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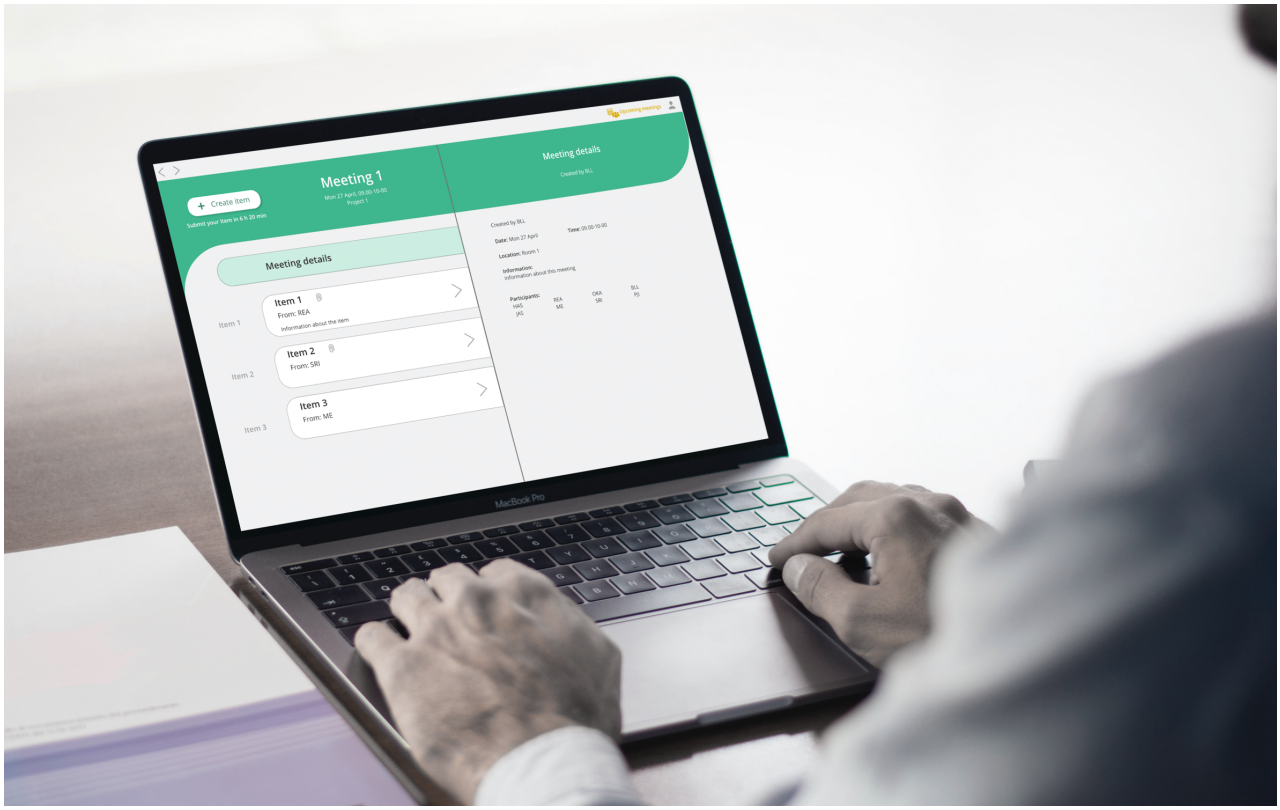

How Usability can Facilitate Adoption

of a Collaborative Meeting Agenda Platform

Master's thesis in Industrial Design Engineering

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CHALMERS UNIVERSITY OF TECHNOLOGY
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Cover: An image of a part of the final concept that was developed in the project.

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How Usability can Facilitate Adoption: of Collaborative Meeting Agenda Platform

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Abstract

In the autumn of 2019, a concept for a digital tool was developed at Yolean with the goal to facilitate meetings, increase quality of answers to questions that were discussed during meetings and to improve collaboration between product development company parties. The digital tool was appreciated at FlexLink, where it was tested however, there were difficulties in getting people to use it on their own.

The purpose of this master thesis project was to explore what obstacles there were preventing the digital tool from being adopted into an organisation and what could be done to facilitate the adoption. There was a strong focus on usability to improve the interaction with the interface and also the development of an implementation support.

