



CASCADE
Model-based Cooperative and
Adaptive Ship-based Context Aware
Design



D1.3 Updated Scenario Models & Requirements

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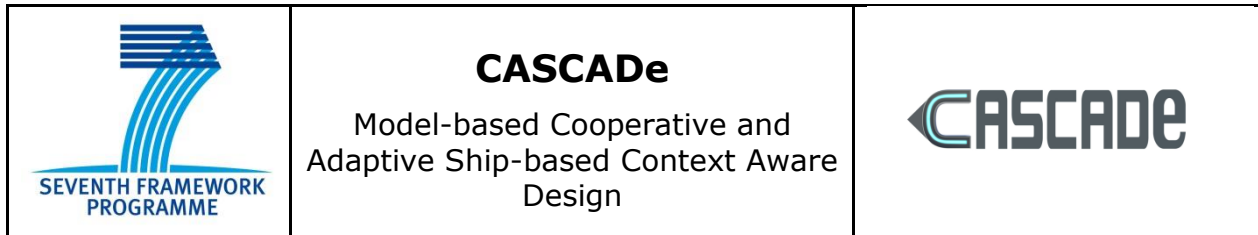
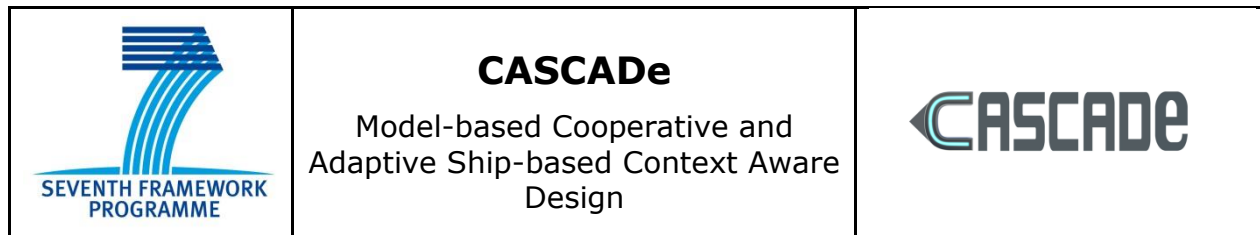


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1 Introduction

The aim of this deliverable is to update the scenarios and requirements used in CASCADE and first presented in [1]. Changes and extensions are based on the work done and feedback received during the first cycle of the project. In particular, we use the experiences from the simulator sessions and the results of the mariner survey [2] to guide this work; in addition, we aim to use the new version of the scenarios as use cases for the tools developed in CASCADE.

The extended scenarios will form the basis of the work in the second cycle of the project.

This document is to be seen as an extension of [1]; we will refer the reader to the relevant sections as appropriate.

2 Updating the Scenarios

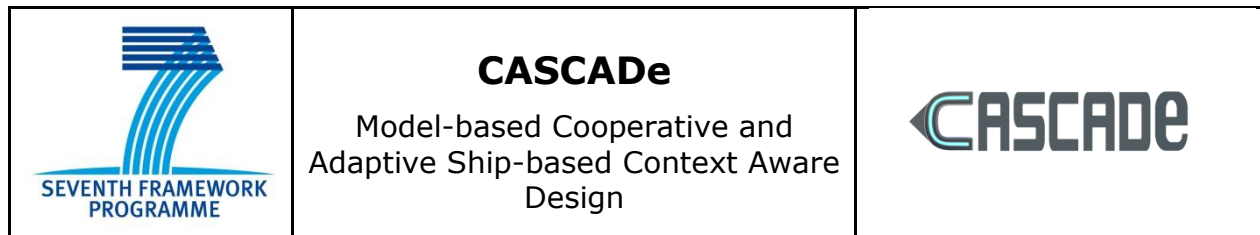
The first cycle of CASCADE produced three new console designs, which were presented as wooden mock-ups (WP5). Central to each design was a new '**Shared Display**', based on the Perspective Editor developed by Raytheon Anschuetz (RAY). The perspective editor allows users to customise the information that is shown on the Shared Display. So, for example, the user might decide to have RADAR in a large window on screen, and two smaller windows showing ECDIS and conning information when sailing in deep sea. If fog came in, the user might decide to minimise the RADAR window, and increase the size of the ECDIS window. Such adaptation of information on the Shared Display could be done manually or automatically depending on certain external parameters. Another concept at the heart of the Shared Display is the idea of a touch-based annotation tool that allows seafarers to "draw" on sea charts and other screens to enhance communication and ensure a shared understanding of navigational situations. Using the Shared Display, it would also be possible to 'capture' information from a watch, keeping notes and recording key information that would then be invaluable at handover. This replicates the use of a 'scribble pad' which seafarers would sometimes use alongside paper sea charts. In this way, the 'handover tool', as conceptualised early on in the project, would become incorporated into the CASCADE Shared Display.

