MONALISA 2.0_D2.3.1-7

Human Aspect Description

Co-financed by the European Union
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### Document Status

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#### Review

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**TEN-T PROJECT NO:** 2012-EU-21007-S

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1 Executive Summary

1.1 Introduction

Human Factors deals with a wide spectrum of analyses from human interaction with devices, to the design of system, to team working, and various aspects of work and organizational design. (Stanton, 2006) The last point includes social factors, ranging from the organization and performance of small teams through to the corporate culture. Shipping depends upon the performance of humans at all possible levels. Further, shipping is a complex process involving several sub-processes such as; navigating the ship, port operation, ship operations and management, customs procedures, agents, etc. International and national regulations, labor unions and other policies are affecting all of these processes. Hence, the maritime industry is a complex sector with several stakeholders and roles. The different stakeholders are interlinked in a rather complex way, often described with the ship operator and owner in the center, (Lützhöft, 2011).

In this section, users are defined as human that operates and interacts with systems that are displaying information shared by the Sea Traffic Management (STM) concept or the services it provides. The focus it put on bridge crew onboard STM compatible ships and operators providing shore services. Human aspects in shipping have been under focus due to some major accidents. Below, some of typical aspects are listed: (Lützhöft, 2011)

- Overreliance on automation and technology
- Understanding of technology
- Suboptimal human machine interface
- Mode awareness
- Situational awareness
- Workload
- Standardization
- Information overload
- Integrity of information
- Operating procedures
- Training needs

1.2 Benefits

The overall objectives of STM are to increase safety, improved efficiency and decreased environmental impact of maritime transport. These high level objectives are captured in the WP2 report “STM Performance Target” document, which gives a broad spectrum of aspects related to STM. However, the main user benefits are
identified in the respective descriptions of the strategic enabling and are mainly connected to:

- Increased interoperability
- Decreased workload
- Increased situational awareness
- Receiving the right information at the right time

All the above are the affected due to increase of sharing information and intensions.

### 1.3 Risks

When introducing new or upgraded bridge equipment and shore based systems in order to display information or implement new ways of ship-to-shore interaction, the following risks needs to be monitored:

<table>
<thead>
<tr>
<th>Risk</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information overload</td>
<td>Adding new information to the bridge crew might lead to information overload in particular situations. The operators’ decision making might be affected in a negative way. This will but high requirements on the HMI design and also keeping the user needs in the centre of the.</td>
</tr>
<tr>
<td>Low integrity of information</td>
<td>Adding new relevant information can increase the situational awareness and make a better base for decision making. However, if the information is user dependent, hence cooperative information, the information can be wrong. This would then lead to miss information or contradicting information affecting the users decision on making negative.</td>
</tr>
<tr>
<td>Contradicting information</td>
<td>Adding new relevant information can increase the situational awareness and make a better base for decision making. However, if the information is user dependent, hence cooperative information, the information can be wrong. This would then lead to miss information or contradicting information affecting the user’s decision on making negative.</td>
</tr>
<tr>
<td>New systems and equipment</td>
<td>Some of these new and updated services need new or upgraded systems and equipment. New systems and equipment could introduce new risks at the bridge work putting higher requirements on the bridge crew knowing all functions and procedures. An updated bridge design should be user centred and user driven.</td>
</tr>
<tr>
<td>Training need</td>
<td>Some of these new and updated services need new or upgraded systems and equipment. New systems and equipment could introduce new risks at the bridge work putting higher requirements on the bridge crew need training of the new or upgraded</td>
</tr>
</tbody>
</table>
1.4 Risk mitigation measures

In order to mitigate risks the following aspects should be accounted for in the definition of the overall STM concept and the implementation of STM:

- The needs should be user driven
- The concept development should follow user centre design principles
- Common functions and HMI standards in order to harmonise the bridge equipment
- Vendor specific solutions should be avoided
- Operating procedures should be adapted for the new functions and services
- Training should be adapted and including new systems and services