In the beginning of the project, interviews and observations were carried out at FlexLink. From that explorative study an understanding of the current meeting habits and routines at FlexLink was achieved as well as a comprehension of attitudes towards introducing the new tool and previous implementations was achieved.

Three iterations were accomplished where the usability of the tool was developed and evaluated, and a user interface called Prep that overcomes the obstacles of use is the result as well as a list of design criteria that explains the functions and flow in the user interface. Also, by investigating features that were difficult to use, an implementation support in the form of a video explaining a critical function has been developed.

Key words: meeting agenda, digital tool, usability, user interface, implementation support

Terminology

These definitions are specific for this master thesis project.

Agenda is a list of agenda points that are going to be discussed on a formal meeting

Data model is a model that organises elements that a software programme is built upon and how the elements are related to each other.

Interactive prototype is a prototype that is possible to interact with but not to enter or store any data, for example text. Meaning that in for example, in user tests the participants cannot write any own data that will be stored in the prototype.

Working prototype is a prototype where it is possible to enter text and other media, for example files. It is built upon a data model and data that is entered is stored in a cloud service.

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1. Introduction

In this section the background, aim, research questions, demarcations and process for the thesis project will be explained.

1.1 Background

Product development companies are often running projects together and this puts a high demand on meetings being efficient and collaborative to get the best results, keep hard deadlines and achieve common set goals (Bertilsson & Wentzel, 2015). This means that efficient communication is crucial during project meetings to be able to answer as many questions as possible with high quality answers and discuss important topics to enable project members to carry on with their work. This applies whether the meetings are physical or digital.

It has been observed that product development companies create their own routines to support them during meetings, however these routines prove not to be the most efficient (Olsson, personal communication, 9th December 2019). The lack of efficiency is partly due to the fact that the tools used do not support the required planning since they are not meant to use for that purpose. For example, they do not give participants in meetings sufficient aid to prepare in advance for the meeting and this leads to a risk that important in-put is lost (Olsson, personal communication, 9th December 2019). In the long run this could lead to that the deadlines are not achieved or that the results do not reach standards.

Yolean, a company that has created a visual planning tool, has recognised the need for a solution that meets the above-mentioned demands. Hence, as a part of the Kidsam research project (Vinnova, 2018), a master thesis project at Yolean was carried out that developed a concept that targeted the demand from product development companies. This tool is from here on referred to as CMAP (Collaborative meeting agenda platform) (Johansson & Ljunglide Christensson, 2020). The focus of the development of CMAP was to create a digital tool that enhanced a collaborative meeting environment which aimed at making meetings between organisations more efficient. In the tool the user was able to contribute to the creation of collaborative meeting agendas with a protocol and a decision log to every meeting to get more answers with high quality to questions during project meetings, where several parties are present. CMAP was developed at and targeted FlexLink, a company to which Yolean delivers their product and who has expertise in factory automation and delivers solutions that help companies optimize their manufacturing processes (FlexLink, 2020).

Tests of CMAP indicated that the functions and the method developed were appreciated by the organisation and that it had potential to solve problems associated with meetings. However, the solution has yet only been tested as a concept. One issue that was discovered was how to engage people in using it on their own accord and make it a natural part of their workday. Neither has the user interface been tested and evaluated why, it is not possible to state anything about the usability of the interface. Engaging employees by supporting the adoption process and ensuring the usability were the two starting points for this master thesis project. Resistance to adopt new software into an organisation is highly associated with the usability of the software (Naij n.d.). As people are resistant to change and have a fear of making errors at their workplace (Lawrence, 1969) it is important to investigate the usability as well as additional obstacles to acceptance to be able to develop good conditions for adoption of a new software.

1.2 Aim

The aim of this master thesis project was to facilitate the adoption of new software for individuals in a company by evaluating and developing the user interface of the CMAP further, as well as creating an implementation support.

The expected deliverables for this thesis project were to create a basis for developers so that a working prototype could be developed.

1.3 Research questions

The research questions for this thesis project were:

- What obstacles are there today preventing a digital tool from being adopted by individuals in a company?
- What kind of support is necessary to facilitate the adoption of the new software?
- What usability aspects are necessary to enhance an efficient interaction with the tool?

