular emphasis on tasks assigned to workers and the related workplace);
- The activities on board (in particular, seafarers’ compliance to the operational procedure).
3 Activities conducted during the pilot applications

3.1 Scenario A1: Seafarers Safety Requirements: D.Lgs. 271/99 survey activities on Italian Ro-Ro pax

The first pilot application is occurred during the survey activities, regularly carried out on board ships of the Italian flag. The survey is performed together with the Shipping companies and the on board representatives.

The three main areas of the survey are:

- The activities on board (with particular emphasis on the activities defined as "dangerous");
- The crew on board (with particular emphasis to the training and professional required certifications);
- Work environment (defined as a place where the seafarers carried out the tasks assigned and the places for the rest/refreshment and hygiene/health).

Survey Activities

An inspection was carried out on-board a Ro-Ro Pax Italian Flag on 17-18 June 2014. During the inspection, some sub-areas related to each 3-macro areas described above were examined.

The table 1 summarizes the areas inspected, the main activities carried out for each area and relevant applicable standards.

<table>
<thead>
<tr>
<th>AREA</th>
<th>TASK</th>
<th>REFERENCE STANDARDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON BOARD ACTIVITIES</td>
<td>The following have been random examined:</td>
<td>D.Lgs. 271/99</td>
</tr>
<tr>
<td></td>
<td>▪ Staff assigned educational qualifications,</td>
<td>D.Lgs. 108/05</td>
</tr>
<tr>
<td></td>
<td>▪ operating procedures of the sector or and activity,</td>
<td>T.U. DPR 1124/65</td>
</tr>
<tr>
<td></td>
<td>▪ individual safety equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Examination of &quot; ship works journal &quot; for evaluate the maximum hours of work and the minimum number of hours of rest carried out;</td>
<td></td>
</tr>
<tr>
<td>CREW</td>
<td>The following check have been carried out:</td>
<td>D. Lgs. 271/99</td>
</tr>
<tr>
<td></td>
<td>▪ Professional, medical, medical exemptions for any types of work certifications,</td>
<td>D. Lgs. 108/05</td>
</tr>
<tr>
<td></td>
<td>▪ Shift rest hours made,</td>
<td>L. n.1602/62</td>
</tr>
<tr>
<td></td>
<td>▪ Crew juvenile training of a minor,</td>
<td>DPR n.114/2010</td>
</tr>
<tr>
<td></td>
<td>▪ Medical assistance outside and injuries/accidents/incidents recording</td>
<td>C.N. art.323</td>
</tr>
<tr>
<td></td>
<td>▪ Claims , and the relevant mitigating process</td>
<td>D. M. 30/11/07</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D. Lgs. n.136/11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DPR n. 231/06</td>
</tr>
<tr>
<td>ON-BOARD WORK ENVIRONMENT</td>
<td>Dangerous work environments and crowded areas have been checked:</td>
<td>D. Lgs. 271/99</td>
</tr>
<tr>
<td></td>
<td>▪ Maneuvering and mooring areas;</td>
<td>L.1045/39</td>
</tr>
</tbody>
</table>
• Bridge and Engine room;
• Infirmary and medical equipment and, if present, the hospital;
• Layout and arrangement of the crew premises
• kitchens, canteen, cafeterias and recreation rooms (crowded place);

Table 1. Survey activities carried on board Ro-Ro Pax on 17-18 June 2014

Before any inspection the surveyor have to preliminary analyze and approve the activity the following documents:

✓ General Plan Safety;
✓ Risk Assessment Evaluation;
✓ Technical Specification (i.e. living quarter, accommodation safety equipment).

The survey is carried out at the presence of the following ship personnel:

✓ Captain;
✓ Deputy Commander of Armament;
✓ Health and Safety Responsible;
✓ Chief Engineer;
✓ Purser ;
✓ Deck Officer.

The survey on board has been carried out accordingly to this procedure:

<table>
<thead>
<tr>
<th>ITEM</th>
<th>SURVEY</th>
<th>CHECKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREW</td>
<td>Work / rest area hours of dangerous areas (the bakery);</td>
<td>Book’s check</td>
</tr>
<tr>
<td>CREW</td>
<td>Crew work / rest hours</td>
<td>Book’s check. All of the crew from 10.00 to 14.00</td>
</tr>
<tr>
<td>CREW</td>
<td>Seafarers’ certified skills</td>
<td>Presence of “OMNIA module” (on paper) and evidences (on paper) of Seafarer certificates (file ACCESS)</td>
</tr>
<tr>
<td>CREW</td>
<td>Claims</td>
<td>No Claims</td>
</tr>
<tr>
<td>ASBESTOS PRESENCE</td>
<td>Presence of no asbestos certificate</td>
<td>Certificate confirmed</td>
</tr>
<tr>
<td>DOCTOR ON BOARD</td>
<td>Due to risks: presence of personnel according to the FSA check</td>
<td>Doctor and nurse on board presence checked</td>
</tr>
<tr>
<td>HEALTHY WORKPLACE</td>
<td>Healthy workplace:</td>
<td>Visual check</td>
</tr>
<tr>
<td>HEALTHY WORKPLACE</td>
<td>• Cabins</td>
<td></td>
</tr>
<tr>
<td>HEALTHY WORKPLACE</td>
<td>• Officers canteen</td>
<td></td>
</tr>
<tr>
<td>HEALTHY WORKPLACE</td>
<td>• Recreational areas</td>
<td></td>
</tr>
</tbody>
</table>
### Table 2. Procedures on board

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DRUGS</strong></td>
<td>Drugs cabinet: weekly check according to SMS procedures</td>
</tr>
<tr>
<td></td>
<td>Cabinet opening and check</td>
</tr>
<tr>
<td><strong>ARMCHAIR ROOM for PAX</strong></td>
<td>Chairs and armchairs Disabled Adapted</td>
</tr>
<tr>
<td></td>
<td>Meeting room check</td>
</tr>
<tr>
<td><strong>MACHINERY AND CONTROL ROOM</strong></td>
<td>Book patrols</td>
</tr>
<tr>
<td></td>
<td>Patrols check</td>
</tr>
<tr>
<td><strong>CREW: INJURY DISEASE</strong></td>
<td>First aid evaluation in short and long navigation</td>
</tr>
<tr>
<td></td>
<td>Visual check/Interviews injuries/diseases book check</td>
</tr>
<tr>
<td></td>
<td>If short: the injured goes ashore and goes to the Cassa Marittima (body of National Health System)</td>
</tr>
<tr>
<td></td>
<td>If long: it could be several cases: emergency, no emergency, request of injury on board with auto-declaration of the involved seafarer.</td>
</tr>
</tbody>
</table>

### 3.2 Scenario A2: Seafarers Safety Requirements: D.Lgs. 271/99 survey activities on Spanish Ro-Ro pax

The second pilot application was carried out on two Spanish vessels, one on Transmediterranea and the other one on Balearia.
It was started an activity of user research on the participants to the pilot studies to identify target users in maritime domain which will use the B-BS ICT tool. User research develops an understanding of users’ needs/constrictions of working environment and how the ICT tool fits into that. It helps determine how the tool meets the determined requirements and how it fits within users’ lives. To achieve this, it was decided to use two methods of profiling, personas and scenario, which require both users’ direct involvement and/or participant observation.

- Persons are hypothetical archetypes of users, which are described as unique characters with specific details that make designers/developers understand the real users who will
adopt the final product. Each persona can represent a group of people with shared behavioral characteristics. Personas are defined by their practical and company-oriented goals as well as by their identities, behaviors, mental models and personal expectations in using the final product. Personas description is used as well as the basis for outlining a scenario that investigates the use of the product from users’ point of view.

✓ Scenarios describe in a narrative way the context in which a user or a user group use a product. They present the goals to be achieved and the eventual criticalities from the particular user point of view, defining the possibilities that the users have in trying to reach their goals through the product. In creating the story for a scenario, causality has to be considered as a necessary narrative element to insert, since the focus is on the relationship between user’s actions and resulting reactions of the product.

For the development of personas and scenario, the seafarers of the Spanish pilot studies were interviewed on the telephone. The sample was composed of thirteen seafarers (one of them was a woman) and equally represented by deck staff (six workers) and engine room staff (eight workers). The questions ranged from their habitual tasks and habits (i.e. shifts span, work wear, communication with colleagues), to their attitude to new technologies (i.e. hours per week surfing on the Internet, smartphones use, interaction with mobile Applications) and to their care for workplace and activities safety.

The results of this activity, on the basis of the most recurring participants’ answers, show that a third of the interviewed decided to work in maritime as a vocation, all of them work in shift change wearing the necessary PPEs and they consider, for better or worse, that new technologies have had an ongoing growing importance in their activities from the very last years. From this evidence, the sample was divided in two streamlined categories:

1. the younger seafarers, with less maritime experience and more interested in new technologies,
2. the older ones, much more skilled, but little or not all inclined to new tools.

Using these information as a starting point, two personas and scenarios about the use of the mobile Application for the B-BS ICT tool were outlined.

<table>
<thead>
<tr>
<th>PERSONAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Personas Image]</td>
</tr>
</tbody>
</table>

“I use the Internet for everything, from talking to my parents’ home to searching the last news bulletins”.

Personal information:
Age: 28 years old
Residence: La Coruña
Position: Second Deck Officer
<table>
<thead>
<tr>
<th>SCENARIOS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deck - mooring</td>
<td>The crew is involved in mooring procedure and the captain asks for everybody’s special attention since just a month before a third officer injured the fingers on his left hand, crushing them between the tug’s line and the vessel’s fairlead when trying to let the tug go.</td>
</tr>
<tr>
<td>Engine room – night shift</td>
<td>Two out of the four hours of the night shift have passed. The youngest between the workers are showing the first signs of boredom.</td>
</tr>
</tbody>
</table>

**Overview about Personas and Scenarios outcomes**

With the previous steps and interviews, it has been created the Checklist for Risk Prevention, starting from the two Ro-Ro Pax procedures and activities on board:

- Step 1 - Planning work: who will be involved in the task.
- Step 2 - Check safety equipment: Officer checks that crew wear safety equipment
- Step 3 - Development of work and notes of the observer: the observer checks crew behavior and takes some notes.
3.3 Scenario B: Injury reporting process on Cruise ship

The pilot application in a cruise ship scenario has been carried out. The selected ship has installed on board an ICT solution for asset management intended for the maintenance purpose and also for the injury reporting. The on board installed ICT tool is capable to record all the injuries in a standard format, according to the principles of B-BS methodology (i.e. the pyramid of risk).