In an ideal world, innovation is based on user needs. This is however not always the case. Because innovation so often is technology driven, it is of crucial importance that the definition and development process involves the users early and throughout the process. Inspired by psychologists and designers like Donald Norman and Jacob Nielsen, Human Centred Design (HCD) emerged as a methodology containing different methods and techniques to ensure that new products and services were developed answering to user needs. HCD calls for developers to interact with users in early context analysis before starting to design low fidelity prototypes of products or services. These prototypes are then tested and evaluated with the users before the re-design of more refined prototypes are undertaken and evaluated in an iterative spiral until the product or service is found useful enough for launching. The backside of HCD is a more time consuming and costly product development process. Some of the STM functionalities and services where tested Sub Activity 1.2 “STM Operations and HMI” and Sub Activity 1.5 “Deep Sea Shore Based Assistance” evaluated by active mariners. These tests have led to both re-design of functions and at the same time confirmation of some of the expected benefits.

1.5 Training needs

The ship’s crew’s competences, certificates and requirements are set in IMO’s International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). STCW includes detailed learning objectives broken down for each subject and for each certificate. IMO also has issued a number of guidelines – IMO model courses - giving detailed curriculum for each course leading to a particular certificate. Officers are trained at maritime academies and universities and includes both theoretical studies and practical training in ship simulators. To hold a valid officer license extensive sea going experience is also required.
VTS operator should be trained according to IALA Recommendation V-103 on Standards of Training and Certification of VTS personnel. These model courses are intended to provide national members and other relevant authorities with specific guidance on the training of VTS staff. However, this is not yet any mandatory requirements.

A training need analysis has been performed at conceptual level in order to be in line with the level of details in the concept definition of STM. Inputs are collected from Sub Activity 1.2 and Sub Activity 1.5 with respect to functionality and updated procedures. The use of the core technical enable – exchange of route information is in line with the navigation process and only minor updates of operating procedures has been proposed. However, an introduction of Deep sea shore based assistance service would need a clear definition and distinction between pilotage (shore or on-board).

The need analysis was divided between onboard and shore side. Required training for bridge crew needs a distinction between mission critical functions or strategic, administrative functions. Mission critical functions should be part of ECDIS training and be included in the IMO ECDIS model course and in the generic and type specific course. Hence, the training should be included in the normal STCW education at maritime academies and universities and a dedicated type course for active mariners. Training of the strategic or administrative services, it is proposed, that is should be arranged by the service providers as part of the service agreement.

Shore side operators should follow the normal curriculum and training and deep understanding of the services provided should be accounted for in the normal basic and reputational education.
Table of contents

1 Executive Summary ........................................................................................................... 3
   1.1 Introduction .................................................................................................................. 3
1.2 Benefits ............................................................................................................................ 3
1.3 Risks .................................................................................................................................. 4
1.4 Risk mitigation measures ............................................................................................... 5
1.5 Training needs .................................................................................................................. 5

2 General Information ........................................................................................................... 8

3 Introduction ......................................................................................................................... 10
   3.1 Scope and purpose ......................................................................................................... 10
   3.2 Objective ....................................................................................................................... 10
   3.3 Background .................................................................................................................. 10
   3.4 Structure of report ....................................................................................................... 11

4 Human Aspects ..................................................................................................................... 12
   4.1 Background .................................................................................................................... 12
   4.2 Identification of human aspects .................................................................................... 13
   4.3 Identification of user benefits ....................................................................................... 14
   4.4 Identification of risks .................................................................................................... 15
      4.4.1 Risk mitigation measures ....................................................................................... 17
      4.4.2 User Centre Design ............................................................................................... 18
      4.4.3 Operating procedures ............................................................................................. 19

5 Training Needs .................................................................................................................... 20
   5.1 Background .................................................................................................................... 20
   5.2 Training needs ................................................................................................................ 21
      5.2.1 Method .................................................................................................................... 21
      5.2.2 Bridge crew ............................................................................................................. 21
      5.2.3 Shore-based operators ............................................................................................ 22
      5.2.4 Port personnel ........................................................................................................ 22

6 References ........................................................................................................................... 24
2 General Information