Each of the three console designs was used to act out a scenario in which a master and a pilot use the Shared Display to plan a vessel's passage out of Kiel harbour. These scenarios were filmed ([3], [4], [5]) and used in an online survey to receive feedback from bridge navigational officers (WP6). The results of the survey were positive, showing a slight preference for the "Central Console" design. Full details of the designs and the survey are reported in deliverable 6.2 [2].

The master/pilot exchange in the video is a use case for the Shared Display and forms (in a slightly generalised form) our first extended scenario.

In addition, we devise further scenarios for the use of the same tool. The first one is a routine watch handover in which the departing Officer of the Watch provides all relevant navigational information to the colleague taking over.

Secondly, we sketch an emergency handover in which the Officer of the Watch calls the master to the bridge due to an impending collision with another vessel. The Shared Display is then used to provide the master with the most relevant information to resolve the situation; this scenario is an extension of the collision scenario first described in [1].



As for the requirements, there is no need for updating. We choose scenarios that serve as use cases for our tools; however they still meet the requirements first compiled in [1]. We list these criteria below for the reader's convenience.

1. Model friendly -> capable of being modelled by existing formalisms
2. Of interest to partners -> reflecting the industrial aims and research interests of the consortium
3. Improvable -> there must be room for optimisation
4. Sufficiently detailed -> especially with regard to cognitive activity
5. Multi-agent -> i.e. involve co-operation at a level greater than one person working alone on a single activity
6. Suitable for experimentation
7. Repeatable
8. Implementable in our simulators

3 Updated Scenarios

As in D1.1, we use UML Sequence Diagrams to describe the scenarios. This diagram format has proven extremely useful in studying and developing the bridge designs in WP3 [6].

3.1 Passage Planning (Master/Pilot Exchange)

This scenario is a generalisation and extension of the scenario enacted in the video used for the online survey [2].

The scenario starts with the master and pilot exchanging relevant information about the vessel and the local conditions. In particular, the master provides the pilot with detailed information about the following:

- Vessel's draft;
- Possible lowest and highest speed;
- Revolution/speed;
- Turning circle (head and sideways);
- Distance run to stop the vessel from full ahead to full astern;
- Turning direction of the propeller;
- Any special hazardous cargo on board.

In turn, the pilot gives information on:

- Tides (height and times);
- Expected currents and sea state;
- Local weather forecast.

Subsequently, the master and pilot use the Shared Display for the detailed passage planning. Essentially, they "draw" the vessel's route on a suitable electronic chart and use this sketch to agree on waypoints and wheelover points. Other vessels and required manoeuvres for collision avoidance are added as necessary.

For the sake of simplicity, we exclude the use of tugs from this scenario. The exact sequence of exchanged information is given in Figure 1.

