MONALISA 2.0 – Activity 3

Report on Pilot application: feedback from pilot results and proposed improved operations

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Founded by: The Trans-European Transport Network (TEN-T) of the European Union
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Work Package: 3.1 - HSQE (Health Safety Quality Environment)

History Version Table

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1 Introduction

The aim of this document is to summarize the pilots and to illustrate the relevant main results and to propose some improvements about the observed activities.

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

The current Deliverable 3.1.7 describes the feedbacks from pilot results and the proposed operations to be improved.
2 Summary

The global objective of Activity 3 is to improve safety of navigation on board large vessels with support of ICT and in particular the aim of Sub-Activity 3.1 is to assess the possibility and benefits of transferring the B-BS approach to the maritime sector as a tool to improve operational safety by reducing unsafe behaviors during normal operations. Therefore, the goal of the Sub-Activity is to verify that B-BS methodology and related ICT tools is adaptable in maritime applications and to test them as appropriate through suitable prototype(s).

The reason of innovation is represented to the fact that B-BS is the one and only most effective method to reduce accidents at work, through the reduction or the elimination of “dangerous” behaviors and actions and that is the first application in a maritime environment.

The selected marine scenario for the pilots application are:

<table>
<thead>
<tr>
<th>MARINE SCENARIOS</th>
<th>SHIPOWNER</th>
<th>FAMILY OF PILOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 1 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 and Balearia</td>
<td>2) MLC</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 Toscana</td>
<td></td>
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All of pilots show that the application of D. Lgs. 271/99 (for the first family of pilots) and the application of MLC principles (for the second family of pilots), represent the B-BS best practices in marine world.
3 Results and Criticalities

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

The main criticalities arisen during the pilot application are the following:

- Plenty of paper records;
- Long time required due necessary checks on paper;
- Inconsistent data and information (the same information is not recorded in the same format);
- Data and information redundancy and duplication.

During the survey, the perspective of the worker was felt in different steps:

- The worker uses an existing set of procedures,
- Those procedures have formats.
- They could switch to our tool, which uses a whole different set of formats.
- The problem is that you were already able to do that before.

<table>
<thead>
<tr>
<th>SUB AREAS</th>
<th>RESULTS</th>
</tr>
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<tbody>
<tr>
<td>ACTIVITIES ON BOARD</td>
<td>A common result was achieved: using an ICT tool the operator could reduce:</td>
</tr>
<tr>
<td>(with particular emphasis on the activities</td>
<td>• Data recording time</td>
</tr>
<tr>
<td>defined as &quot;dangerous&quot;)</td>
<td>• Redundancy of data, because the information on paper are often</td>
</tr>
<tr>
<td></td>
<td>redundant</td>
</tr>
<tr>
<td></td>
<td>• Duplication of data, because different standards require the same</td>
</tr>
<tr>
<td></td>
<td>information, even if in different format.</td>
</tr>
<tr>
<td>CREW ON BOARD</td>
<td></td>
</tr>
<tr>
<td>(with particular emphasis to the training</td>
<td></td>
</tr>
<tr>
<td>and professional required certifications)</td>
<td></td>
</tr>
<tr>
<td>WORK ENVIRONMENT</td>
<td></td>
</tr>
<tr>
<td>(Defined as a place where the seafarers</td>
<td></td>
</tr>
<tr>
<td>carried out the tasks assigned and the places</td>
<td></td>
</tr>
<tr>
<td>for the rest/refreshment and hygiene/health)</td>
<td></td>
</tr>
</tbody>
</table>

The proposed solution related to that pilot application is the using of ICT tool, unique standard format based on an agreed and compliant taxonomy.
3.2 Pilot A2: Seafarers Safety Requirements: D.Lgs. 271/99 survey activities on Spanish Ro-Ro pax

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.

The interview results have been shown that the proposed B-BS methodology is the correct strategy to prevent accidents modifying crews' behaviors.

If the B-BS methodology on board could be mandatory, the application on a maritime environment will be more effective.

3.3 Pilot 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 behavioural observations (near miss).

From this pilot application, the following considerations have been stated:

- An average 90% of the “injury” audit is realised 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.
Therefore, Near Miss are detected only with a daily on board behavioral observation, using the proposed Database2.0® and that is the only strategy to reduce injury.

Because a cruise ship is a very crowded environment, we developed in Database2.0® a self-observation component, which has been added to guarantee a “spontaneous observation” because crew activities are often carried out alone.

3.4 Pilot C: Job analysis and behavioral checklists 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 were:

- 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.

PERSONAS

“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
Education: Bachelor of Engineering
Character: exuberant, curious
“In my opinion, computers have not simplified so much our job, they have just papers got reduced”.