The following activities have been carried out:
- How the “injury” process is performed on board;
- The Non Conformities (NC) management (record and follow up), coming from behavioral observations (near miss).

From this pilot application, the following considerations have been stated:
- An average 90% of the “injury” audit is realized by a documentary process (ex post analysis).
- The existing ICT tool detects previously (not on board) “Non Conformity” but not all the occurred Near Miss, that are at the basis of the risk pyramid of Heinrich, the true warning that something doesn’t work.
- Heinrich’s Law: in a workplace, for every accident that causes one major injury, there are 29 accidents that cause minor injuries and 300 accidents that cause no injuries. Because many accidents share common root causes, addressing more commonplace accidents that cause no injuries can prevent accidents that cause injuries.

![H.W. Heinrich (1931)](image)

The activity carried out by the Minister today is a "safety investigation "(which follows the Resolution A20 / 849 of the IMO Assembly of 27 November 1997, also referred to as the IMO Code for the Investigation on Claims and maritime accidents - marine casualty or incident safety investigation) and is defined as a process, held in public or in private session, and led to the prevention of accidents and injuries, including the collection and analysis of information, the assessment of the circumstances and determination of the causes and contributing factors, the resolution of the conclusions and the issue of any recommendations.

The purpose of "re-definition of the Standard" comes from the fact that the model suffers from the need for standardization, codification, optimization and it needs for a greater efficiency in the statistical analysis, considering also that the activity of identification of the knowledge of all occurrences / events is long and delicate.

It is not a task that can be accomplished once and for all and is particularly demanding, especially because in the maritime sector, characterized by particular conditions of life and work
(stress, extra-ordinary, distance from home, the plurality of languages and nationalities of the crew).

The on board installed ICT tool is capable to record all the injury by mean of a Log Book, a ship's logs, i.e. it is a record of important events in the management, operation, and navigation of a ship. It is essential to traditional navigation, and must be daily filled in at least.

The ICT tool has been developed to fill in the injury in standard format. The scope of the tool is to fill the records by means of an ELB - Electronic Log Book.

The ELB system will be a software system which make logbook entries quick and easy, meeting requirements of IMO, Marpol, SOLAS and several flag states for replacing many of the traditional paper logbooks. Daily reporting tasks will become less time consuming, reducing workload for officers.

The main features consolidate are the following:

- Software system collects data from ship systems into one single data storage manually or automatically.
- Supports event based recording of data related to the occurred injury.
- Supports data exchange for events that shall be recorded in multiple logbooks.
- The data are automatically sent to external source (ashore) making the daily reporting tasks less time consuming.
- Easy access to recording/editing the occurrence, thanks to the new format standard.
- Periodical and emergency backup of data.
- Security features like user identification, password protection, traceability of entries, and database encryption.

The new format standard, defined for the injury reporting, will be also compliant to the Italian Decree 271/99 and the MIT purposes (statistics and data exchange model between Shipowner and Public Administration (other Authorities such as Port Authorities, Public Sanity etc.).

Starting from the existing template, provided by Italian Minister of Transportation and present into the Legislative Decree about Occupational Health and Safety in maritime transportation, we punctually analyzed:

1. The Injury Registry (ship logbook on paper) with notes on the filling in the Register. Manually filled.
2. Detection tab Injuries (it is not a ship logbook, but a document filled in on paper and needed for statistic purpose). Manually filled.
### Italian Detection tab - Injuries

**Attachment B to the D.D. of 30 May, 2000 – Page 1**

<table>
<thead>
<tr>
<th>N. occidui</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
</tr>
</thead>
</table>

**Columns:**
- **A:** Data dell'incidente
- **B:** Data dell'incidente
- **C:** Condizioni di lavoro
- **D:** Posizione della sece
- **E:** Condizioni della sece
- **F:** Natura di lavoro
- **G:** Natura di sece
- **H:** Luogo dell'incidente
- **I:** Occupazione del lavoratore
- **J:** Condizioni di lavoro
- **K:** Ela dell'incidente
- **L:** Note
- **M:** Attività di lavoro
- **N:** Note
- **O:** Note
- **P:** Note

**Rows:**
- **1:** Data dell'incidente
- **2:** Data dell'incidente
- **3:** Condizioni di lavoro
- **4:** Posizione della sece
- **5:** Condizioni della sece
- **6:** Natura di lavoro
- **7:** Natura di sece
- **8:** Luogo dell'incidente
- **9:** Occupazione del lavoratore
- **10:** Condizioni di lavoro
- **11:** Ela dell'incidente
- **12:** Note
- **13:** Note
- **14:** Note

**Notes:**
- A: Data dell'incidente
- B: Data dell'incidente
- C: Condizioni di lavoro
- D: Posizione della sece
- E: Condizioni della sece
- F: Natura di lavoro
- G: Natura di sece
- H: Luogo dell'incidente
- I: Occupazione del lavoratore
- J: Condizioni di lavoro
- K: Ela dell'incidente
- L: Note
- M: Attività di lavoro
- N: Note
- O: Note
- P: Note
### Scheda rilevazione infortuni

(Art. 26 D.Lgs. 27 luglio 1999, n. 271)

<table>
<thead>
<tr>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contusione / Colpo</td>
<td>Testa</td>
<td>Causa dell’incidente</td>
<td>Misure adottate</td>
<td>Conseguenze</td>
</tr>
<tr>
<td>Lacerazione / Taglio</td>
<td>Occhi</td>
<td></td>
<td></td>
<td>Esercizio del servizio (+ di 24 ore)</td>
</tr>
<tr>
<td>Puntura</td>
<td></td>
<td></td>
<td></td>
<td>Esercizio del servizio (+ di 24 ore)</td>
</tr>
<tr>
<td>Distrizione / Erba</td>
<td></td>
<td></td>
<td></td>
<td>Consenso immediato e lato</td>
</tr>
<tr>
<td>Frattura</td>
<td></td>
<td></td>
<td></td>
<td>Decesso dopo ___ ore</td>
</tr>
<tr>
<td>Schiacciamento</td>
<td></td>
<td></td>
<td></td>
<td>Scompensato in mare / Alleggerimento</td>
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<tr>
<td>Amputazione</td>
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<td></td>
</tr>
<tr>
<td>Lesione</td>
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<td>Congelamento</td>
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<td>Asfissia</td>
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<tr>
<td>Arricciamento</td>
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<td></td>
</tr>
<tr>
<td>Diminuzione temperatura del corpo</td>
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<td></td>
</tr>
<tr>
<td>Lesioni di tipo</td>
<td></td>
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</tr>
<tr>
<td>Corpo estranei</td>
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</tr>
<tr>
<td>Altri (specificare)</td>
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</tr>
</tbody>
</table>

**Italian Detection tab Injuries - Attachment B to the D.D. of 30 May, 2000 – Page 2**
With reference to the figure below, we analyzed the safety inspection which is the basis of the injury process on board, in particular on a cruise ship and the related workflow (starting from the occurred injury, through the opening and the end of the injury itself).

**Workflow from Injury data model to ELB**

We elaborated:
1. One and only information table (Injury data model = Injury Register + Detection tab Injuries)
2. XSD Standard for data transfer in XML format

This work deals with the injury of crew and also of all the other people that are on board, for example:
- Concessionary (shops, hotel recreational etc.)
- Contactors (Certify Authority surveyor, Inspectors of NCA – National Competent Authority, maintenance technician etc.)

At the end of the analysis, we proposed the new format standard for injury reporting and the data logical flow for injury management. The upper layer is the B-BS methodology (i.e. the behavior and the pyramid top is relevant to the injury analysis and management).
Please, for more details, see the Appendix A: Revised Italian Standard Injury Recording Process_rev.9 – (separate file CONFIDENTIAL).

3.4 Scenario C: Job analysis and behavioral check lists on LNG Offshore Platform

The pilot application on an offshore installation was carried out by a selected staff, who have been on board of the regasification terminal “FSRU Tuscany”, located about 22 km off the coast between Pisa and Livorno to observe different activities, characterized by high risk, performed by crew members, to acquire some data needed to prepare a check list to implement the B-BS ICT software tool, developed by IB.

Preliminary activities in order to finalized and generalized the developed ICT tool for a general maritime environment have been:

- Interviews to Spanish crews (Transmediterranea, Balearia): deck staff (six workers) and engine room staff (eight workers).
- Questions ranged from habitual tasks to attitude to new technologies and to care for workplace and activities safety.
- Developing “personas” and “scenarios” to understand and specify users and context of use of the B-BS ICT tool.

With the previous steps, it has been analyzed the terminal procedures and it has been created three checklists, one for each activity/related job:

1. Load lifting,
2. Restricted enclosed space entry,
3. Working on electrical equipment.

Six participants were selected on the basis of their main working area, two of them for each activities. They have seen observed during their job, in order to verify the compliance with the previous agreed procedures. Finally we recorded on mobile device of the observed data.

After we did the usability testing, in order to determine B-BS ICT tool effectiveness, as to say users’ ability to achieve a task, through each task success (user achieved or failed the task) and error (user committed at least 1 error or no errors at all) rates.
The on board activity plan, shared among OLT/ECOS, IB and ERGOPROJECT

<table>
<thead>
<tr>
<th>N.</th>
<th>Action</th>
<th>Who*</th>
<th>by When</th>
<th>to Whom*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project and boarding communication</td>
<td>IB/EP</td>
<td>05/06/2015</td>
<td>ECOS/OLT</td>
</tr>
<tr>
<td>2</td>
<td>Validation of previous communication and sending to crew onboard</td>
<td>ECOS</td>
<td>08/06/2015</td>
<td>CREW</td>
</tr>
<tr>
<td>3</td>
<td>Acceptance survey</td>
<td>EP</td>
<td>05/06/2015</td>
<td>ECOS</td>
</tr>
<tr>
<td>4</td>
<td>Validation of previous survey</td>
<td>ECOS</td>
<td>10/06/2015</td>
<td>EP</td>
</tr>
<tr>
<td>5</td>
<td>List of operations to observe</td>
<td>IB</td>
<td>05/06/2015</td>
<td>ECOS/OLT</td>
</tr>
</tbody>
</table>

*Where IB (named IB) and Ergoproject (named EP) are partners of Monalisa project, ECOS (named ECOS) is the company that is the Terminal Manager and OLT OFFSHORE (named OLT) is the Terminal Owner.