This report is a deliverable from Activity 2 of the MONALISA 2.0 project. MONALISA 2.0 is a project gathering 39 private, public and academic partners from 10 different countries. The overall objective of MONALISA 2.0 is to strengthen efficiency, safety and environmental performance of maritime transportation. Coordinator of the project is the Swedish Maritime Administration. The project is co-financed by TEN-T under the Motorways of the Sea Programme and is part of the EU’s e-Maritime initiative. MONALISA 2.0 has taken its point of departure in the results and experiences from the MONALISA project (2010-EU-21109-S) and also re-uses results and experiences from the development within the aviation sector and its SESAR (Air Traffic Management) programme.

MONALISA 2.0 is constituted by four Activities: Activity 1 - STM Operations and Tools, Activity 2 - STM Definition Phase Study, Activity 3 - Safer Ships, and Activity 4 - Operational Safety. The objective of Activity 2 is to outline the framework for Sea Traffic Management (STM), elaborate the target concept, and develop a plan for further development and deployment.

Activity 2 is divided into 7 different sub-activities (work packages);

Current Situation Analysis – describes a snapshot of today’s maritime transport industry, focusing on information sharing. It highlights strengths, weaknesses, current development as well as needs and recommendations. The main results of this analysis are presented in report D2.1.1 STM The Current Situation.

STM Performance Targets Development – includes analysis and elaboration of a performance framework including e.g. performance targets, key performances areas and vision and goals based on the performance framework. The main results of this work are presented in the report D2.2.1 STM Performance Framework.

STM Target Analysis – develops the target concept(s) of Sea Traffic Management based on the analysis of the current situation and driven by the performance targets. Different aspects are taken into account, such as for example, legislations and regulations, and business models of different stakeholders. The results of this work are summarized in the report D2.3.1 STM - The Target Concept.

STM Strategic Roadmap Development – establishes a shared vision of the overall transition sequence for implementation of the STM Target Concept. The roadmap includes operational improvements and enablers as well as development activities needed to support the transition. This work has been performed in conjunction with, and the results are also presented together with, the work in sub-activity 5; Develop STM Master Plan.

Develop STM Master Plan – creates a Master plan for implementing Sea Traffic Management in Europe, by further elaborating and detailing the STM Strategic Roadmap, hence providing a link to the STM Work Programme. The STM Master Plan is described together with the STM Strategic Roadmap in the report D2.4.2/D2.5.1 STM Strategic Roadmap and Master Plan. The STM Master Plan is also available in an electronic version: LINK.
Development of a Port CDM Demonstrator – develops and demonstrates in two ports the first versions of some of the information sharing services that are a part of the Port CDM (Collaborative Decision Making) concept. The results of this sub-activity are presented in the report D2.7.1 Port CDM Technical Description and D2.7.2 Port CDM Validation Report.

This report summarizes the results from transversal analysis of Human aspects of Sea Traffic Management, D2.3.1-7.
3 Introduction

3.1 Scope and purpose
This document presents a transvers analysis of the Sea Traffic Management Concept with respect to human perspective and constitutes the deliverable D3.2.1-7. This analysis has been divided into two parts:

• Human aspects
• Training needs

The document is structured accordingly.

The scope of the report is human perspective of STM and different user aspects are identified. Users are here defined as operators that are interacting with STM compliant equipment or whom are directly interacting with STM shared information.

3.2 Objective
The objectives of report are to:

• Identify possible user benefits introduced by the proposed STM operational services
• Identify possible user risks introduced by the proposed STM operational services
• Propose risk mitigation actions for the development and implementation of STM operational services
• Analyze training needs which would be introduced by the proposed STM operational services

The main research question in this the report is to answer:

• What would be the main area of impact on users in case of implementation of the STM-concept?

3.3 Background
In “Current Situation Analysis”, (D.2.1.1) Human Factors (HF) were discussed and is was stated that HF is concerned with analysis from human interaction with devices, to the design of system, to team working, and various aspects of work and organizational design. (Stanton, 2006) This includes also social factors, ranging from the organization and performance of small teams through to the corporate culture. It was concluded in “Current Situation Analysis”, (D.2.1.1) that the maritime industry of today heavily depends upon the performance of humans at all possible levels.