1.4 Demarcation

The demarcations of this master thesis project were:

- The focus of the project was the situation of the employees at FLexLink.
- The starting point for this thesis project was the culture and working routines that are used at FlexLink.
- The project assumed that employees are used to an open culture where there is no hindrance asking questions to other colleagues during meetings and privately.

- The focus of the thesis project was events happening between meetings during office hours.
- The project was based on a tool that already exists but is not yet implemented, more specifically a tool for creating agenda points prior to a meeting.

1.5 Process

The design process that was followed in this thesis project was the user-centred Double Diamond by the Design Council (2020). However, adjustments to the approach for this specific thesis (Figure 1) were made to better match the expectations from Yolean as well as FlexLink and find space for iterative work throughout the thesis project to develop a better result. The process consisted of two main parts: of which the first included an explorative study and definition. The second part, which is the major one, consisted of development, prototyping, testing, analysing and evaluation of the developed concept. The second part was iterative to allow room for re-defining previous statements about users and the problem. Due to COVID-19, the process changed throughout the thesis project and it was difficult to access users from the target group at FlexLink for the explorative study as well as for the iterative process. Hence, people from other areas were reached out to in order to collect data.

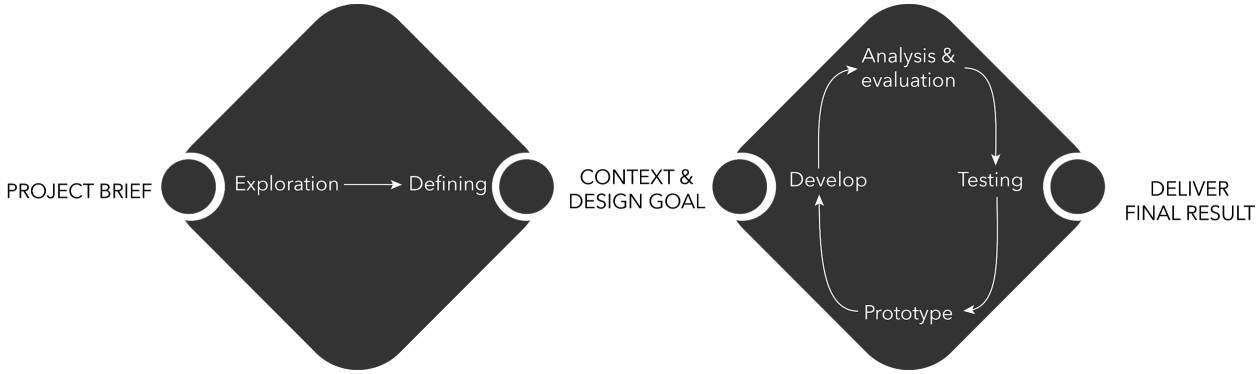


Figure 1: The Double Diamond process

The first step in this thesis project was to discover the scope and problems connected to it. The purpose was also to get an understanding for the target group: employees at FlexLink that go to meetings with varying agenda. This was done by initiating an explorative study during which several data collection techniques were used. To gain an overall picture of the situation, find problems and understand challenges with the current situation and obstacles for implementation of new software tools, discussions with Yolean and FlexLink were arranged. Further, interviews with employees at FlexLink and other companies were carried out as well as observations of digital meetings at FlexLink to create empathy for users. Further, theories were studied on how

individuals adopt technology and about implementations. The CMAP was studied to gain more background information about the tool. The problems were analysed and a clear direction for the thesis project and the problem context was defined. Also, a design goals were formulated to be used when continuing the project.

When a foundation for the thesis project had been established based on the findings from the initial part, i.e. the "first diamond", the next step was to start development of prototypes to be able to evaluate the usability of the interface. This is the major part of the thesis project and at this stage an interactive prototype was created, and this was then tested with a number of participants of which two were from FlexLink and appeared in the last test. The participants' skill and knowledge about the context and tool varied. As a total, three iterations were accomplished containing developing, prototyping and testing. After each test the result was analysed and evaluated, and new problems connected to the usability of the tool were discovered. As a final step a video was developed as support to the implementation and individuals' adoption of the software.

The thesis project delivered a concept for a user interface as well as the design criteria and design guidelines for developing a working software tool that could be implemented into an organisation as well as supporting material to facilitate the implementation.