### OPENING AND ACTIVITY PRESENTATION

A presentation was shown to mentioned participants concerning terminal activity PHASE A, with following agenda:

- **10.00 - 10.30** MONALISA 2.0 project IB-EP
- **10.30 - 11.30** Presentation of B-BS methodology IB
- **11.30 - 12.00** Presentation of onboard activity ECOS-OLT
- **12.00 - 12.30** Discussion and activity planning ALL
- **13.30 - 16.30** Internal documentation examination IB-EP
- **16.30 - 17.30** Closing and conclusion ALL
<table>
<thead>
<tr>
<th>Topic</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>COMMUNICATION TO CREW ONBOARD</td>
<td>1) IB and Ergoproject will send a communication via email to ECOS and OLT to present the purpose of the pilot project within the European Monalisa 2.0, the type of intervention on board, the partners who will work on this project (IB and Ergoproject, on behalf of MIT) and to simultaneously notify the boarding of experts (on behavior and usability) who shall perform cooperative assessment activities of B-BS software system developed by IB (<strong>Action 1</strong>).&lt;br&gt;2) ECOS will send the Ergoproject <strong>Acceptance survey</strong> (very short with 9 items only) attached to this communication (<strong>Action 2</strong>) to identify ideas, beliefs and opinions about eventual implementation of a B-BS software system. The communication will be sent only to ECOS top management for its acceptance. (<strong>Action 3 and 4</strong>).&lt;br&gt;3) IB &amp; Ergoproject will ask for boarding available data. ECOS will confirm these dates depending on weather and operating conditions. During <strong>first boarding</strong> IB will distribute the mentioned validated survey to the crew.&lt;br&gt;4) IB will send to ECOS the <strong>list of possible steps to be followed involving the crew</strong>, mutually agreed with ECOS / OLT during the meeting, after the IMS’s analysis (<strong>Action 5</strong>). ECOS will simply evaluate the proposals received by IB and eventually will simulate activities (organized on purpose) to facilitate its compliance.</td>
</tr>
<tr>
<td>DOCUMENTATION REQUIRED FOR THE ACTIVITY</td>
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<tr>
<td>REGULATION OF EQUIPMENT TO BE USED IN</td>
<td>A weak point has been surveyed in the project output: on OLT only ATEX devices are authorized. ATEX smartphone are also available (very expensive 2,000€/each). Only on deck/ engine/recreational areas no ATEX devices are admitted.&lt;br&gt;ECOS confirms that the equipment used in OLT can be used for pictures in ATEX area.</td>
</tr>
<tr>
<td>POTENTIAL EXPLOSIVE AREAS</td>
<td></td>
</tr>
<tr>
<td>BOARDING DETAILS</td>
<td><strong>- Crew boarding every Wednesday, therefore the IB and Ergoproject boarding should be fixed from same Wednesday up to next Tuesday in order to work with the same users.</strong>&lt;br&gt;<strong>- “Cassa Marittima” visit to be done before boarding (open at 8.30 close at 15.00)</strong>&lt;br&gt;• Boarding PPE: safety shoes, anti-static overalls, helmet, gloves. ECOS may provide all required PPE, except shoes.&lt;br&gt;• Possibility to stay overnight on board up to 19.00.</td>
</tr>
<tr>
<td>IB/ERGOPROJECT PROPOSAL FOR BOARDING</td>
<td><strong>IB &amp; Ergoproject propose to ECOS/OLT following dates:</strong>&lt;br&gt;<strong>Thursday 19/ Friday 20 and Monday 22/Tuesday 23 June 2015</strong>&lt;br&gt;<strong>In alternative:</strong>&lt;br&gt;<strong>Thursday 26/ Friday 27 and Monday 29/ Tuesday 30 June 2015</strong></td>
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<td>Topic</td>
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<tr>
<td>TYPE OF BOARDING PROPOSED FOR ECOS/OLT</td>
<td>IB/Ergoproject staff before boarding should pass through “Cassa Marittima” and then do boarding formalities (Sunday visits are not possible). IB/Ergoproject have to send as soon as possible the list of people involved in the boarding and disembark.</td>
</tr>
</tbody>
</table>

**Equipment for pilot application on board**

OLT ICT Infrastructure must meet following requirements on board:

- a dedicated laptop PC with internet connection limited by web sense in compliance with company Policy;
- other PC (MAC address control) linked to the network shouldn’t be connected to internet;
- a PC with on board cabled connection on Utl OLT;
- OLT doesn’t have a WIFI access point on FSRU Toscana. The Access Points for the crew have a limited 800 Kbps band with ECOS;
- Every private network between the Access point (that you supply) and your tablet should be limited to specific use in compliance to safety measures and company policy.

The following software equipment was required in our previous test pilot:

- **ON BOARD SUPPLIED BY OLT:**
  - a pc with Internet connection (without external limits)
  - an on line printer
  - a camera

- **ON BOARD SUPPLIED BY IB:**
  - a Windows notebook with MySQL Server and TomCat Applic. Server installed
  - n° 1 or 2 mobile devices (Android or iOS tablet or smartphone)
  - n° 1 access point to create a private wi-fi network between the mobile device and the notebook

With this solution, we didn’t need to connect to any OLT device or wireless network.
4 Report on activities performed on board of the terminal "FSRU Tuscany" - OLT

FIRST PHASE (3rd July 2015)
Within the Project Mona Lisa 2.0 - Act. 3 - Safer Ships, a selected staff of IB went on board of the regasification terminal "FSRU Tuscany", located about 22 km off the coast between Pisa and Livorno to observe different activities, characterized by medium-high risk, performed by crew members, to acquire some data needed to prepare a check list to implement and the ICT software tool, developed by IB. Its aim is to improve and increase safety on board, owing to the high dangerousness of these operations.

To get on board you need to use the shuttle service operated by motorboat "LNG Express"; the journey from the ground terminal, located in the Port of Livorno, until the FSRU Toscana takes about 45 minutes.

It is not possible to go on board by other vessels, except LNG express and the Tug Boats dedicated to the Terminal because, due to security reasons, it is provided a total interdiction zone to navigation which extends for a range of two-miles around the terminal; a controller service of the interdiction area is active 24/24h and it’s performed by the ship "LNG Guardian".

Even before embarking on LNG Express is required to wear the following PPE, requested by the Manager ECOS:

- Helmet with strap
- Suit antistatic
- Antistatic and safety shoes
- Antistatic gloves
- Goggles
- Ear plugs (if necessary).

Once arrived on board of the terminal, visitors are subjected to an additional security inspection by the PFSO (Port Facility Security Officer) and to a further familiarization about safety and behaviours in case of emergency; a first security check, consisting in a personal and luggage inspection, is carried out ashore by Security Guards, which are on duty at the pier and a basic safety training joined to a training about behaviors to be held on board, was done by a Master in the office of ECOS / OLT.

ECOS Srl, a joint venture between EXMAR SHIPMANAGEMENT (Belgium) and FRATELLI COSULICH SPA (Genoa, Italy), is the company in charge of the operative management and the maintenance of the terminal and OLT Offshore LNG Toscana S.p.A. is the owner of the terminal.
It’s evident that the Staff pay great attention to the safety, owing to the particular type of the cargo of the ship (almost 70,000 tons of liquefied natural gas).
The smoking ban is present everywhere, both outdoors and indoors, and owing to this, there is an only one room designed for smokers located close to the kitchen and canteen.
It is not allowed to use any electrical or electronic equipment in the outdoor areas of the terminal, except for the devices certified ATEX, used in explosive atmospheres.

Observation of activities and staff on board
During the planning of the activities on board, followed for several days both by IB in Rapallo, and by ECOS in the Port of Livorno, it was established to observe three types of activities:

1. lifting loads with board cranes
2. inspection of enclosed spaces
3. intervention on the electrical high voltage.

These operations were identified as the most significant for the study because:
- the first two are unique in the world shipbuilding,
- the third, common in any industrial environment, is considered particularly delicate owing to the possible presence of an explosive atmosphere and adverse environmental conditions (such as the movement of the vessel).

Another reason for the choice of these three activities is that for each of them are provided very detailed procedures by ECOS for their execution (check list of preliminary control, special requirements, etc.) that allowed us to optimize our intervention, helping us to identify the key points and the technical-procedural issues on which to focus our attention.

We went on with the evaluation of existing procedures and the verification of their correct implementation on the ground, and it has shown that the analyzed procedures are complete, easy to understand and that all personnel on board, during the observations, showed their perfect knowledge.

All the operations described below require, before their execution, a specific work permit, written off by the applicant and with different levels of authorization depending on the type of the intervention. This paper form contains very detailed information on the type of work, like for example, the expected duration, the affected area, people involved, the personal protective equipment needed, and so on.

A. LIFTING LOADS WITH BOARD CRANES

It deals with an operation that takes place almost daily, since it consists in the use of one of the several board cranes for loading / unloading from other naval units that approach to the platform to provide:
• various supplies to support the crew

• supplies of different materials such as spare parts, specific equipment, lubricants, detergents and in general all what is necessary to ensure the correct working of the ship and of the onboard systems, both for ordinary maintenance and the extraordinary one.

• the discharge of waste and garbage generated on board, because the existing procedures prohibit the disposal of any type of waste at sea.

• the transfer of staff by basketball (a very delicate procedure used to embark / disembark people through a special basket when the weather conditions do not allow the normal loading / unloading through the aft deck).

To perform this operation is required the composition of a team of at least three people (a responsible officer, a signaler and a crane operator), but that can be reduced to two if the officer takes on also the role of the signaler, as in the course of the operation that we have observed.

