

# Master Thesis

## Background

ABB supplies a large quantity of devices for the operations of large vessels, from engines to pumps, from drives to turbines. When there is a fault with one of these devices, the on-site engineer can call an ABB remote expert to receive assistance in troubleshooting the issue. The expert has remote access to data from various sensors. Nowadays, experts are bounded in accessing the information through common (and limiting) interfaces such as websites. We want to explore new technologies and interaction paradigms in order to enhance the workflow of the remote expert.

As a result, I will attempt at developing a vision for an interactive interface that will provide the experts with an overview of the fleet they are assisting at all times. The experts have a set of problems and needs that need to be satisfied. ABB has already performed, and is in the process of extending, a series of user studies with these users. I will have access to the data of these studies. However, as the specific data is strictly confidential and cannot be made public.

My expectations for the thesis project is to be able to play and prototype with different solutions and technologies, go through a redesign process, and finish my work at ABB with a high-fidelity video prototype that conveys what the vision for this system is.

The research topics strictly involved with this are mainly of Situation Awareness and Information Visualisation. On a broader scale, Tabletop Interaction, Large displays, Interactive Walls, Peripheral Awareness, Fluid Interaction, are all insightful research fields.

## Introduction

In the scope of this project, reaching the users can be problematic for a number of reasons. It would be valuable to perform quick evaluations of the prototypes before exposing the prototypes to the users, as their availability is limited. There are a number of evaluation methods used in the literature for evaluating SA systems, such as SART, SARS, SAGAT, and more. All these studies involve users directly in the process. However, In our case, due to the high costs of reaching users, we want to involve them later on in the design study, thus showing the need for a “cheap and dirty” evaluation method that can be used “in-house”.

Moreover, SA studies are often based on military environments and rarely in marine. To my knowledge, there has been few discussion about whether using “more traditional” quick evaluation methods can be effective in this particular field. Here, “more traditional” techniques refer to Focus groups, Design heuristics, Design walkthrough, and similar. I am particularly interested in researching how Heuristics evaluation works with evaluating SA systems. There is considerable contribution in terms of heuristics in other different topics, but to my knowledge, little work has been done in using heuristics in the field of SA.

# Related Work

Extensive work has been done in designing and evaluating Situation Awareness systems with users<sup>1 2</sup>, and many frameworks have been developed, such as SART, SARS, SAGAT, for analysing and measuring SA<sup>3 4 5</sup>. Contribution to this field are mainly in the scope of Military and Air Traffic Control. Much work has been done in the topic of Remote Collaboration<sup>6</sup> and Groupware<sup>7</sup>, also connected with SA<sup>8</sup>. research has also been done in providing meaningful ways of data visualisation in various scopes of SA<sup>9</sup>.

To my knowledge, there hasn't been much research on using heuristics in this topic. However, Heuristics as an evaluation technique have been extensively analysed by Nielsen et al.<sup>10</sup> and others. In the recent years, heuristics have received some criticism for their effectiveness and when compared to other methods<sup>11 12 13</sup>.

The major body of work in using heuristics for SA seems to be Designing for Situation Awareness, that contains 50 principles for designing for SA (unfortunately, the copy we ordered hasn't arrived yet).

# Research Contribution

My research contribution would be either to show that heuristics evaluation can be used with effectiveness to find usability problems early in the design process of a SA solution, or to show that important usability problems (either known, or discovered later), were not highlighted by the heuristic evaluations performed. My research question, as of the time of writing, would be along the lines of: "Can heuristic evaluation be used effectively for finding usability issues in the scope of remote SA?"

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<sup>1</sup> Endsley-Jones, M. Designing for Situation Awareness in Complex System.

<sup>2</sup> Endsley, Jones (2011) Designing for Situation Awareness: An Approach to User-Centered Design, Second Edition

<sup>3</sup> A Comparative Analysis of SAGAT and SART for Evaluations of Situation Awareness. (2000).

<sup>4</sup> Salmon, P. (2008). Situation Awareness Assessment in Complex Systems: A Comparison of Measures Study.

<sup>5</sup> Endsley, Garland (2000) Situation Awareness Analysis and Measurement

<sup>6</sup> Olson G. and J. (2001). Distance Matters.

<sup>7</sup> A Descriptive Framework of Workspace Awareness for Real-Time Groupware.

<sup>8</sup> Chang, Y. L. B., Scott, S. D., & Hancock, M. (2014). Supporting Situation Awareness in Collaborative Tabletop Systems with Automation (pp. 185–194).

<sup>9</sup> Maria Riveiro, G. F. T. Z. (2008). Improving maritime anomaly detection and situation awareness through interactive visualization,

<sup>10</sup> Nielsen J. Heuristic Evaluation of User Interfaces

<sup>11</sup> Siegel, D., & Dray, S. (2002). Sale Must End: Should Discount Methods be Cleared off HCI's Shelves?, 1–6.

<sup>12</sup> Gray, W. D., & Salzman, M. C. (1998). Damaged Merchandise? A Review of Experiments That Compare Usability Evaluation Methods, 1–59.