The shipping is very complex, involving several sub-processes such as; navigating the ship, port operation, ship operations and management, customs procedures, agents, etc. International and national regulations, labor unions and other policies are
affecting all of these processes. Hence, the maritime industry is a complex sector with several stakeholders and roles. The different stakeholders are interlinked in a rather complex way, often described with the ship operator and owner in the center, (Lützhöft, 2011).

Further, it was concluded in “Current Situation Analysis”, (D.2.1.1), that some major accidents in shipping have put focus on the human aspects in the maritime domain, (Lützhöft, 2011). Below, some examples of aspects affecting the human element are listed:

• Overreliance on automation and technology
• System and knowledge and understanding
• Suboptimal human machine interface design
• Inherent system latency interfering with error recovery efforts
• System mode awareness
• Situational awareness
• Workload
• Standardization
• Information overload
• Integrity of information
• Operating procedures
• Training needs

One of the main methods of dealing with the above listed elements is to use human centered design.

3.4 Structure of report

Based on the study logic and methods used, this report is organised as followed:

• **Chapter 1** is this introduction defining scope and purpose, giving a background and lists of abbreviation used in the report.
• **Chapter 2** presents the analysis of human perspective
• **Chapter 3** identifies training needs
4 Human Aspects

4.1 Background

The STM concept is described in the “Sea Traffic Management – A Holistic View” (D2.3.1-4.0) where it is concluded that “STM concept takes a holistic approach to services and processes making the berth-to-berth ship voyage more efficient, safe, and environmentally sustainable.” The concept puts the voyage in focus and is used as the core element for information sharing among actors and stakeholders. Further, the concept builds upon an enhanced interaction between ship-to-ship, ship-to-shore, shore-to-ship, shore-to-shore. In order to define the STM concept, existing and novel operational services have been studied in the context of a higher degree of actor interactions and information sharing. Further, the STM concept is defined by its operational services, which involves already existing processes and services and in some cases new defined services by:

- Enhancing existing services
- Proposing And Validating New Innovative Services

The operational services can be considered to be high level functions in the overall STM concept involving operators, user, procedures and technical systems. The operational services are organized into four strategic enabling concepts, which are:

- **Port Collaborative Decision Making (Port CDM)**, in which the process for arrivals and departures is made more efficient through information sharing, common situational awareness and improved processes;
- **Strategic Voyage Management (SVM)**, which deals with route planning, route exchange and route optimization before the voyage has started;
- **Dynamic Voyage Management (DVM)** which deals with route planning, route exchange and route optimization whilst the ship is on its way;
- **Flow Management (FM)**, which includes services that will support both land organisations and ships in optimizing overall traffic flow through areas of dense traffic and areas particular navigational challenges.

These are all enabled by:

- Information sharing by **Sea System Wide Information Management (Sea SWIM)**, which has the intention of being a common framework for information sharing and service distribution for maritime activities.

In the following analysis, these four strategic enabling concepts will be used as a reference for categorizing operational services and human aspects and training needs associated to them.
4.2 Identification of human aspects

This paragraph is focusing on human aspects with respect to benefits and risks introduced by STM. The overall objectives of STM are to increase safety, efficiency and environment. These high level objectives are captured in the “STM Performance Target” document, which gives a broad spectrum of aspects related to STM. These high level aspects where organised in Key Performance Areas (KPAs). Each KPA are then further broken down to Key Performance Objectives (KPO). Most of these KPO:s will have an overall positive impact on humans. However, very few human aspects are identified in the “STM Performance Target Analysis”, (D2.2.2). Hence, more direct human aspects of STM needs to be identified with respect to the four strategic concepts.

Before, human aspects are discussed further, users and especially operators are identified. Operators are here defined as a user that are interacting with STM compliant equipment or whom are directly interacting with STM shared information. Below a summary of the expected operators are given.