In addition to a main crane located aft to left-handed, the terminal has two auxiliary cranes Hydralift with a SWL of 8 tons, located one per side; during the observation it was used the auxiliary crane starboard.

In the specific case, it dealt with the load of small refrigerated containers of 10 feet, that weighed 2.7 tons if empty and with a load capacity of 5 Euro pallets, which contained some fresh food and the discharge of other identical empty container on a tugboat approached plane side to starboard and moored securely to the terminal.

The sea conditions and wind (perfectly calm the first one and the second one absent), joined to the restricted dimensions and the low weights of the lifted loads, have made the whole operation very simple.

Moreover, the procedure provides that the crane operator and the signaler always maintain the visual mutual control, although they are also in contact via transceiver, and that the correct closure of the hook has to be verified before every lifting.

The crane operator is certified according to the most high standard: "Offshore Crane Operator Stage III"

The most delicate phase is that in which the load, hanging out of the deck of the terminal and lowered, is located outside the visual range of the crane operator because it is covered by the same bridge. In this situation, to avoid damaging the load and the tug, the crane operator must perform the reports issued by the signaler in a perfect way and it has to move the load with extreme delicacy.

**B. INSPECTION OF ENCLOSED SPACES**

On every ship there are tanks, hollow spaces, spaces for the load, various boxes and closed rooms in general, which are not in direct contact with the external atmosphere without a
natural air exchange and in which it is very likely to find low percentages of oxygen and even concentrations of toxic gases extremely dangerous, formed, for example, as a result of substances previously contained in the tanks or owing to a leakage of a pipeline. People involved in those which concerned safety know very well the high number of fatalities that occur in tanks or similar and that often involve more people because the rescuers “of that occasion” go in the enclosed space to bring help to their injured colleagues and, remaining themselves victims of the lethal atmosphere inside.

With these premises, it is absolutely essential to strictly observe the provided procedures, which require not start or stop immediately the activity, if only one of the conditions that impose the preliminary checklist is not satisfied for any reason.

Since this procedure provides that the local which has to be inspected, has to be subjected to a forced ventilation for at least 24 hours before accessing in it and that this operation had not been carried out before, it was not possible to carry out an inspection in enclosed spaces, but it has instead organized an inspection in an auxiliary enclosed space, consisting of an interspace for the passage of cables and pipes.

The requirements for the access to this type of enclosed spaces are less restrictive because, being these spaces in direct communication with the outside through doors or hatches, the risk of formation of dangerous atmospheres is significantly low.

Anyway, in the course of the observed activity, the provided procedures, put in place in case of the most dangerous situation, were entirely followed by involving a full complement of DPI:

- suit antistatic
- safety shoes
- helmet
- gloves
- glasses
- Detector Portable Toxic Gas
- electric torch
- transceiver.

Moreover, it’s provided that particular and special rescue equipment have to be placed near the access of the enclosed space, such as an apparatus for artificial respiration, a stretcher and a turret (tripod) with winch to lift the operator injured by cable.

In particular cases where there is a risk of falling down or slipping of the operator, it is provided that the operator has to be connected with a safety rope outside.

It is also defined a rule to communicate between the inside operator and the outside one trough a radio transmitter, with a specific agreed frequency in three minutes; if the transceiver does not operate, they have to use light signals via a flashlight or beeps by hitting the structure
of the ship with a tool. The failure to communicate the status of "ok" on time cause the immediate recovery action by the security personnel outside.

In the enclosed environment where the inspection or the work are carried out, it must be assured the constant air exchange by forced ventilation using specific flexible piping.

C. WORKING ON ELECTRICAL HIGH VOLTAGE EQUIPMENT

To increase the need of operational safety for working on Electrical Equipment, our program should have followed a “live” operation on an high voltage equipment over 440 volts, but we didn’t know that to perform such type of intervention was necessary a specific authorization, which could be only issued by the land offices. So, owing to the very restrictive time to obtain the authorization, we decided to perform the same operation on a medium voltage equipment, instead of an high voltage one.

The operation consisted in an insulation test (Megger test) on an electric motor of an auxiliary compressor.

The operation, which was performed by an electrician, supervised by the electrician chief, required the use of a common tester used for voltage test and the adoption of insulated gloves suitable for the voltages.

Moreover, it was established that the operator must not wear any watch, necklaces, bracelets, rings or other metal objects; He must always work keeping both feet on a special rubber insulating mat and he must avoid any contact with any metal part as much as possible.

Before starting the operation the technician has to affix a notice to indicate the work in progress, isolate the power line by removing the fuse or by opening the dedicated switch, prevent access to the electrical voltage equipment with a lock to avoid that others people could restore the voltage, because it is essential that there is no voltage during the operation. In other words it applies the method and the basic procedures of the Lock Out - Tag Out (LOTO).

For some specific activities, such as troubleshooting, it is expected the presence of a second person to follow the operations, ready to intervene in case of emergency.

D. OBSERVATION OF CREW ACTIVITIES

Following the request of ErgoProject, responsible to evaluate the software capabilities and ICT tool developed by IB by using specific tests, it was necessary to find six people belonging to the crew and to follow them during the course of their normal work during the first phase of the activities, and then to use the information collected in the second phase during our second visit on board.

Observed Activities and related personnel:

- activity of lifting loads by on board cranes: the SSM (Safety and Security Manager) and the Crane Operator.
- inspection activities in enclosed spaces: the CWO (Second Deck Officer) and the DKR (Sailor).
activity of intervention on the electrical high voltage: the ELM (Electrical Manager) and the INT (Instrument Technician).

This choice follows the need to ensure as much as possible a statistical aim between the personnel selected for the observation activity and the whole crew, considering:

- grade coated board (from First Officer to Sailor)
- language (the observed group is composed by four Italians, one Croatian and one Polish).

We need to underline that, in this specific case, the official onboard language is English. At the time of our intervention on board the crew was made up mainly of Italians. However, the knowledge of the English language, both for the Italian and the foreign staff, particularly referred to technical terms, allowed us to understand the crew and vice versa during our visit onboard.

SECOND PHASE (06-07/07/2015)

In the second phase IB and ErgoProject decide to return aboard of FSRU Terminal Tuscany to evaluate, through practical tests among the selected crew, the clarity and the ease of use of the software prepared by IB for the acquisition of safety data, and for the possible application of BBS Protocol (Behavior Based Safety) in similar situations. This software was born as IT support to facilitate a specific activity of BBS, namely the recording of data prescribed DPI and safe and insecure behavior. Moreover, it is thought to be used in by each worker to observe himself and his colleagues during the execution of the operation.

For that reason, we provided specific check lists relating to the activities described in detail, that, after the first visit on board, has been adapted to what was really observed on the terminal, and then implemented in software to be filled through a mobile device as a PDA or a smartphone.

For this test it has been used a smartphone Samsung S4 connected to the trial website software designed for the occasion.

After selecting a meeting room to perform the test in, it was decided to place a miniature camera to record a short movie about the movements of the user's fingers while he is using the smartphone.

This is an essential step because it allow to analyze the users’ actions, to identify problems of the software, and to measure the time required for achieving each goal.

The presence of the camera has been communicate to the operators, that have also been informed that in any case were not taken over people's faces, but only the hands for reasons of privacy.

Moreover, It was provided that each user had to use the software through a mobile device and he had also to achieve some specific task selected, such as access to the system with a username and password, fill out a checklist, look for a historical archive the completed checklist previous month, and so on.
It is provided that the user mustn’t have any training about the use of the software, so as to evaluate if the software is easy to understand.
The test performed on the six crew members selected, was quite extensive, lasting 45 minutes for each other. For this reason, it was necessary to extend the stay on board for two days to complete the test with all six operators.
After each test, some specialist questioned the staff to understand certain mistakes and difficulties observed during the experiences of use, and to know their opinion about the use of the software and of the device.
We observed that, the younger staff, or those that have more experience in the use of electronic devices, for professional reasons or for their own passion, found less difficulty to perform the required tasks.
Conversely, users with vision problems encountered some difficulties with the very small text characters, those with larger fingers have experienced some problems in the use of the keyboard to press the desired icon correctly.
There were relevant observations, provided voluntarily by users, about the possible adoption of an instrument of that type in their work environment: as technicians with many years of experience at sea, they expressed a fairly positive opinion about the usefulness of the software in exam, while some doubts have been raised especially related to the hardware. In fact, in the outer parts of the ship it is prohibited the use of electronic devices not ATEX certified. Devices such as PDAs and smartphones are also ATEX version, but have a very high cost.
Moreover, to survive in the particular environment of naval and marine, these devices should also be waterproof to withstand rain or splashes of seawater, when used outside.
Some operators have thought about the possibility of a more widespread use of the device, not only seen as a tool to record data about safety, but also used to include for example the compilation of the check lists provided by the preliminary operating procedures, work permits, closures of operations, access historical maintenance operations performed, the consultation of maintenance manuals. The possible integration of the software in these terms could make easier and faster the acceptance, among the crew, of the instrument in question on board of the terminal.

**Conclusions**

It is necessary to define some assessment on the possible adoption of the Protocol BBS in a reality such as that examined.
The conclusions about those assessments will be drawn up in the Deliverable 3.1.7.

5 **Expert analysis of the B-BS ICT tool**
Pilot application of Behavior-Based Safety (B-BS) approach to the marine domain

This work aims to present the results of the activities that were executed to assess the usability and users’ acceptance of the beta version of the B-BS ICT software. It was decided to perform an expert evaluation (i.e. task analysis and heuristic evaluation) firstly and then activities with users (i.e. usability testing and acceptance evaluation) to allow a continuing evaluation of the software during the early stages of the development process. Many of the heuristic violations reported by the expert suggested the potential of a range of different usability problems, which was later verified and increased through usability testing. B-BS ICT tool usability issues identified by these two methods resulted in problems that are severe enough to cause users either to fail completing the tasks and/or to commit one or more errors in completing them. Moreover, the mixture of two evaluation approaches was due to ensure the completeness of the gathered information, since the participants to the usability testing and acceptance evaluation belonged to the observers’ category only and the expert evaluation permitted to assess the usability of all software’s areas, including the ones which would be used by other user profiles.