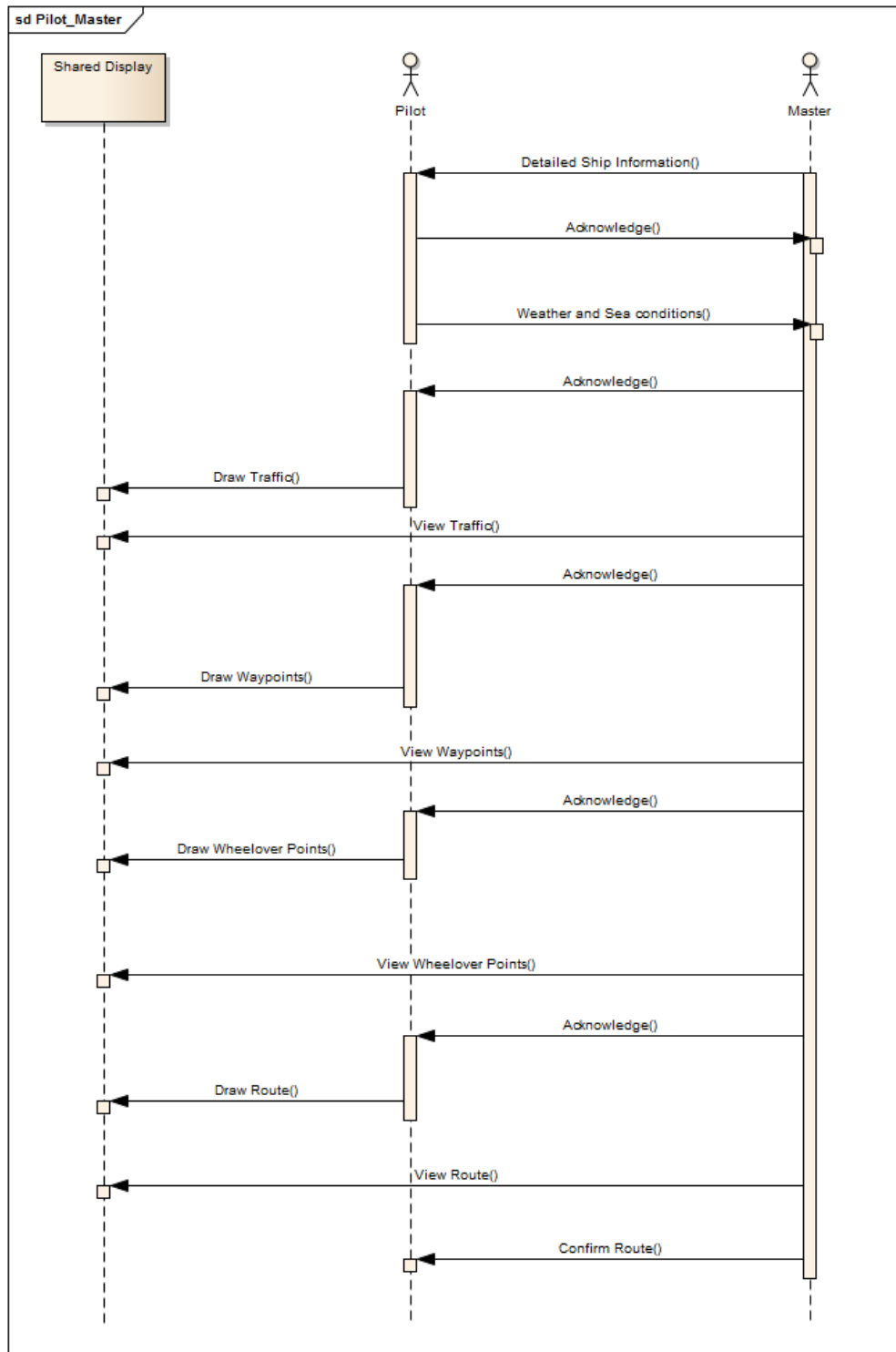
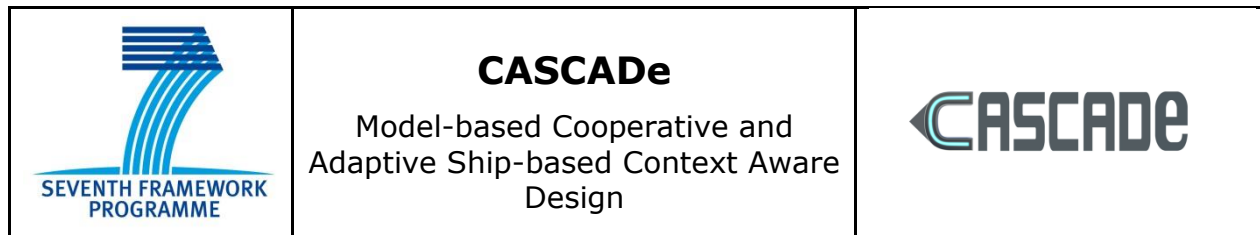