Personal information:
Age: 52 years old
Residence: Malaga
Position: Engine Room Supervisor
Education: High School Diploma
Character: commanding, reserved

<table>
<thead>
<tr>
<th>SCENARIOS</th>
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<tbody>
<tr>
<td><strong>Deck - mooring</strong></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><strong>Engine room – night shift</strong></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>

With the previous steps, it has been analyzed the terminal procedures and it has 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 activity. 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.
Users’ and context profiling influenced deeply the use of the tool, since it spreads a new safety procedure in a digital way to users with different levels of digitalization (according to age and job position), which are usually involved in fragmentary work activities.

The user acceptance evaluation suggested that seafarers’ opinions about the introduction of the B-BS tool are not clear and need to be deepened again with users.

As it is written in Deliverable 3.1.6, it is necessary to define some assessment on the possible adoption of the Protocol BBS in a reality such as that examined.

Although the terminal FSRU Tuscany is considered as a complex environment, which can be "decomposable" in a part of the vessel and in a part of chemical industry, it has many important features that make difficult the introduction on board of a BBS protocol standard.

For example, the number of people on board is greatly reduced, only 28 units, and the most part of the operations is performed by one, or at most two workers together. This fact would result in a very large number of self-observations or observations of one worker only, and so the acquisition of a very small amount of data in relation to the time taken. Owing to this, it would also take a lot of time to collect a useful volume of data for statistical purposes.

Moreover, the self-observation tends to rapidly lose efficacy when used as a single observing system, because the personnel with less and less interest and attention do it. Then, there is also a serious lack of immediate feedback to the employee, a key element for the correct application of the BBS.

Furthermore, the possible operations performed on board are innumerable, making nearly impossible the realization of a check list for each of them, and the board technical almost never perform the same operations on a continuous and repetitive way, as occurs, for example, in an assembly line.

In the specific case, it deals with an high-risk work environment in which, at all levels, it was found an higher attention to the issues of security and staff training on specific operations, than the average of the individual workplace "ship" and "chemical industry", in which the FSRU Toscana can be divided.
3.4.1 Focus on: 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.

3.4.2 Conclusion

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.

Regarding this phase of analysis, it was possible to determine that context and users’ profiling (presented in D 3.1.3) influenced deeply the use of the tool, since it spreads at the same time a new safety procedure (B-BS) in a new way (a digital one) to users with different levels of digitalization (according to age and job position), which are generally involved in fragmentary and sometimes frantic work activities. As of today, the actual version of the B-BS ICT tool does not support completely the above-mentioned conditions.

Moreover, the heuristic evaluation and the observations of participants to usability testing revealed that the beta version still misses an adhesion to seafarers’ needs, by underlining some potential software-related issues, such as difficulty in identifying the system state, lack of error prevention and confirmatory feedback, and confusing iconography, labeling and information architecture.

Finally, the user acceptance evaluation suggested that seafarers’ opinions about the introduction of the B-BS tool are not clear and they need to be further investigated. The evaluation also highlights some possible issues in introducing a BB-S protocol considering the daily operating methods to whom seafarers are accustomed.

In conclusion, it could be assumed that at the moment there are significant barriers for seafarers in using the B-BS ICT tool, but it was important to detect these issues in the actual
early stages of the development process of the beta version of the software, since they could be relevant to the development team in considering the future implementations of the software.

In general we can underline that:

- The younger staff, or those that have more experience in the use of electronic devices found less difficulty to perform the required tasks.
- Users with vision problems encountered some difficulties with the very small text characters of the ICT portable tool.
- The PPE required by law do not allow easy use of the portable device chosen for ICT tools application.

Although the terminal FSRU Tuscany is considered as a complex environment, which can be "decomposable" in a part of the vessel and in a part of chemical industry, it has many important features that make difficult the introduction on board of a BBS protocol standard.

For example the number of people on board is greatly reduced, only 28 units, and the most part of the operations is performed by one, or at most two workers together. This fact would result in a very large number of self-observations or observations of one worker only, and so the acquisition of a very small amount of data in relation to the time taken.

Moreover, the self-observation tends to rapidly lose efficacy when used as a single observing system, because it is done by the personnel with less and less interest and attention. Then, there is also a serious lack of immediate feedback to the employee, a key element for the correct application of the BBS.

4 The final outcomes about the success factors in marine domain

Regard to the success factors, it is possible to identify a hierarchy of importance. Each application of B-BS methodology in industrial sector shows its scale of success factors, which is important to analyze in order to organize the protocol and decide where concentrate the action of the change.

We analyzed one by one the industrial success factors, comparing with the marine ones.