Task analysis

Task analysis is a methodology that can be defined as the study of what an operator (or team of operators) is required to do, in terms of actions and/or cognitive processes, to achieve a system goal (Kirwan e Ainsworth, 1992). It represents a widely used method in Human Computer Interaction (HCI) and it can be use at all stages of system development. One of most used variant of task analysis is the Hierarchical Task Analysis (HTA), originally developed by Annett et al (1971). This method has been extensively employed in Human Factors and User Experience and it provides an understanding of the tasks that users need to perform to achieve certain goals. Compared to other variant of task analysis, this method allows to decompose hierarchically the main goals in subtasks and to analyze in detail which steps are required to achieve a specific goal. Figure 1 shows an example of HTA related to the goal “make a cup of tea” (Dix, 1994). The main goal is marked with the number “0” while all subtasks needed to accomplish this goal are depicted with the numbers “1”, “2”, “3”, “4”, “5”, “6”. The relations that define how subtasks need to be performed (e.g. in which order) to achieve the main goal are called “plan”. Further explanations about the relations between the subtasks are illustrated in section “Method”.

Figure 1. Hierarchical Task Analysis of tea making (Dix, 1994)
With respect to the B-BS ICT tool, the HTA was carried out to define which primary goals users should perform through the software. This activity was also conducted to understand which goals needed to be further investigated through the activities that involve users. In particular, before conducting the heuristic evaluation and usability testing it was fundamental to investigate which were the primary objectives of the interface. On one hand, with respect to the heuristic evaluation the HTA allowed to understand the specific context of analysis since this expert evaluation is typically non-specific and based upon general guidelines. On the other hand, the HTA permitted to defined which goals needed to be further investigated through usability testing.

In order to identify the main goals within the software, it was conduct an analysis of which activities and sub activities the different user roles\textsuperscript{1} of the B-BS protocol (for a detailed presentation of the B-BS protocol, see D. 3.1.1) need to carry out. Figure 2 shows an example of HTA carried out for the goal “new observation”. This activity is typically performed by the role of Observer\textsuperscript{2} that, according to the B-BS protocol, records the safe and unsafe behaviors within an organization. Figure 3 (Stanton, 2006) instead shows the conventions (called notation) used to describe how to conduct the subtasks (e.g. in which order carry out the subtasks) in order to achieve the primary goal.

**Figure 2. A Hierarchical Task Analysis for making a new observation**

\textsuperscript{1} For further information about the different roles of the B-BS protocol see deliverable

\textsuperscript{2} For further information about the different roles of the B-BS protocol see deliverable
The figure 2 highlights how the main goal “new observations” is decomposed in six sub activities. In particular, the first box shows the main goal and the related plan that defines how the six sub activities should be conducted. The convention “>” (as illustrated in the FIGURE 3) indicates that the sub activity “indicate an area of observation” need to be carried out after the first sub activity, thus it implies that a specific order need to be followed. Instead, the convention “/” specifies that two sub activities (i.e. “4” and “5”) can be conducted without a specific order. The HTA above described represents only an example of the main activities that users should perform within the software. Through this activity were investigated all mains goals that users should achieve. To deepen the task analysis carried out for all users’ goals see the Appendix B.
Results of HTA showed which main goals different users of the B-BS ICT tool should perform within the system. The analysis also detailed which steps users must perform to accomplish their goals that could be used to optimize the procedures within the software. In particular, the analysis revealed that the role observer should perform three main activities within the software (i.e. make an observation, visualize an observation, visualize a checklist); the supervisor, instead, should carry out thirteen main activities (e.g. create a new meeting, visualize goal, create a new data analysis). Finally, the role of the administrator should conduct five main activities (e.g. define new users, define a new plant).

The HTA highlighted an overview of the main goals that every user’s profile (i.e. observer, supervisor, administrator) could carry out within the software. The development team will use them to implement the software according to real users’ needs and based on their most frequent operations. Further issues and indications for developers are deepened in the heuristic evaluation and usability testing.

**Heuristic evaluation**

Through heuristic evaluation, one or more experts examine a software to identify potential usability issues which are mainly related to user interface aspects and also easy to demonstrate. The issues are noted when the software characteristics violate constraints that are based on reviewed guidelines or principles and/or validated criteria.

For the expert review of the B-BS ICT tool were used Nielsen’s 10 heuristics (Nielsen N., 1995), that cover various aspects of software usability (see Table 1). In literature it is commonly assumed that a single expert can detect by oneself approximately 68% of usability issues through heuristic evaluation (Sauro J., 2012). Assuming that the mentioned data is a persistent discussion topic among experts regarding the kind and number of recognizable issues (i.e. how many users identify them, how severe these issues are), in the case of the B-BS ICT tool, this can be explained as the experts’ attempt to deepen the evaluation of the software by forerun the activities with users with an expert preparatory review.

<table>
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<tr>
<th></th>
<th>Visibility of system status</th>
<th>The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.</th>
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<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>Match between system and the real world</strong></td>
<td>The system should speak the users’ language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.</td>
</tr>
<tr>
<td>3</td>
<td><strong>User control and freedom</strong></td>
<td>Users often choose system functions by mistake and will need a clearly marked &quot;emergency exit&quot; to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.</td>
</tr>
</tbody>
</table>

**Table 2**
<table>
<thead>
<tr>
<th></th>
<th>Consistency and standards</th>
<th>Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Error prevention</td>
<td>Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.</td>
</tr>
<tr>
<td>6</td>
<td>Recognition rather than recall</td>
<td>Minimize the user’s memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.</td>
</tr>
<tr>
<td>7</td>
<td>Flexibility and efficiency of use</td>
<td>Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.</td>
</tr>
<tr>
<td>8</td>
<td>Aesthetic and minimalist design</td>
<td>Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.</td>
</tr>
<tr>
<td>9</td>
<td>Help users recognize, diagnose, and recover from errors</td>
<td>Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.</td>
</tr>
<tr>
<td>10</td>
<td>Help and documentation</td>
<td>Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user’s task, list concrete steps to be carried out, and not be too large.</td>
</tr>
</tbody>
</table>

**Method**

To investigate the usability issues related to the B-BS ICT tool, an heuristic evaluation of each software screen was performed using the Nielsen’s 10 heuristics as above mentioned. The experts provided ratings for each heuristic based on severity, according to a rating system out of 5, where 1 represents extremely severe violation and 5 represents no violation at all. In order to deliver a more comprehensive evaluation about how each violation could affect software functionality, the experts also assigned a second score from 0.25 to 1 (called weight) based on the relevance of each heuristic. This second parameter allows experts to understand, beyond
the usability guidelines, how each violation influences the possibility to conduct certain operations within the software. The score assigned to each software screen was then grouped operating a mean for each heuristic in order to have an overview of the violations relates to different aspects (e.g. visibility of system status) and weighted based on the relevance. Details of violations for every single heuristic and the assigned scores are presented in Appendix B. Figure 4 shows the weighted average scores gained for different heuristics. In particular, the radar chart highlights that the lowest scores can be observed for the first heuristic (mean = 0.81), the second heuristic (mean = 0.81) and the fourth heuristic (mean = 0.7) concerning the visibility of system status, the match between system and real world and the consistency respectively; the eighth heuristic gained a average score of mean = 1, instead the heuristics 3, 5, 7, 9 and 10 reached and average score of mean = 1.25; the highest score was observed for the sixth heuristic mean = 1.5.

**Figure 4. Weighted Average scores gained for Nielsen’s ten heuristics**

An heuristic evaluation of the B-BS ICT tool was performed based on the Nielsen’s ten heuristics. Results showed different levels of violations for different usability aspects. These results allowed experts to provide a list of recommendation (see Appendix B.) that development team can use to modify various aspects of the interface in following releases.
Usability testing

Usability testing allows to evaluate “the extent to which a product can be used by specified users to achieve specified goals with effectiveness\(^3\), efficiency\(^4\), and satisfaction\(^5\) in a specified context of use” (usability definition, ISO 9241-11 standard) as it rests upon the observation of representative users which are individually asked to complete a series of typical and/or critical tasks using the interface. During the sessions, usability experts study as participants act through predefined scenarios and note when participants make mistakes and decide to give up. Through the usability testing it was possible to test for the first time the interaction of real seafarers with the beta version of the B-BS ICT tool.

Goal

The usability testing performed on the B-BS ICT tool was mainly a qualitative activity (Johnson R. B., Christensen L. B., 2010) which was focused on how users interact with the B-BS software to identify the UI elements/navigation paths that they did not understand clearly and/or use easily.

Arising from the well-known rule of five users (Nielsen J., Landauer T., 1993), which states that a five users’ test can find 85% of the usability problems of a software, six users were involved in the session of usability testing of the B-BS ICT tool. Previous studies showed that testing with five users allows to find 85% of problems that affect 31% of users for the targeted population and set of tasks (Sauro J., 2010): for the evaluation of the B-BS ICT tool this merely means that through usability testing there were identified the major (more recurring/more severe) usability criticalities. These are the most interesting at the current development stage, as to say a beta version which needs continuous improvements.

As mentioned before, along with the usability testing and acceptance evaluation, an heuristic evaluation was also performed to determine possible software criticalities from experts’ point of view.

First of all, this was necessary in the case of the B-BS ICT tool since testing with users was possible with observers only, as deepened below. Moreover, task analysis and heuristic evaluation permitted to define all possible tasks for all different user profiles and to uncover the usability problems of all areas which were not evaluated in usability testing.

Problems identified by these two approaches are significantly non-overlapping: 34% of problems identified in heuristic evaluation are not found by users in usability tests, because experts tend to assess users’ less frequented areas of a software, and concurrently on average heuristic evaluations miss around 49% of the issues uncovered from usability tests (Law L.,

\(^3\) Completeness and accuracy with which users achieve specified goals.

\(^4\) Effort (e.g. time) in which users can complete the tasks for which they use the software.

\(^5\) Ease of use as perceived by users.
Hvannberg E. T., 2002). Indeed, usability testing reveals design issues which are more related to task scenarios (e.g. task flows do not reflect the order that users expect) while expert review highlights problems which are innate to the features (e.g. consistency) of the system itself.