Figure 1: Master/Pilot Exchange



3.2 Routine Watch Handover

This scenario describes the routine watch handover between two OOWs; one finishes his or her shift, the other comes to the bridge to take over the command. It is crucial for the safety of the ship that all relevant navigational information is passed on to the relieving officer. We show how the CASCADE Shared Display can be used to present (most of) the relevant information in a compact form. This information includes:

- Current conditions (weather, visibility, sea state);
- Vessel's position, course and speed;
- Vessel's route and waypoints;
- Navigational hazards;
- Upcoming manoeuvres.

Other instruments may be used to double-check some of the information. The flow of information is shown in Figure 2.

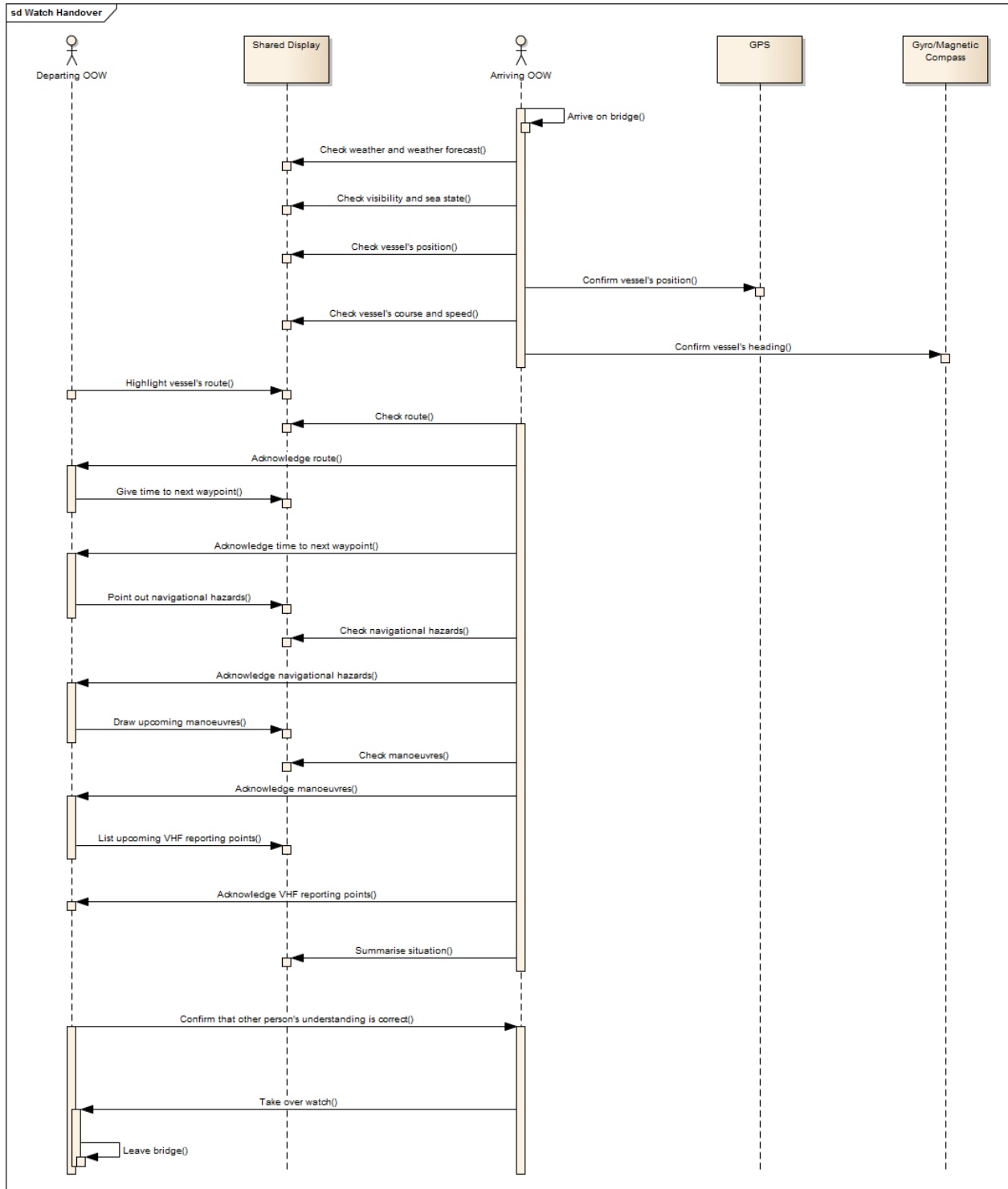
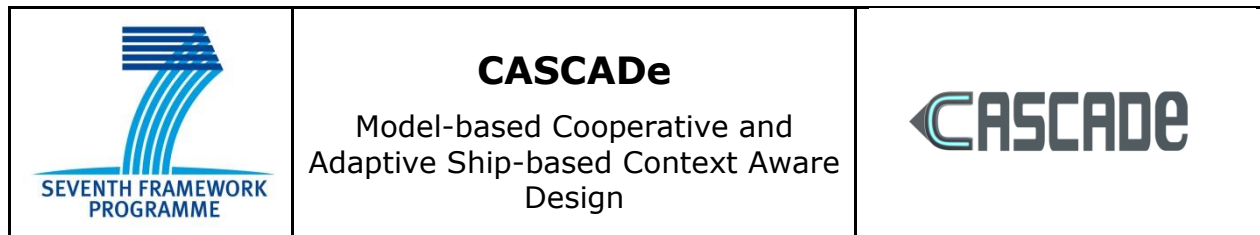