<table>
<thead>
<tr>
<th>Strategic concept</th>
<th>Operators</th>
<th>Comments</th>
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<tbody>
<tr>
<td>PortCDM</td>
<td>Agents, Masters, Tug masters, Pilot planning, Lineman planning, Port authorities, VTS operators, Terminal operators</td>
<td>On board aspects are the most critical.</td>
</tr>
<tr>
<td>Strategic Voyage management</td>
<td>Shipping company personnel, Masters</td>
<td>Shipping companies administrative</td>
</tr>
<tr>
<td>Dynamic Voyage Management</td>
<td>Bridge crew, Master, Pilots, VTS operators</td>
<td>On board aspects are here the most critical. Mostly connected to bridge equipment and the ships administrative systems</td>
</tr>
<tr>
<td>Flow management</td>
<td>VTS operators, Other shore based operators, Pilots, Bridge crew, Master, Pilots</td>
<td>VTS operators with VTS support tools</td>
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</table>
4.3 Identification of user benefits

The main operator benefits identified in “STM Performance Target Analysis”, (D2.2.2) and in STM concept is described in the “Sea Traffic Management – A Holistic View” (D2.3.1-4.0) and are mainly connected to:

- Interoperability
- Workload
- Situational awareness
- Right information at the right time

In doing so, each strategic enabling concept, are broken down to its effect on the operators.

PortCDM is as an infrastructure for information sharing within the port call process (the activities performed prior, during, and after the “physical” turn-around process), giving different involved actors the possibility to share intentions digitally in real-time creating a common view of all available information relevant for that actor, and using this information as a tool to create a common situational awareness supporting the involved actors to make more efficient collective decisions. The holistic and standardized approach to information management would increase interoperability between systems and services, which is beneficial for the users. HMI is important but not as for mission critical systems like on-board systems.

The two concepts of Voyage Management; supports the overall navigation process. It will lower the workload in the navigation process:

- Voyage planning
- On-board navigation
- Ship reporting

One important aspect here is that the basic ideas in the navigation process and the basic procedures should not be changed. Further, Voyage Management contributes to increase the situational awareness of the navigators by e.g. visualising surrounding ship’s routes.

Flow management focus on the interaction between ship and shore with three fundamental ideas:

- Operator should receive right and applicable information at the right time
- Achieved by increased situational awareness
- Shore based organizations can contribute considerable by adding valuable information and advice based on:
  - Enhanced traffic image can be used to detect potential collisions, groundings and traffic congestions alerting ships
Updated regional information and effective way of informing ships about potential hazards

One aim is also to achieve a better ship and shore team work based on the common situational picture.

### 4.4 Identification of risks

When introducing new or upgraded procedures or equipment in order to display information or implement new ways of ship-to-shore interaction, it is also possible that new risks are identified. In the case of STM, the focus is put on three operator specific situations:

- On-board navigation bridge
- Shore side service center
- PortCDM applications

**On board / shore side**

The following main risks are identified as common for both the on-board and shore side:

- Information overload
- Overreliance
- Low integrity of the information
- Contradicting information
- New equipment and systems
- New training needs

These identified risks on board and ashore are explained and described in more detail in the table below.

<table>
<thead>
<tr>
<th>Risk</th>
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<tbody>
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<td>Information overload</td>
<td>Adding new information to the bridge crew might lead to information overload in particular situations. The operators’ decision making might be affected in a negative way. This will but high requirements on the HMI design and also keeping the user needs in the centre of the design.</td>
</tr>
<tr>
<td>Overreliance</td>
<td>Adding new and detailed information to the bridge crew might lead to overreliance of the information and systems instead of looking cross checking information.</td>
</tr>
<tr>
<td>Low integrity of the information</td>
<td>Adding new relevant information can increase the</td>
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</table>
information | situational awareness and make a better base for decision making. However, if the information is user dependent, hence cooperative information, the information can be wrong. This would then lead to miss information or contradicting information affecting the users decision on making negative.

Contradicting information | Adding new relevant information can increase the situational awareness and make a better base for decision making. However, if the information is user dependent, hence cooperative information, the information can be wrong. This would then lead to miss information or contradicting information affecting the users decision on making negative.