2. Concept summary

In this chapter the final concept (Figure 2) is described in a summary. The complete explanation can be found in section 9.3.1 and chapter 12. The concept is called Prep and is a digital tool for meetings with the goal to make them more efficient by facilitating creation of meeting agendas, increasing quality of answers and improving collaboration between company parties. Two views from the tool are shown in Figures 3 and 4.

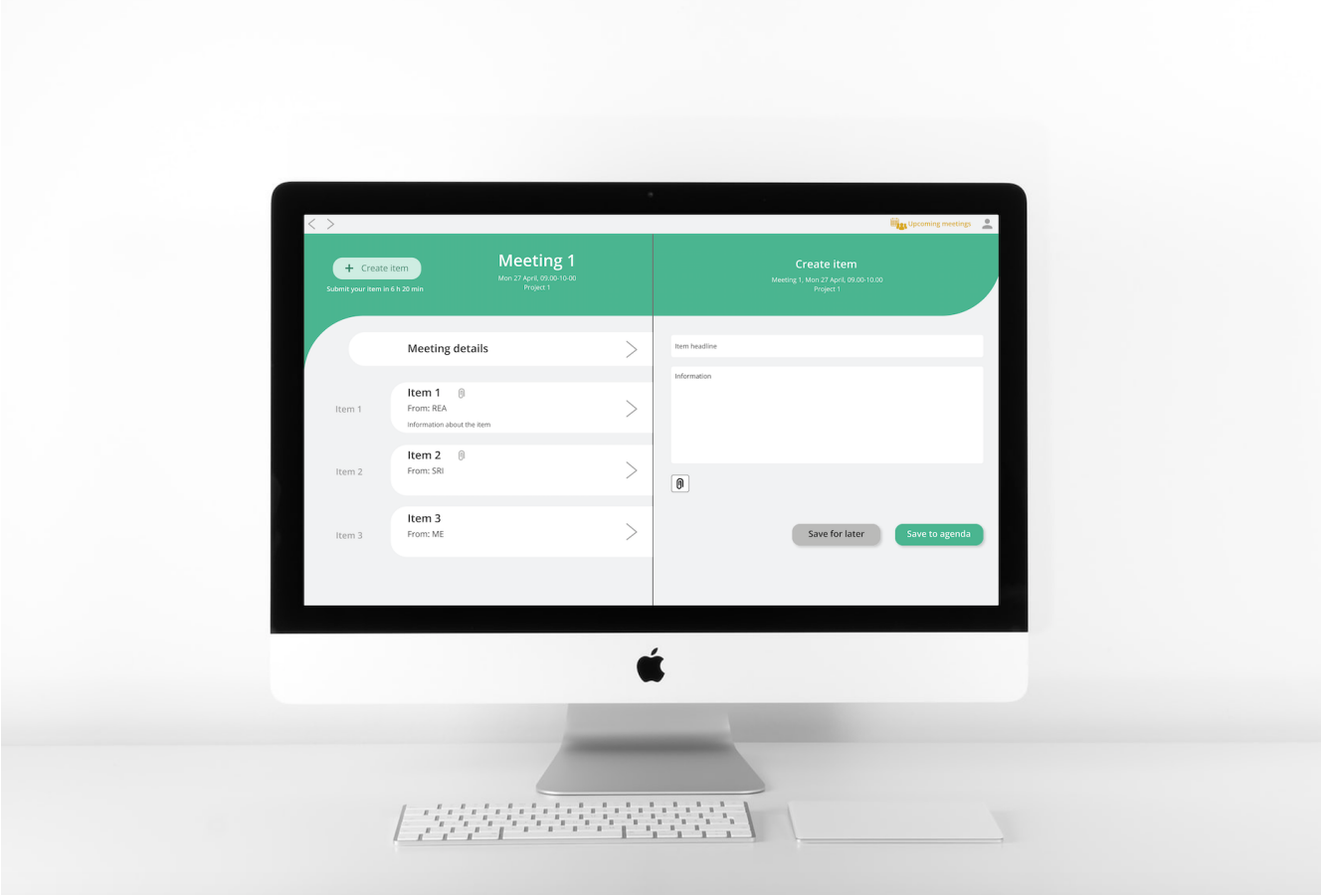


Figure 2: The final concept

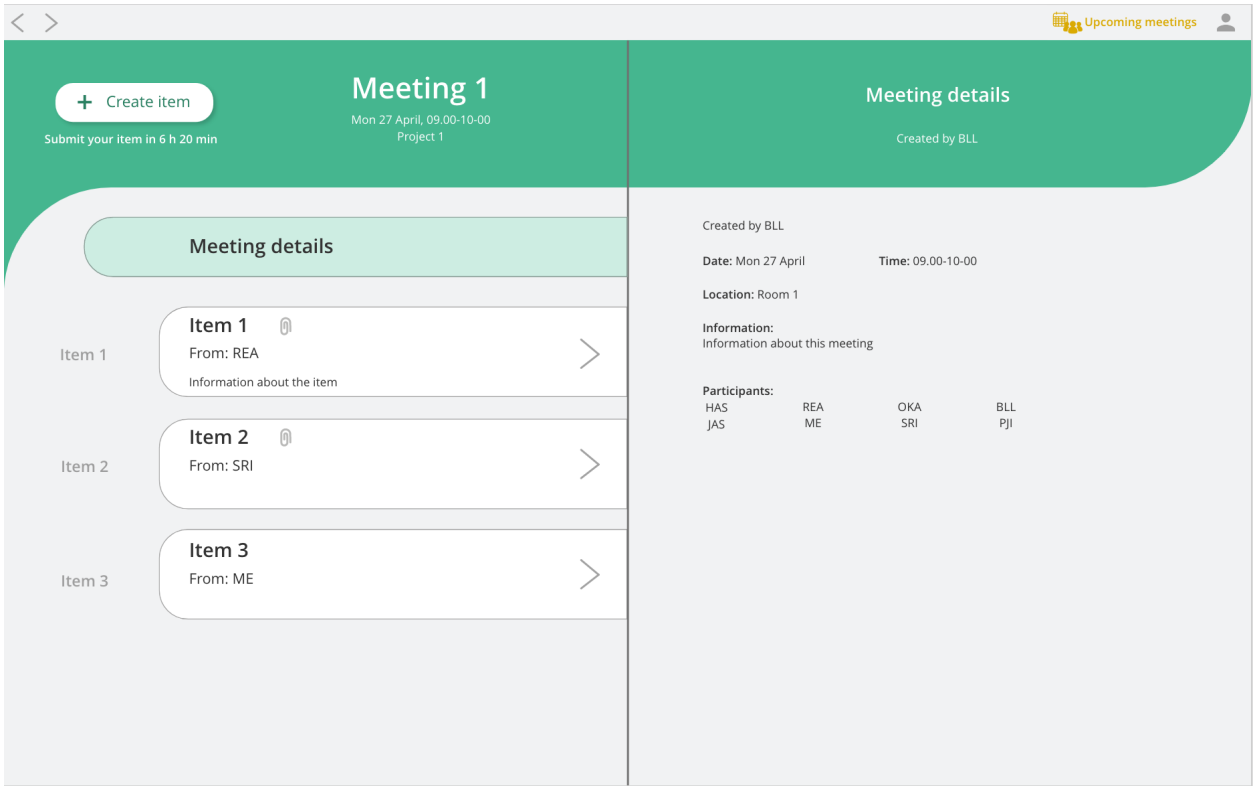


Figure 3: The agenda preview for the final interactive prototype

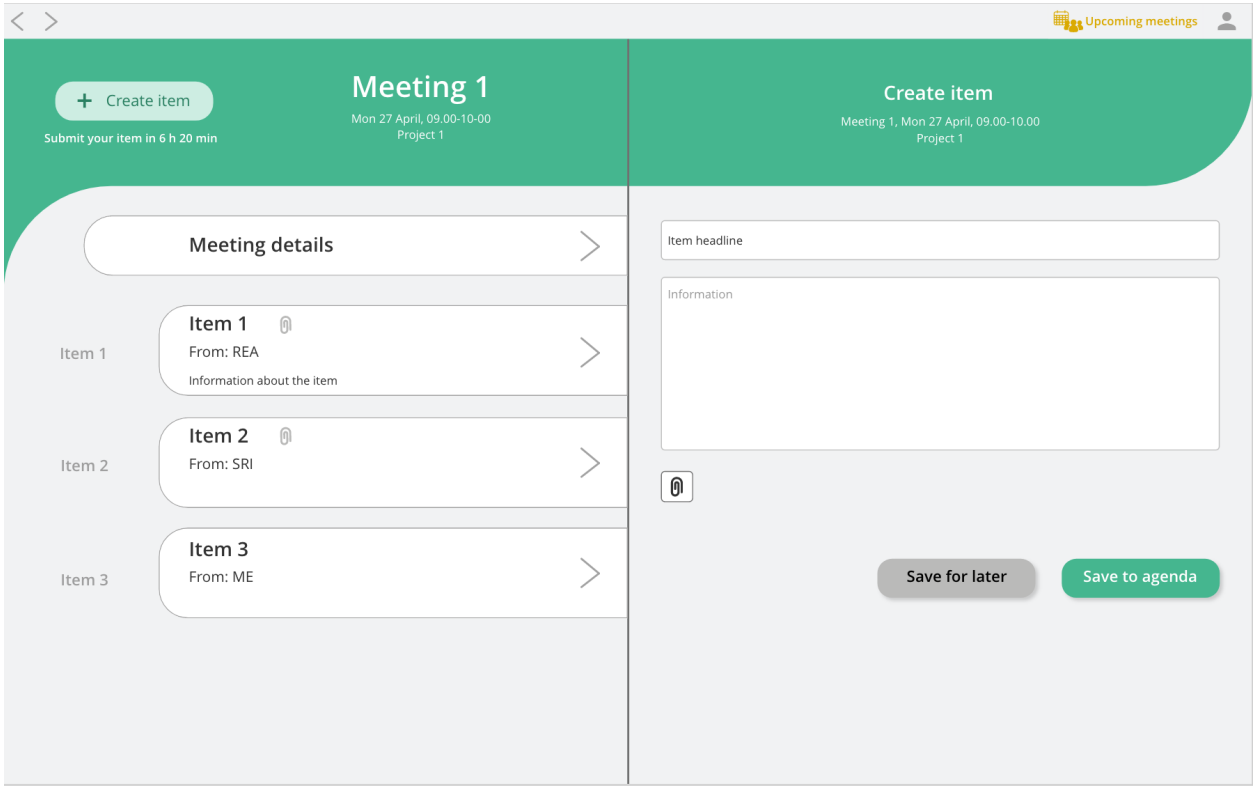


Figure 4: The "Create item"-page for the final interactive prototype

2.1 Main parts

The parts of the user interface that have been developed during the thesis project are explained in this section. This section covers the agenda preview, "Create item", "My saved items", "Upcoming meetings" and a meeting view.

2.1.1 Agenda preview