Figure 2: Routine Watch Handover



3.3 Emergency Handover

In this scenario, the OOW hands over the command to the master because of an impending collision with another vessel.

This scenario is an extension of the Collision Event first described in D1.1; to be precise, we have broken down the “Assess Situation” action taken by the master (see Figure 16 in [1]). In this extended scenario, the master uses the Shared Display to quickly get an overview of the situation; the tool provides all the crucial information (incoming vessel’s speed and course, expected time to collision, other traffic) in one place. The intent here is to save valuable time in an emergency situation.

The sequence of events is shown in Figure 3.

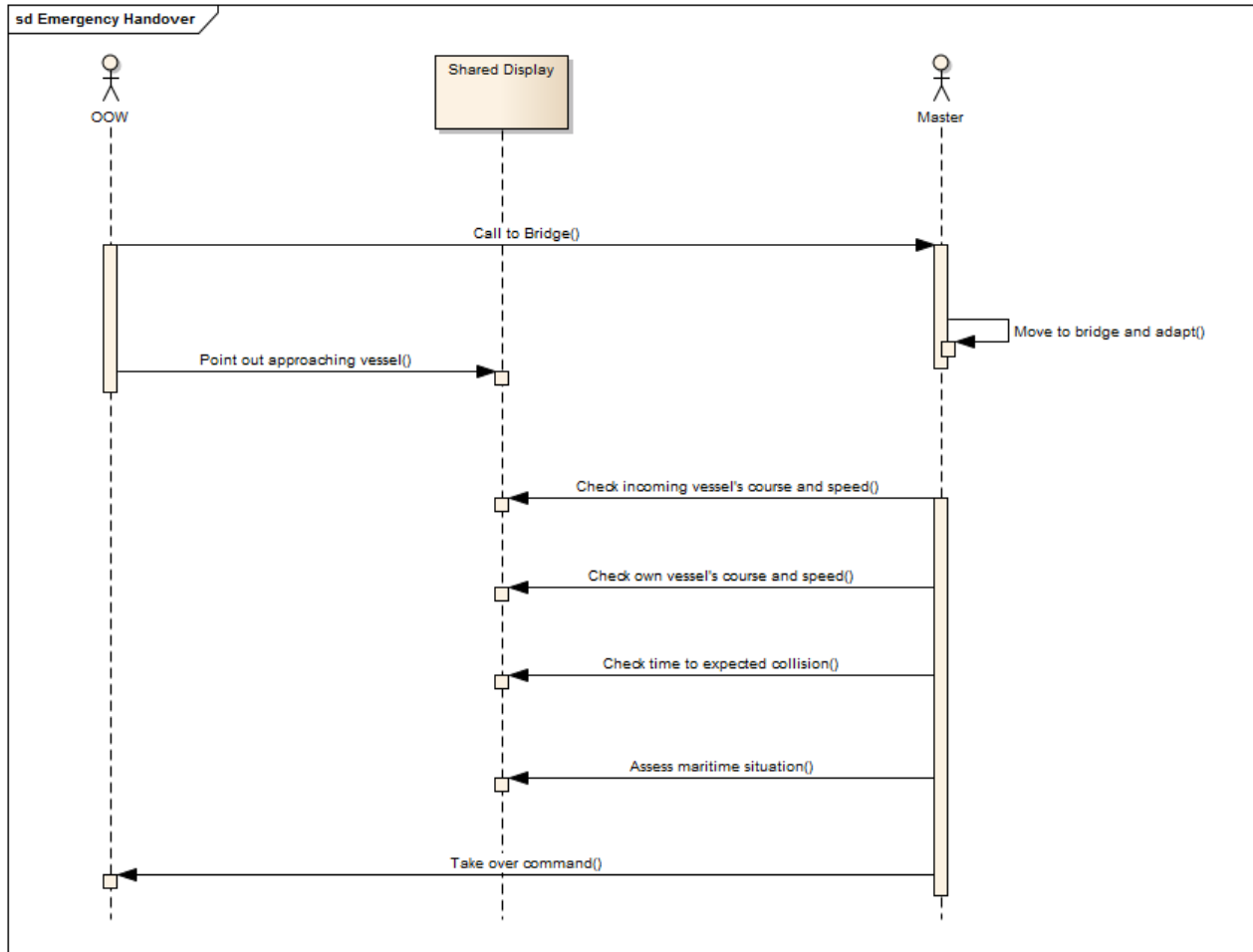




Figure 3: Emergency Handover

3.4 Extended List of Scenarios for Development of the Perspective Editor

In addition to updating the scenarios from the first cycle, and incorporating information learnt from the evaluation in cycle 1, an extended list of scenarios was drawn up specifically for the purpose of helping Raytheon Anschuetz develop their perspective editor. This extended list will not be modelled in detail, but is purely to aid Raytheon Anschuetz in developing specific 'modes' for their perspective editor (the basis of the Shared Display). When switching between different modes, the information that is shown on the Shared Display will change. These modes are based on specific scenarios that a ship will encounter. For this, the next stage is to collect

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information on what information seafarers would like to see on the Shared Display when in different modes of operation – this will be addressed in Work Package 4 in the 2nd cycle of the project.

Three types of modes were identified which might require a new configuration of the Shared Display:

1. Operation based – reflecting the different modes of ship operation
 - a. Under pilotage
 - b. Berthing
 - c. Unberthing
 - d. Navigating Coastal Waters
 - e. Navigating Deep Sea
 - f. Watch hand-over
 - g. Master-pilot exchange
 - h. Bunkering
 - i. Vessel Separation Scheme
 - j. Anchoring

2. Emergency Situations
 - a. Collision avoidance situation (heading for collision with another ship / object)
 - b. Fire in engine room
 - c. Man overboard
 - d. Piracy Situation
 - e. Power failure
 - f. Steering Failure
 - g. Main engine failure
 - h. Flooding

3. Conditions
 - a. Restricted visibility e.g. fog
 - b. Night vs Day
 - c. Heavy weather
 - d. Ice

Combinations of these modes might also be possible. This list will now be used in Work Package 4 to establish what information should be shown on the Shared Display during a whole range of different scenarios. This work will continue in parallel with the in-depth work on the specific scenarios detailed in 3.1 – 3.3; continued in WP2 and WP3.