New systems and equipment | Some of these new and updated services need new or upgraded systems and equipment. New systems and equipment could introduce new risks at the bridge work putting higher requirements on the bridge crew knowing all functions and procedures. An updated bridge design should be user centred and user driven.

Training need | Some of these new and updated services need new or upgraded systems and equipment. New systems and equipment could introduce new risks at the bridge work putting higher requirements on the bridge crew need training of the new or upgraded equipment.

**PortCDM**

The following main risks are identified for PortCDM:

- Information overflow
- Low integrity of the information
- Contradicting information
- New system integration

These identified risks on PortCDM are explained and described in more detail in the table below.

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<td>Information overload</td>
<td>Adding new information to the different actors in the port call process might lead to information overload in particular situations. The operators´ ability to make decisions might be affected in a negative way. This will put high requirements on the HMI design and also</td>
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</table>
keeping the user needs in the centre.

| Low integrity of information | Adding new relevant information can increase the situational awareness and create a better base for decision-making, since the users have more information to base their planning and decisions on. However, if the information is user dependent, hence cooperative information, the information can be wrong. This could then lead to miss information or contradicting information affecting the users possibility to make good decisions. |
| Contradicting information | Adding new relevant information can increase the situational awareness and make a better base for decision-making since you can show contradicting information that would not have been exposed before. However, if the information is user dependent, hence cooperative information, the contradicting information could be misleading. This would then lead to miss information or contradicting information affecting the users decision in a negative way. |
| New systems and equipment | Some of these new and updated services need new or upgraded systems, new integrations with other systems or new equipment. New systems or new integrations between systems and equipment could introduce new working process. |
| Training need | Some of these new and updated services need new or upgraded systems, new integrations with other systems or new equipment. New systems or new integrations between systems and equipment could introduce new risks that the users need to be aware of and in some cases additional training. |

4.4.1 Risk mitigation measures

When defining the overall STM concept and the implementation of STM in the form of new or updated operational services, the following aspects should be accounted for in order to meet and mitigate the risks identified in the previous paragraph.

- The needs should be user driver
- The concept development should follow user center design principles
- Common functions and HMI standards in order to harmonise the bridge equipment
- Number of key strikes should be minimized
- Vendor specific solutions should be avoided
• Operating procedures should be adapted for the new functions and services
• Training should be adapted and including new systems and services

User centre design and operating procedures are discussed further below, and training is discussed further in the next section.

4.4.2 User Centre Design

In an ideal world, innovation is based on user needs. This is however not always the case. Because innovation so often is technology driven, it is of crucial importance that the definition and development process involves the users early and throughout the process. Inspired by psychologists and designers like Donald Norman and Jacob Nielsen, Human Centred Design (HCD) emerged as a methodology containing different methods and techniques to ensure that new products and services were developed answering to user needs. HCD calls for developers to interact with users in early context analysis before starting to design low fidelity prototypes of products or services. These prototypes are then tested and evaluated with the users before the re-design of more refined prototypes are undertaken and evaluated in an iterative spiral until the product or service is found useful enough for launching. The backside of HCD is a more time consuming and costly product development process.

Figure 1: Donald Norman’ HCD model (The Psychology of Everyday Things, Basic Books, 1988)

In the STM concept definition phase, HCD has been used in the following way:

**Context analysis:** feedback from users and reference groups like the Operational Advisory Group (OAG) and Policy Advisory Group (PAG) have been used in the overall definition of services.

**Low fidelity prototypes:** some of the STM operational services has been implemented as prototypes or demonstrators in a real environment or simulated environment:
• PortCDM: demonstrating the Port Synchronisation and Port Optimization and monitoring in a real port environment;
• Dynamic Voyage Management: demonstrating route exchange, tactical routes and route optimisation simulating ship and shore users; and
• Flow Management: demonstrating flow optimization and enhanced monitoring simulating ship and shore uses.

**Tested and evaluated:** the demonstrators are tested with real users in real life or using advanced simulators virtually interconnected into a European Maritime Simulator Network (EMSN). The simulation tests gives input both to usability analysis and safety analysis, being able to perform both micro and macro simulations.