The preview of the agenda (Figure 3) is accessed either directly from a link in a meeting invitation or by logging in to the tool and finding it via the list of upcoming meetings. In the agenda preview it is possible to create items, which are topics or information a user wants to share in the meeting and edit those that are already in the agenda preview. An item can be created until 24h before the scheduled start of the meeting. After that it will only be open for reading to prepare for the meeting. When the meeting starts it is possible to enter it from the agenda preview.

2.1.2 "Create item"

To save an item it must minimum contain a headline, but it is possible to add additional information and files. The user decides whether to save the item to the agenda or to save it for later (Figure 4).

2.1.3 "My saved items"

"My saved items" are found under the profile icon on the upper bar and can be accessed from everywhere except the meeting view. This page is personal for the user and holds all items that the user has saved for later independently of which meeting they belong to. The purpose of the page is to finish the items for example, by filling in more information and add them to the agenda. The goal is to have as few items as possible that are saved for later. Hence all of them appear in the same list to make it easy to tick them off one after the other.

The main difference between saving an item directly to the agenda and saving it for later is that if you save it for later it will end up in the user's private "My saved items"-page. This can be useful for example when the user wants to create an item but not yet post it to the public agenda.

2.1.4 "Upcoming meetings"

The "Upcoming meetings"-page can also be accessed from all pages except the meeting view. It is the first page the user sees if they are not logging via a meeting invitation, and it lists all upcoming meetings in the chronological order according to which date they occur.

2.1.5 Meeting view

The user can enter the meeting view when the meeting starts. It is accessed from the preview of that agenda and shows all items for that meeting. Available information is visible about the item that is currently open. Every item can be opened and for each of them it is possible to assign an owner.