**Method**

- **a) Background/Screening Questionnaire**

A questionnaire was issued to participants to collect background information, such as user demographics (age, gender, educational level, nationality), specifications about their work as seafarers (job on board, years of experience) and details about Internet experience (time spent online and favorite devices). The purpose of the questionnaire was to define each user’s profile and ensure that participants met – totally or partially – the personas’ (users’ archetypes) features (as presented in D 3.1.3).

The B-BS protocol, and consequently the B-BS ICT tool, considers two main positions, such as supervisors and observers. Supervisors play a completing role in promoting and reinforcing the application of the protocol, but they are relatively few and selected upon their experience and/or competencies. Starting from this consideration, the session of usability testing and acceptance evaluation of the B-BS ICT tool was performed by the observers, which are the more numerous frontline employees.

- **b) Task-based testing**

To develop the tasks to be proposed to users, the first preparatory activities were defining users and their goals through personas, the context in which they are going to use the B-BS tool through scenarios and the details about their work activities through the job analysis performed by B-BS experts.

Starting from the outcomes of the above activities and the task analysis presented above, the four tasks which were proposed to usability testing participants to complete were:

1. Access the B-BS software
2. Get to the form about safe and unsafe behaviors
3. Fill in all the fields of the checklist
4. Check a form that was filled in the past

Users were selected on the basis of their main working area/activity, two of them for each, such as load lifting, restricted enclosed space entry and working on electrical equipment. So, B-BS experts observed and took pictures of these working activities related to these three environments for a detailed description of this research activity). Once that were defined the tasks to be tested, the results of these observations and the pictures were used to create a realistic background to put users in the context situation during the tests, as to say asking them to imagine of using the B-BS tool during their work shifts through a photographic scenario.

These tests were assessed on two objective standards, such as the achievement of each task and the number of errors made, and subjective aspects which relate to observe how users carried out the tasks and to collect their comments during and/or after the test.
Audio and video of all sessions were registered through a HD camera, which was focused on the screen of the mobile device (i.e., Samsung smartphone) used to test the B-BS ICT tool.

The sessions were moderated by an expert who presented the photographic scenario to participants, read out each task and hand them the perceived satisfaction questionnaire (ASQ questionnaire, as below).

Another expert observed the sessions and, alongside with the moderator, asked to participants follow-up questions about eventual wrong paths taken during each task or general mistakes and misunderstandings, as well as closing, de-briefing questions.

c) After Scenario Questionnaire (ASQ)
To measure users’ satisfaction it was used the After-Scenario Questionnaire (ASQ) (Sauro J., Lewis J.R., 2012), which considers the easiness in completing tasks, the satisfaction towards the completion time and the satisfaction towards the support information.

This questionnaire was distributed at the end of each task to users which had completed it only and so it represents these users’ opinions exclusively.

Participants had to indicate their level of agreement (from 1, highest agreement, to 7, highest disagreement) towards the following items:

1. Overall, I am satisfied with the ease of completing this task.
2. Overall, I am satisfied with the amount of time it took to complete this task.
3. Overall, I am satisfied with the support information (on-line help, messages, documentation) when completing this task.
Results

a) Background/Screening Questionnaire
In the test there were involved six seafarers among men aged between 29 and 57 years old (mean 43 years old, standard deviation 8.92). There were four Italian seafarers and two foreigners (from Croatia and Poland).

The sample, although statistically speaking not representative (since there were no sampling), still is coherent to personas, which were presented in D 3.1.3. The participants to the tests were indeed representative of the two previously outlined archetypes. Indeed, they were all expert seafarers with different years of experience (average 17 years of experience): the older ones with a lower experience in managing mobile tools and more skeptical about the introduction of an ICT tool in working activities, the younger ones, on the other hand, more expert in mobile use and keen or curious to the application of a new tool to their working environment. Nevertheless, all of them declared to use the Internet (the older ones through personal computers) for personal purposes (i.e. contacting their families at home) at least 2/3 times per week.

b) Task-based testing
As mentioned before, through usability testing it was possible to determine B-BS ICT tool effectiveness, as to say users’ ability to achieve a task, through each tasks’ success (user achieved or failed the task) and error (user committed at least 1 error or no errors at all) rates.

Figure 5 illustrates the success rate for task 1, 2 and 4. Task 1, accessing the B-BS software, was successfully achieved in 83% of cases; task 2, getting to the form to fill in, got a 0% success rate and task 4, checking a past form, was successfully completed in 16% of cases (see figure 5).

Figure 5 shows also the confidence interval for the three tasks. This data indicates that we can be 95% confident that the success rate is between 41.9% and 98.9% for the first task, between 0% and 44.3% for the second task, and between 1.1% and 58.2% for the third task. More specifically, taking into account the third task as an example, this evidence shows that we can be 95% sure the success rate is not higher than 58.2%. It also highlights that even with a small sample of users (6 users in this case) it is possible to gain a reliable measure of success rate, based on probabilistic data, that can be used as a metric to describe the level of software usability.

Besides from task 1, users proved to be confused about the navigation patterns offered by the software and they spent time and efforts to searching the right paths, groping around and failing the majority of tasks.

Figure 5. Success rate for task 1, 2 and 4
Errors number

As regards the error rate, 33.3% of users committed errors for task 1, as to say 2 out of 6 committed at least one mistake, and to 100% for task 2 and task 4, that is all users were mistaken at least once in trying to achieve these tasks.

Moreover, the average number of errors was 1.2 for task 1, it was 10.7 for task 2 and it was 4 for task 4.

As for success rate, participants fumbled around the software by trial and error, so they made mistakes since they had not a clear idea of how getting to their navigation goals.

Figure 6
Special reference needs to be made to task 3, filling in all the fields of a checklist, which is a subtask connected to task 2 achievement: since no user identified the checklist to be filled in, users were directed to it by the moderator to ensure that users’ interaction with the form and the compiling process were tested as well.

**Major problems**
Starting from the general high failure rate of the tasks, to deepen the motivations, several macroscopic problems were identified:

1. Users do not log in at the first attempt
   Although task 1 success rate was the highest one, as to say the majority of users logged in at the first attempt, during other tasks 67% of users accidentally log out from the software and they experienced many difficulties (at least 3 errors per user) in logging in back, even though it was the same required action of task 1. This problem could be linked to the “masking” issue: password masking is tough in testing with mobile devices (Nielsen, 2009), where typing is difficult and typing errors are common, so users make more errors when they cannot see what they are typing while filling in a form. In task 1 users took their time to calmly write username and password because their goal was this, during other tasks they were more careless and hasty in typing log-in information because they want to go back and continue navigating where they accidentally left as quickly as possible.
Image: users make more errors when they cannot see what they are typing while filling in a form.

Furthermore, when they accidentally logged out and inserted the log in information back, the system gave them a redundant confusing message to ask them to confirm the log in.

Image: the system gave users a redundant confusing message to ask them to log in back.

2. Users do not recognize the menu
In the B-BS software it was used a three staked lines icon to represent the menu, the so-called hamburger. This icon is not conventional yet, although it is used in applications more and more commonly. Not even B-BS tool users (83%) recognized it as the menu icon and tried, instead, to click on the unclickable label “Home/B-BS” on the left, where they expected to find the menu, or to click on the yellow flat washer label of layout options because it drew their attention for the color difference.

Image: while finding the menu, users accidentally click on other elements (i.e. yellow label of layout options).

3. Users accidentally log out
As mentioned before, the majority of users (83%) at least once logged out from the software by mistake. This happened mainly during task 2, when users navigate for the first time the software interface to identify the checklist and click nearly every button. They did not recognize the log
out button and did not understand the confirmation message with an annotation about security reinforcement which assumes a positive answer that contradicts the answer to not log out. Accidentally logging out was also common for task 4, when users had to find a past checklist and they (four on six) consulted the Chrome browser history.

Image users accidentally log out consulting the Chrome browser history.

4. Users do not recognize clickable and unclickable icons
During task 2, when users explored the software functionalities, they clicked all icons and labels since they did not recognize the difference between clickable and unclickable elements and their functions. In particular, they had problems in clicking on menu and submenu labels because in some cases they had to click on the textual labels and in others on the “plus” icons. Furthermore they thought that the unclickable titles of the areas of the software were clickable “breadcrumbs” to use as short ways out to go back to the homepage.

5. Users do not understand the status of the system
In this beta version of the B-BS tool there were some bugs which stopped the normal functioning of the system (e.g. consulting the calendar). In these cases the system did not provide to users an error message, compelling them to leave the software by logging out from the browser. Furthermore, when users completed to fill in the checklist and proceeded to save it, the system did not give them any feedback about this operation and they clicked several times before independently deciding that the form was saved.

6. Users do not understand the difference between Observations and Checklists labels
FSRU seafarers work in a high risk environment, so they are used to routine work with daily checklists of activities to be done to guarantee the right functioning of the platform and everybody safety onboard. In the view of this, users were confused about the difference between the labels Checklist, which is the checklist that only supervisors an/or administrators can modify or consult, and Observation, which is the actual checklist that observers should fill in. All six users failed task 3 in locating the checklist to fill in because they were certain to find it in Checklist area. During the interview phase after each test, users highlighted that they did not understand the label Observation and the contents in it.

7. Users do not understand the general structure of the checklist
Based on the log in information, the system presented to users the checklist which was linked to their working area, but they could change it and moreover they had to insert all other information (e.g. observation area, group) before inserting numerical data. Given that, some users filled in the incorrect form because they changed the working area and/or insert another observer ID. Moreover, they did not understand the meaning of the numbers to insert for each item of the checklist: they could not decide if numbers indicate the observed people or a judgement vote to a safe/unsafe situation or the time spans between the observations.

![Image of a mobile phone with a checklist interface](image)

Image users do not understand the meaning of numbers in checklists.

Ultimately, the above presented problems could be divided in two categories:

- Problems connected to interface elements
  Problems from 1 to 5 are strictly connected to UI elements, such as unconventional icons and confusing system messages. These issues could be improved by development team using the recommendations of the experts (see Appendix C).

- Problems connected to context (B-BS procedure/maritime domain)
  Problems 6 and 7 are linked to users’ expectation about the software: they were confused and/or not persuaded about the main goal of the software and its practical use in their everyday working activities. These issues could be improved by spreading the B-BS procedure knowledge through effective training and by trying to adapt it to the fragmented and frenzied working activities in maritime domain.

c) After Scenario Questionnaire (ASQ)
As for user satisfaction, since ASQ was distributed to users who achieve each task only, it is possible to present coherent results for task 1 only. It appears that participants were very satisfied on average about the logging in for the first time.