4 Conclusions



In this report we have extended the scenarios first presented in D1.1. In particular, we have shown how the CASCADE Shared Display can be used to simplify the exchange of navigational information between crew members or between a master and a pilot. The scenarios cover routine situations (path planning and watch handover) and one emergency situation (master taking over the command due to an impending collision). In addition, we have developed an extended list of scenarios purely for the purpose of product development on the perspective editor. This extended list stretches to more complex navigation and other maritime operations.

As in the first cycle of the project, these scenarios will constitute the input for WPs 2 and 3. In particular, the representation of the scenarios as sequence diagrams will be heavily used in D3.3: Functional Level Bridge Study and Design, which is the second cycle update of [6].

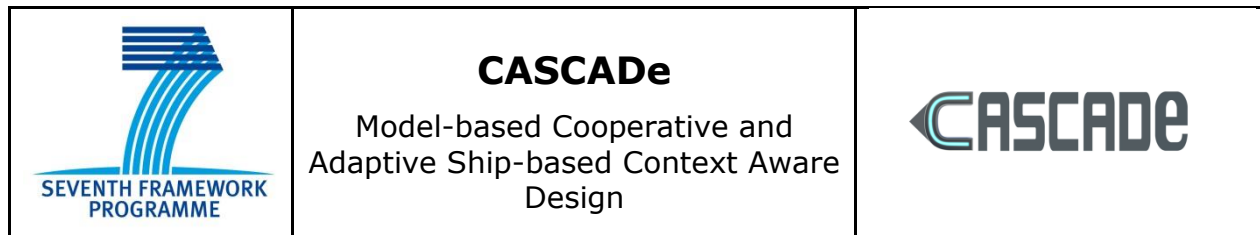
The CASCADE consortium will continue to refine and update these scenarios as required throughout the remainder of the project; in particular, we will seek to further specify the scenarios listed in Section 3.1-3.3 in further studies of WP2 and WP3, and of Section 3.4 in WP4.

Appendix 1: Abbreviations and Definitions

Abbreviation	Definition
AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
CAM	Central alarm management
CCRS	Consistent Common Reference System
COLREGS	Collision Regulations
CPA	Closest time of approach
DSA	Distributed Situation Awareness
ECDIS	Electronic Chart Display and Information System
EMSA	European Maritime Safety Agency
ETA	Estimated time of arrival
GISIS	Global Integrated Shipping Information System
GPS	Global Positioning System
ICS	International Chamber of Shipping
IMO	International Maritime Organisation
INS	Integrated Navigation System
MAIB	Marine Accident & Investigation Board
MARPOL	"Marine Pollution" regulations e.g. International Convention for the Prevention of Pollution From Ships
MTT	Methods, techniques and tools
OOW	Officer of the watch
PPI	Plan Position Indicator
SA	Situation Awareness
SOLAS	Safety-of-life-at-sea
TCPA	Time to closest time of approach
TSS	Traffic Separation Scheme
VTS	Vessel Traffic Service

 <p>SEVENTH FRAMEWORK PROGRAMME</p>	<p align="center">CASCADE</p> <p align="center">Model-based Cooperative and Adaptive Ship-based Context Aware Design</p>	
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WPT	Waypoint
XTD	Cross track distance
XTE	Cross track error



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- [1] G. Randall, P. Lohrmann, D. Griffiths, C. Denker, D. Javaux, P. Allen, T. G. Mikkelsen, T. Lehmann and E. Adami, "CASCADE Deliverable 1.1 - Scenario Models and Adaptive Bridge Requirements," 2013.
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