At IMO’s subcommittee of navigation 2014 (NAV 59) it was stated that a number of guidelines were very important for the future development and implementation of e-navigation solutions (NAV 59/20, paragraphs 6.1 to 6.43 and NCSR 1/9/1):

• Guidelines on Human Centred Design (HCD) for navigational equipment and systems
• Guidelines on Usability evaluation of navigational equipment
• Guidelines for the Harmonization of test beds reporting

Part of these above listed guidelines is used in the STM testing, evaluation and usability analysis.

**4.4.3 Operating procedures**

In the “Current Situation Analysis”, (D.2.1.1), the role of management systems and procedures in the maritime domain where discussed. The Safety Management Standard (SMS) was introduced and in 1998, the ISM Code was made mandatory and included within SOLAS. Regulated by the IMO, this code requires ship operators to implement a formal SMS. One of the main aims of the code is to link every ship to a ship operator ashore. This code applies to and affects most activities carried out on board ships as well as ashore. The ISM Code provided the maritime domain with a measurable safety indicator. Part of the SMS is implemented as Standard Operating Procedures (SOP) and check lists.

Operating procedures need to be updated when new processes, services and equipment are introduced. When establishing new procedures the organization should first have a method in place for determining what procedures or processes need to be documented. Those SOPs should then be written by individuals knowledgeable with the activity and the organization’s internal structure. These individuals are essentially subject-matter experts who actually perform the work or use the process. A team approach can be followed, especially for multi-tasked processes where the experiences of a number of individuals are critical, which also promotes “buy-in” from potential users of the procedures.
Procedures should be written with sufficient detail so that someone with limited experience with or knowledge of the procedure, but with a basic understanding, can successfully reproduce the procedure when unsupervised. The experience requirement for performing an activity should be noted in the section on personnel qualifications. For example, if a basic chemistry or biological course experience or additional training is required that requirement should be indicated.

Further, procedures should be reviewed or validated by one or more individuals with appropriate training and experience with the process. It is especially helpful if draft SOPs are actually tested by individuals other than the original writer before the SOPs are finalized.

In Activity 1 Sub Activity 1.2 “STM Operations and HMI” (SA1.2) and Sub Activity 1.5 “Deep Sea Shore Based Assistance” (SA1.5). High level procedures for some of the STM services have been proposed. In this case the starting point was the role and functions that the operator has to perform and based on that establishing a high level task analysis. Further, the existing processes in the VTS domain and the onboard navigation process were used.

5 Training Needs

The second important aspect of the Human perspective, mentioned in the introduction is training, which is discussed in this section. It is important that note that training and training needs should be considered in parallel when developing new concept, processes and technical solutions.

Results from the training need analysis are presented focusing on the ship bridge crew and shore-based operators.

5.1 Background

In the Current Situation Analysis”, (D.2.1.1) the background of ship crew’s competes and training where giving. Below follows a short summary giving the background to the training need analysis.

IMO’s International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), (STCW, 95) regulates and sets the requirement on ship’s crew’s competences, certificates and training. STCW includes detailed learning objectives broken down for each subject and for each certificate. IMO also has issued a number of guidelines – IMO model courses - giving detailed curriculum for each course leading to a particular certificate.

Normally deck and engine officers are trained at national maritime academies typically during a period of three years. The training includes both theoretical studies and practical training in ship simulators and periods at sea. To hold a valid officer license extensive sea going experience is also required.

Any new training needs identified for the ship’s crew when introducing the STM concept should be:
1. If mandatory be included in STCW and described in one or several IMO model courses
2. If not mandatory be an additional training module for the additional functions and procedures

In the following discussion, alternative 1) is assumed.

VTS operator should be trained according to IALA Recommendation V-103 on Standards of Training and Certification of VTS personnel (IALA, 2011). These model courses are intended to provide national members and other relevant authorities with specific guidance on the training of VTS staff. However, this is only guidelines not yet any mandatory requirements. The VTS training is decided by the national VTS authority.