Figure 7
For other tasks, it was possible to detect users’ satisfaction by registering users’ comments during or after every task. Users were particularly critical and in two occasions bothered by the button sizes when they could not click on them immediately, stating that their fingers were too big for a smartphone screen. Three users gave up on task 2, searching the checklist to fill in, stating that they had already looked for it in every area of the software and were not inclined to search it any longer. Two users filled in all items in the checklist, but they declared that they were not well aware of what they were writing or why.

**Discussion**

In most instances, as seafarers performed the assigned tasks, there was not always a clear distinction between responses resulting from “learning” from the system and ones that were simply “guessing” the navigation path. Surely, single results were affected by individual seafarers’ levels of technical proficiency and learning abilities. Yet, the major usability problems which were identified in the use of the software were transversal to all users.

As from the major problems, besides from the first log-in task, users proceeded blindly in the software, trying their best to identify the navigation paths to reach the assigned tasks. None of them expressed the sensation of knowing exactly what they were doing and they were confused about the general purpose of the software (all of them, except one, believed that the ICT tool proposes a digital version of the work activities checklists that they use daily).

This was due to the B-BS ICT tool’s general lack of self-evidence⁶ (Lidwell, W., Holden, K., and Butler, J., 2003), as previously demonstrated: starting from the ambiguous (as perceived by participants) labelling to the unclear navigation and menu links and the unexpected arrangement of content, users cannot use it without a minimum time of familiarization and memorization.

It was important to record these major issues in these early stages of the development process, since making changes at this phase is still easier and less expensive for the development team,

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⁶ A software is self-evident when it is usable without instruction by the appropriate target users.
which will receive and implement the recommendations deduced from these evaluation activities.

**Acceptance evaluation**

In the last two decades an increasing number of Human Factors professional has oriented their attention towards the comprehension of how users perceive the introduction of new systems and/or technologies. This interest led to the definition of a new construct called *User Acceptance* that can be defined as “the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support” (Dillon, 2001).

**Goal**

With regard to the B-BS ICT tool\(^7\), a user acceptance evaluation was conduct to understand how seafarers would consider the introduction of this technology. This choice was made both to investigate seafarers’ opinions about the introduction of this kind of tool and to verify whether the operating methods of the maritime domain could be suitable for the introduction of this tool.

**Method**

To assess user acceptance it was employed a questionnaire, already used in other domains (e.g. automotive), called “A simple procedure for the assessment of acceptance of advanced transport telematics” (Van Der Laan et al., 1996). This methodological choice was made after a review of the existing questionnaires that assess user acceptance among which the “Technology Acceptance Model” (TAM) by Davis et al (1989) and the “Unified Theory of Acceptance and Use of Technology (UATUT) by Venkatesh et al (2003). Compared to other instruments, this questionnaire allows an easier administration also considering some operating methods of maritime domain (e.g. short breaks during work shifts). The questionnaire consists of nine 5-point rating-scale items and it offers an evaluation of user acceptance on two dimensions: perceived usefulness and satisfaction (See Figure 8).

**Figure 8**

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\(^7\) A preliminary presentation of the B-BS protocol was made in order to avoid biases related to the protocol rather than the ICT tool.
To avoid any biases related to opinions that users could have on the introduction of this tool, the questionnaire was administered before and after the use of the B-BS ICT tool (called before and after measurement respectively). During the before measurement users were asked to indicate their judgment answering the following question - What is your judgement about a system that would collect data on safe and unsafe behaviors within an organization through a mobile device? . Users had to indicate whether their judgment agreed more with the first attribute or the opposite one. Although in the after measurement users were asked to indicate their judgment in the same way, they had to answer to a different question - What is your judgement about the system you just used?.

**Results**

Results of the analysis showed that seafarers seem to offer slightly more positive judgments about the acceptance of the B-BS of the ICT tool during the before measurement (see Figure 9) compared to the after measurement (Figure 10). This evidence can be observed for both dimensions of user acceptance: usefulness and satisfaction. In particular, the figures below highlight average scores of 0,7 and 0,49 for usefulness and satisfaction in the before measurement and average scores of 0,47 and 0,46 in the after measurement for the same dimensions, even though a statistical analysis did not show significant differences\(^8\) between them. These scores need to be considered and compared also with the neutral score of the scale that in this case corresponds to 0. Both scores are very close to the neutral score, thus it seems that seafarers do not report judgments firmly in favor of an acceptance or a rejection of the B-BS ICT tool.

**Figure 9**

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\(^8\) A t-test was performed to investigate whether the average scores between before and after measurement where different from a statistical point of view.
Figure 10
Discussion

A user acceptance evaluation of the B-BS ICT tool was conducted to understand if the maritime domain would be an appropriate context to introduce this kind of tool. A before and after measurement was performed using *A simple procedure for the assessment of acceptance of advanced transport telematics* - to track any biases related to users’ beliefs and to investigate any emerging effects in users’ judgments after the use of the B-BS ICT tool. Results showed lower scores in seafarers’ judgments after the use of tool indicating a slight trend toward the rejection rather than the acceptance. However, as above mentioned, these differences did not reach a statistical significance thus further research are necessary to investigate this phenomenon. From a more qualitative perspective, it could be that the seafarers’ judgments were partially influenced by the safe work procedures they are accustomed to follow during daily work shifts. The work environment in which they operate, in fact, imposes a daily compilation of checklists and other safety related operations that could be hardly compatible with the introduction of a B-BS protocol and/or a B-BS ICT tool. This evidence emphasizes, on one hand, the importance of this kind of activity within this domain and, on the other hand, that a possible introduction of this tool should take strongly in account the operating method that seafarers are required to observe.

Conclusions

Conducting the evaluation activities presented in this Deliverable permitted to identify seafarers’ real needs and goals and to early recognize the set of issues of the beta version of the B-BS ICT tool.

The conclusions about this expert analysis will be drawn up in the Deliverable 3.1.7.
6 APPENDIX A: Revised Italian Standard Injury Recording Process_rev.9 – (separate file CONFIDENTIAL)

Will be provided, if requested, only to the European Commission
## APPENDIX B

<table>
<thead>
<tr>
<th>Software screen</th>
<th>Violation</th>
<th>Heuristic</th>
<th>Ranking</th>
<th>Weight</th>
<th>Weighted score</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>The software does not conform to the meta of the main menu page.</td>
<td>1</td>
<td>1</td>
<td>8.5</td>
<td>8.5</td>
<td>The navigation is designed to look like a &quot;home&quot; instead of displaying the label &quot;home&quot; more prominently. The menu should be updated to reflect the correct hierarchy.</td>
</tr>
<tr>
<td>Menu</td>
<td>The menu does not provide feedback about the position of users within the software.</td>
<td>1</td>
<td>1</td>
<td>7.5</td>
<td>7.5</td>
<td>The menu should highlight the corresponding section within which users are operating. (e.g., highlighting live observations)</td>
</tr>
<tr>
<td>New user</td>
<td>The software shows a navigation path that does not correspond to the current location.</td>
<td>1</td>
<td>2</td>
<td>8.3</td>
<td>1</td>
<td>The software should present a navigation path that corresponds to what users are doing in a certain manner. For example, in order to define a new ture, the software should show a navigation path with &quot;New User &gt; Define User&quot; then &quot;New Ture&quot;</td>
</tr>
<tr>
<td>New observation</td>
<td>The software does not provide adequate instructions for a new user's completion.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>The software should provide feedback related to the checklist completion (e.g., &quot;Checklist done&quot;)</td>
</tr>
<tr>
<td>Search plant</td>
<td>The search function does not match any search strings used in the current software.</td>
<td>2</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
<td>The software should enable users to search for specific terms (e.g., search box)</td>
</tr>
<tr>
<td>New Plant</td>
<td>The search function does not match any search strings used in the current software.</td>
<td>2</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
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</tr>
<tr>
<td>Search user</td>
<td>The search function does not match any search strings used in the current software.</td>
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<td>3</td>
<td>2.5</td>
<td>7.5</td>
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</tr>
<tr>
<td>Search activity</td>
<td>The search function does not match any search strings used in the current software.</td>
<td>2</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
<td>The software should enable users to search for specific terms (e.g., search box)</td>
</tr>
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<td>Search activity</td>
<td>The search function does not match any search strings used in the current software.</td>
<td>2</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
<td>The software should enable users to search for specific terms (e.g., search box)</td>
</tr>
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<td>Search activity</td>
<td>The search function does not match any search strings used in the current software.</td>
<td>2</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
<td>The software should enable users to search for specific terms (e.g., search box)</td>
</tr>
<tr>
<td>Action Plan</td>
<td>The element used is not a consistent user interface element used to interface with the software.</td>
<td>3</td>
<td>2</td>
<td>8.5</td>
<td>1</td>
<td>The software should employ a different element to add comments to a particular component (e.g., the software should present a comment instead of pressing enter)</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>2.15</td>
<td>0.80</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>The software does not provide adequate instructions for a new user's completion.</td>
<td>4</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
<td>The software should enable users to search for specific terms (e.g., search box)</td>
</tr>
<tr>
<td>New check</td>
<td>The search function does not match any search strings used in the current software.</td>
<td>4</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
<td>The software should enable users to search for specific terms (e.g., search box)</td>
</tr>
<tr>
<td>New check</td>
<td>The search function does not match any search strings used in the current software.</td>
<td>4</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
<td>The software should enable users to search for specific terms (e.g., search box)</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>2.8</td>
<td>0.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New observation</td>
<td>The software does not provide adequate instructions for a new user's completion.</td>
<td>4</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
<td>The software should enable users to search for specific terms (e.g., search box)</td>
</tr>
<tr>
<td>Action Plan</td>
<td>The element used is not a consistent user interface element used to interface with the software.</td>
<td>4</td>
<td>3</td>
<td>2.5</td>
<td>7.5</td>
<td>The software should enable users to search for specific terms (e.g., search box)</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>2.8</td>
<td>0.70</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>The navigation path is not consistent across the main menu page.</td>
<td>5</td>
<td>2</td>
<td>8.5</td>
<td>1</td>
<td>The navigation path should match the menu linkages in the main menu page. For example, if users are in the Home section, indicated as &quot;Home&quot;, the navigation path should show &quot;Home&quot; and &quot;Home/2.0&quot;.</td>
</tr>
<tr>
<td>New observation</td>
<td>Adding the button &quot;+&quot; and &quot;-&quot; is not suitable for the current context.</td>
<td>6</td>
<td>3</td>
<td>8.6</td>
<td>1</td>
<td>The software should use a way to mark the number of comments or space the element &quot;+&quot; and &quot;-&quot; in a different portion of the software screen.</td>
</tr>
<tr>
<td>Action Plan</td>
<td>The element used is not a consistent user interface element used to interface with the software.</td>
<td>2.5</td>
<td>2</td>
<td>8.5</td>
<td>1</td>
<td>The software should present two different boxes to present a staring data and an end data.</td>
</tr>
<tr>
<td>New observation</td>
<td>The software does not provide adequate instructions for a new user's completion.</td>
<td>2.5</td>
<td>2</td>
<td>0.75</td>
<td>1.5</td>
<td>The software should employ a different element to add comments to a particular component (e.g., the software should present a comment instead of pressing enter)</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>2.5</td>
<td>1.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New observation</td>
<td>The software does not provide adequate instructions for a new user's completion.</td>
<td>8</td>
<td>2</td>
<td>0.75</td>
<td>1.8</td>
<td>The software should employ a different element to add comments to a particular component (e.g., the software should present a comment instead of pressing enter)</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>2</td>
<td>1.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>The element used is not a consistent user interface element used to interface with the software.</td>
<td>8</td>
<td>2</td>
<td>0.25</td>
<td>0.8</td>
<td>The element &quot;-&quot; should indicate some actions within the software or should be removed.</td>
</tr>
</tbody>
</table>
8 APPENDIX C