- Language: all of the workers usually speak different idiom;
- High turnover: the maritime workers make long journeys, but they always stop over in
different places and the team, in general, is changing. This could mean low control of B-BS procedures, unfamiliarity and lack of sharing of practices;

- Repetitiveness of working actions: it could be partial true for maritime workers as well, but the high turnover slow the possible success of B-BS, because it means distinction of training and loss of time in training and finally, the working actions are different depending on which reality we are going to realize the pilot application (cargo, ro-ro pax, cruise,..);
- High specialization of job: it could be partial true for maritime workers as well, but the negative element for success it could be the large observation area (ship, terminal, not a production line area..) and the difficulty to be observed;
- Working in team: linked to the high turnover and to the specialization of job, for maritime workers it could be difficult working in team, they usually work under stress, far from home and subjected to continuous changes of colleagues;
- Environment: as far as we know the environments are considered hostile and harsh in all of the sites (ship, terminal, cargo, offshore LNG,..).

<table>
<thead>
<tr>
<th>SUCCESS FACTOR</th>
<th>INDUSTRIAL DOMAIN</th>
<th>MARINE DOMAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>FIXED</td>
<td>CHANGING</td>
</tr>
<tr>
<td>Turnover</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td>Repetitiveness of working actions</td>
<td>PREVAILING</td>
<td>MISSING</td>
</tr>
<tr>
<td>Specialization of job</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td>Working in team</td>
<td>PREVAILING</td>
<td>MISSING</td>
</tr>
<tr>
<td>Environment</td>
<td>FIXED-ORDINARY</td>
<td>CHANGING-STRESS</td>
</tr>
</tbody>
</table>

*Success factors (from industrial to marine domain)*

5 The final results of the B-BS application

Generally the expected result is a highly injuries reduction. The average result in any industrial domain of application of B-BS is a reduction of injuries by 40% (first year) and by 20% (following years) until reaching an asymptote of 0 (zero).

The right application will lead to a positive scenario:

<table>
<thead>
<tr>
<th></th>
<th>40% INJURIES REDUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRST YEAR</td>
<td></td>
</tr>
<tr>
<td>SECOND YEAR</td>
<td>20% INJURIES REDUCTION</td>
</tr>
<tr>
<td></td>
<td>(over the first 40%, progressively in addition)</td>
</tr>
</tbody>
</table>
We expect a percentage reduction, but lacking the whole of the success factors like in land domain. Getting to the point, we could think in a reduction, even though almost certainly it will be lower in marine domain, which is known as more risky, hazardous, stressful and more exposed to extra-ordinary situations.

It is confirmed that in the marine domain, B-BS gets the same positive already verified and spotted in industrial domain, where the methodology begins. Our studies point out that, due to the heterogeneity of the jobs and the hyper-skill of the seafarers, it’s required a strong characterization of the methodology for the application on a vessel. To remedy this, a major adjustment of the B-BSs methodology has been made and a self-observation” component has been added.

6 Conclusions

In general, in the basis of the industrial experiences in over 30 years (American and Italian implementations), we could say that: if used correctly and consistently its application creates culture where:

- Crew members on each ship take responsibility for their own and each other’s safety;
- Unsafe acts and conditions are not tolerated.

Behavioral safety should aim to develop a culture in which crew members take responsibility for their own and each other’s safety. It relies upon peer pressure - crew members need to be prepared to challenge, and be challenged by, their colleagues, though not in a confrontational manner. It is a key principle of behavioral safety that officers can be observed by ratings - it is not a "top-down" policy. Everyone else may observe everyone.

Behavioral safety policies should usually encourage also crew members to recognize and report unsafe acts and unsafe conditions - whether of not they result in harm. An "unsafe act / unsafe condition" form may be used for such reporting.

The effective implementation of a behavioral safety system requires management commitment and leadership by example. However it should avoid micro-management of staff and in order to ensure ‘by in’, must include commitment of crew members to the implementation of health and safety policies and programs.

A behavioral safety system should not replace the safety management system or any other Safe Working Practice Program. A behavioral safety policy should be developed incorporating the following elements:

- Clearly defined expectations
- Good communication
- Clear leadership
- Risk awareness
- Accountability of all involved personnel
- Established safety culture
- Effective knowledge management

Behavioral safety systems cannot work in isolation and will fail unless they form part of a sound safety management system that addresses the following issues:

- The organization should have and open and just culture
- Management should be totally committed to supporting the system and allowing it to work, providing sufficient time and resources for those involved
- The system must be easy to understand and implement
- Everyone must have the opportunity to contribute and be involved
- Training should include everyone and should be practical and interactive
- Feedback to individuals must be open, prompt, timely and meaningful
- Statistics must be regularly and prominently issued and communicated

Finally it is of paramount importance that for a BBS initiative to be effective it needs to be integrated within company’s SMS (Safe Management System) and safety culture. It is a new challenge but it should be noted that feedback so far indicates positive land-based results.
39 partners from 10 countries
taking maritime transport into the digital age

By designing and demonstrating innovative use of ICT solutions
MONALISA 2.0 will provide the route to improved

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