<sup>13</sup> Jeffries, R., Miller, J. R., Wharton, C., & Uyeda, K. M. (2001). User Interface Evaluation in the Real World: A Comparison of Four Techniques, 1–12.

Furthermore, the study could be enriched in two ways:

First, formulating a richer set of heuristics for the topic of SA and that of remote assistance would provide insight on the whether general heuristics are too poor for the specific case. Some work have been done on this topic, although not extensive, nor sufficient to answer my question. These heuristics would be based on previous user studies, and perhaps strongly oriented towards the use case of Marine.

Second, performing a user study at the end of the design process could reveal whether heuristics have been successful in assessing the most important usability problems. The results would be beneficial in supporting the findings of the thesis.

## Methodology

I intend to carry out a number of heuristic evaluations on the various stages of the prototype. The heuristics evaluations will be performed with experts on the field from ABB, and Usability experts (but not direct users). Every study will be carried out with at least 5 experts. The results of the studies, measured in number and importance of usability problems found per expert, will be reported.

Once the results from the heuristics study are obtained, the challenge is on how to assess whether the studies were successful or not in their purpose of identifying major usability flaws. Three possible ways I identified to approach this problem are reported below:

1. Another study could be performed, such as a Design Walkthrough, in order to assess whether the heuristic study was able to identify major design flaws. The results can be compared. The downside of this is that we do not know whether the other study was successful in identifying the flaws of the prototype, so the result could be problematic to handle and report.
2. The results of the heuristic study could be compared with the results of a user study carried out later in the design process, or with usability issues that were known before the study. The downside of this is that it might not be possible to reach the users before the end of the thesis project.
3. The results of the heuristic study could be evaluated by the designer to assess to which extent the heuristics were useful in finding usability problems and allowing for a redesign of the system.

At the time of writing, I am not sure of which way to pursue. It is left to future discussion with my supervisors.

Nevertheless, I intend to use a number of design techniques in the designing of the prototype, which I think will not be mentioned, if not briefly, in the final body of the work.

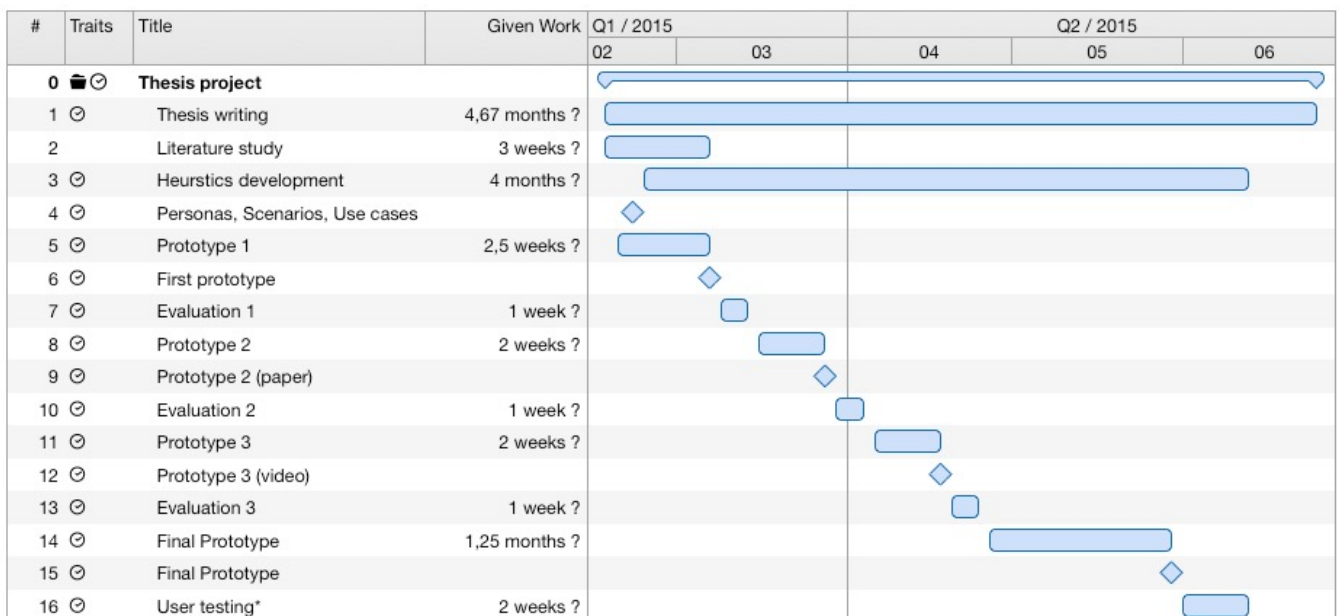
## Expected Results

Expected results are assessments on whether heuristics studies were a valuable tool for our design, and whether we were able to rapidly identify and solve usability problems in the early stages of the design work, designing system for maintaining situation awareness.

# Risks

I have identified some of the risks of the study:

1. Being Unable to access the users before the end of the study may limit the ability to compare the result of the user studies carried out in-house.
2. Possible issues with disclosing part of background user studies that informed the design of the prototype



Timeline