Below there are shown all the main goals that were investigated through the activity of hierarchical task analysis. The goals were separated based on different users (see table 2). Figure 11 shows the conventions that are necessary to understand how subtasks need to be performed in order to achieve the main goal.

**Figure 11**

Different plan types with three notation conventions

<table>
<thead>
<tr>
<th>Type of plan</th>
<th>Types of notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear</td>
<td>1 &gt; 2 &gt; 3 &gt; 4</td>
</tr>
<tr>
<td>Sequential plan</td>
<td>1 then 2 then 3 then 4</td>
</tr>
<tr>
<td></td>
<td>Do in order</td>
</tr>
<tr>
<td>Non-linear plan</td>
<td>1/2/3/4</td>
</tr>
<tr>
<td>Non-sequential</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Do in any order</td>
</tr>
<tr>
<td>Concurrent plan</td>
<td>1 + 2 + 3 + 4</td>
</tr>
<tr>
<td></td>
<td>Do at the same time</td>
</tr>
<tr>
<td>Branching</td>
<td>X? Y &gt; 2 N &gt; 3</td>
</tr>
<tr>
<td>Choice plan</td>
<td>If X present then 2 else 3</td>
</tr>
<tr>
<td></td>
<td>Do when required</td>
</tr>
<tr>
<td>Cyclical</td>
<td>1 &gt; 2 &gt; 3 &gt; 4 &gt; 1...</td>
</tr>
<tr>
<td>Repetitious plan</td>
<td>1 then 2 then 3 then 4 then repeat from 1 until</td>
</tr>
<tr>
<td></td>
<td>Repeat the following until</td>
</tr>
<tr>
<td>Selection</td>
<td>1:2:3:4</td>
</tr>
<tr>
<td>Exclusive plan</td>
<td>1 or 2 or 3 or 4</td>
</tr>
<tr>
<td></td>
<td>Choose one of the following</td>
</tr>
</tbody>
</table>

**Table 2**

<table>
<thead>
<tr>
<th>Observer</th>
<th>Supervisor</th>
<th>Administrator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visualize checklists</td>
<td>Create new data analyses</td>
<td>Create new users</td>
</tr>
<tr>
<td>Visualize observations</td>
<td>Visualize safety meeting</td>
<td>Create new behaviours</td>
</tr>
<tr>
<td>Create new observations</td>
<td>Define goals</td>
<td>Visualize plants</td>
</tr>
<tr>
<td>Create new safety meetings</td>
<td>Create new activities</td>
<td></td>
</tr>
<tr>
<td>Visualize data analyses</td>
<td>Visualize activities</td>
<td></td>
</tr>
<tr>
<td>Create new checklists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visualize action plans</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Create new meetings mentorship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Create new observations mentorship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visualize action opening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visualize meetings mentorship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visualize observations mentorship</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hierarchical task analysis of visualizing a checklist

0. Visualize a checklist
   1:2

1. Select a checklist from the list
   2. Filter checklists 1/2/3:4

2.1 Select a plant
2.2 Indicate a checklist name
2.3 Select an activity category
2.4 Search the checklist

Hierarchical task analysis of visualizing an observation

0. Visualize an observation
   1:2

1. Select an observation from the list
   2. Filter observations 1/2/3/4:5

2.1 Select a checklist
2.2 Select an observer
2.3 Indicate an observation date
2.4 Select observations with feedback
2.5 Search the observation
Hierarchical task analysis of a new observation

0. New observation
1-2-3-4-5-6

1. Select a checklist
2. Indicate an area of observation
3. Indicate for each behavior the number of those safe/unsafe
4. Indicate the number of observed people
5. Indicate the number of people who left feedback
6. Complete the observation

Supervisor
Hierarchical task analysis of a new data analysis

1. Indicate a chart template
2. Define a period of analysis
3. Select a chart type
4. Select a group of data analysis
5. Add chart to the analysis
6. Save the data analysis

Hierarchical task analysis of visualizing a safety meeting

1. Select a safety meeting from the list
2. Filter safety meetings
3. Indicate a creation date
4. Indicate a meeting date
5. Select a supervisor
6. Select a group
7. Select an area of observation
8. Select a goal under revision
9. Search the meeting
Hierarchical task analysis of visualizing a data analysis

0. Visualize a data analysis
   1:2

1. Select a data analysis from the list
   2. Filter data analysis
      1:2-3

   2.1 Indicate a creation date
   2.2 Indicate a data analysis name
   2.3 Search the data analysis

Hierarchical task analysis of a new checklist

0. New checklist
   1:2/3/4/5

1. Select a plant
   2. Select an activity category
   3. Indicate a name

4. Add an activity to the checklist
   1:2

4.1 Search an activity
   1:2

   4.1.1 Select an activity from the list
   4.1.2 Filters activity
      1:2

   4.1.2.1 Indicate an activity name
   4.1.2.2 Search the activity

4.2 Define a new activity
   1:2/3

   4.2.1 Select an activity
   4.2.2 Select a behavior

   4.2.3 Select an activity order

5. Save the checklist
Hierarchical task analysis of visualizing an action plan

1. Select an action plan from the list
2. Visualize an action plan
   a. Indicate a starting date
   b. Indicate an ending date
   c. Indicate a sharing date
   d. Indicate a recipient
   e. Indicate a verifier
   f. Indicate an assigned
   g. Indicate an action keyword
   h. Indicate an image keyword
   i. Indicate a minimum cost
   j. Search the action plan

Hierarchical task analysis of a new meeting mentorship

3. Select a data entry user
4. Select an observation date
5. Indicate the number of observed people
6. Indicate the number of people who left feedback

Hierarchical task analysis of a new observation mentorship

1. Select a checklist
2. Select an observer
3. Select a data entry user
4. Select the person observed
5. Select an observation date
6. Indicate the number of observed people
7. Indicate the number of people who left feedback
Hierarchical task analysis of visualizing an action opening

0. Visualize an action opening

1. Select an action opening from the list
   2. Filter action openings: 1/2/3/4
      2.1 Indicate an interval of observation
      2.2 Select a group
      2.3 Select an area of observation
      2.4 Search the action opening
Hierarchical task analysis of visualizing a meeting mentorship

0. Visualize a meeting mentorship 1:2

1. Select a meeting mentorship from the list

2. Filter observations 1/2/3/4

   2.1 Select a checklist
   2.2 Select an observer
   2.3 Indicate an observation date
   2.4 Search the meeting mentorship

Hierarchical task analysis of visualizing an observation mentorship

0. Visualize an observation mentorship 1:2

1. Select an observation mentorship from the list

2. Filter observations 1/2/3/4

   2.1 Select a checklist
   2.2 Select an observer
   2.3 Indicate an observation date
   2.4 Search the observation mentorship

Administrator
Hierarchical task analysis of a new activity

0. New activity 1/2/3/4>5

1. Indicate an italian activity name
2. Indicate an english activity name
3. Select an activity category
4. Add a behavior 1:2
4.1 Select a behavior
4.2 Define a new behavior
5. Save the activity

Hierarchical task analysis of visualizing a plant

0. Visualize a plant 1:2
1. Select a plant from the list

2. Filter plants 1/2>3
2.1 Indicate a plant name
2.2 Indicate a plant
2.3 Search the plant
9 Bibliography

The complexity of this essay does not allow you to insert the bibliography “quote by quote”. We chose to collect all the used sources below, indicating the language in which they were made.

<table>
<thead>
<tr>
<th>Level</th>
<th>Source</th>
<th>Language</th>
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<td>Authors</td>
<td>Title</td>
<td>Details</td>
</tr>
<tr>
<td>---------</td>
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</tr>
<tr>
<td>Nielsen, J.</td>
<td>Enhancing the explanatory power of usability heuristics.</td>
<td>Proc. ACM CHI’94 Conf. (Boston, MA, April 24-28), 152-158.</td>
</tr>
<tr>
<td>Sauro J., Lewis J. R.</td>
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<td></td>
</tr>
<tr>
<td>Venkatesh, V.; Morris, M. G.; Davis, G. B.; Davis, F. D.</td>
<td>&quot;User acceptance of information technology: Toward a unified view&quot; (PDF), MIS Quarterly 27 (3): 425–478.</td>
<td></td>
</tr>
</tbody>
</table>
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