However, if the STM concept is introduced, changes in working processes and procedures should be included in IALA Recommendation V-103 on Standards of Training and Certification of VTS personnel (IALA, 2011).

5.2 Training needs

5.2.1 Method

This training need analysis has been performed at a conceptual level in order to be in line with the level of details as for which the STM concept is defined. The scope of this analysis limited to FM, PortCDM and VM for the following operators:

- Onboard, representing the bridge crew working primarily with navigation
- Shore side, representing VTS or SRS operators or other shore based service providers
- Port, representing users connected to the port operations

The above listed user categories will use different equipment’s and services and will work in different operational environment. Hence, these groups will have different training needs.

Inputs are collected from Sub Activity 1.2 “STM Operations and HMI” (SA1.2) and Sub Activity 1.5 “Deep Sea Shore Based Assistance” (SA1.5) in Activity 1 of this project. In those Sub Activities high level SOP were established, as described in the previous section, by starting with the different roles and their tasks.

Based on this high level SOP, training needs can be identified. Further, gaps in the current training or required modifications are then identified.

5.2.2 Bridge crew

When discussing the required training for bridge crew their needs need to be a distinction between mission critical functions and strategic or administrative functions. Mission critical functions are here defined as functions required by IMO
equipment carriage requirements together with relating IMO Performance Standards. This is normally the functions implemented in the bridge equipment.

To administrative functions could functions for voyage planning, dynamic re-planning of the voyage and the ship reporting be included.

The main component introduced by the STM concept is the route exchange function and the processes connected to this. This will have an impact both on the mission critical and strategic functions. SOPs have been updated, with respect to route exchange in Sub Activity 1.2 “STM Operations and HMI”. These updates fully follows today’s navigation process and only minor changes in the procedures regarding voyage planning and voyage monitoring are required. One main different could be a shorter time scale in the dynamic update of a voyage plan.

Further, the issue of overreliance of information must be addressed in the training. This will include but understanding of concepts, pros and cons of the bridge equipment and the level of integrity can be expected of the information.

The above listed changes will affect the Deck officer training both on the operational level and the management level.

Route exchange and similar mission critical functions should be part of ECDIS training and be included in the IMO ECDIS model course and in the generic and type specific course. Hence, the training should be included in the normal STCW education at maritime academies and universities and a dedicated type course for active mariners.

Training of the strategic or administrative services should be arranged by the service providers as part of the service agreement.

5.2.3 Shore-based operators

Shore side operators should follow the normal curriculum and training and deep understanding of the services provided should be accounted for in the normal basic and reputational education.

In the case of STM, the operators need to be able of handling the route exchange process, dynamic No Go Areas and electronic MSIs. Further, the operators also need to train potentially new services:

- Enhanced shore-based monitoring
- Area management
- Flow optimization
- Shore-based navigation assistance (conducted by a pilot)

5.2.4 Port personnel

PortCDM is not a new system; it is an infrastructure for information sharing to enable exchange of real-time information between the various actors, involved in a port call process, different operational systems. The basic idea is that users share the information they decide to share, and since they are already working in their own
system environment we do not see that excessive additional training is needed but it requires a good understanding of how their own operating system environment works.

In cases where actors operational systems are not sufficient to exchange the correct information or where the absence of systems that can exchange digital information with other systems, additional training could be required in how to use a web-based application for information sharing with other actors participating in the port call process.
6 References

Sea Traffic Management – A Holistic View, MONALISA 2.0 – D2.3.1-4.0, Activity 2, 2015. Available from: URL

Current Situation Analysis, Report D 2.1.1, MONALISA 2.0 Activity 2, WP1, Available from URL

STM Performance Target Analysis Report D 2.2.2, MONALISA 2.0 Activity2, WP2, Available from: URL

Sub Activity 1.2 “STM Operations and HMI” (SA1.2), MONALISA 2.0 Activity 1, Available from: URL

Sub Activity 1.5 “Deep Sea Shore Based Assistance” (SA1.5) MONALISA 2.0 Activity 1, Available from: URL


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