2.2 Usability aspects

The usability of the tool has been evaluated throughout this thesis project. It has shown good prerequisites for learnability, which means that only after one interaction the user found it much easier to use and navigate through the interface. The guessability of the user interface has also been developed by taking inspiration from commonly used interfaces and hence there is a chance that it matches users' mental models better.

To achieve a good interaction between the user and interface the simplicity of the interface has been developed. This has been done by using a simple colour scheme, symbols that make sense to the user and structuring information in a logical way where the most important information is visible first and easy to read and comprehend. In this way the user's cognitive resources are not burdened during use which contributes to a pleasant user experience. Further, proper and sufficient guidance has been developed to assist the user when they strive to reach their goal with the usage. For example, feedback is used to communicate to a user that their action has been successful. This is done by providing textual feedback for most parts but also colour.

A key factor that was identified during this thesis project was that user control is connected to engagement. This means that if the user experiences control when using a tool, it is more likely that they become and stay engaged in the use. Hence, it has been important that the user experiences as much control as possible but also to establish how constraints and feedback can be presented to the user to facilitate use and create an easy to learn and use workflow. For example, items always have the same shape and similar operations are done in similar ways in the interface. There is also a constraint that an item without a headline cannot be saved for later or into the agenda to prevent the user from saving empty items that clutter the agenda.

2.3 Flowcharts

The flowcharts presented in this section show six possible ways of interaction between Prep and the user. They were chosen since they match the tasks that were tested during the usability evaluations. The full explanation of them can be found in section 7.3.3 for the three first flowcharts and in section 9.3.3 for the three last flowcharts.

As it is possible in the first three flowcharts to login either via a link from a meeting invitation or directly into the tool is represented in one flowchart each (Figures 5 and 6). The three next flowcharts (Figures 7, 8 and 9) assume that the user logs in via a meeting specific link which means that the first page is the agenda preview for that meeting. After saving an item to an agenda the user will come back to the preview of the agenda for the meeting they saved the item in. Figure 10 shows how the user enters the meeting view.

(1) Flowchart (1) shows how users can create an item to the agenda for the meeting they logged in to, or to an agenda for another meeting.

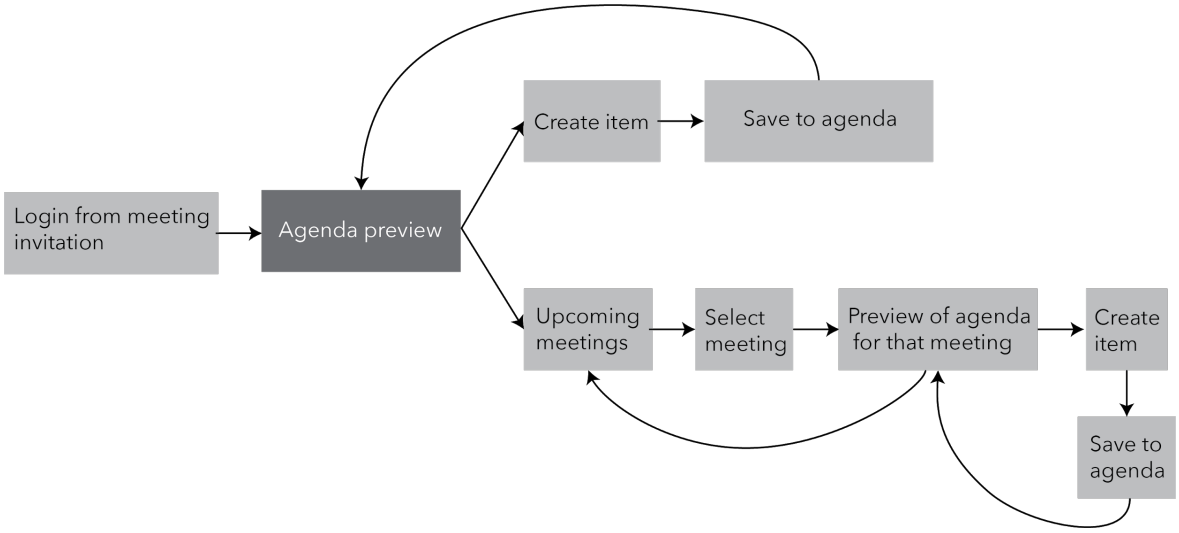


Figure 5: Flowchart (1)

(2) Flowchart (2) shows how to create an item to the agenda when logging in without a link to a specific meeting.

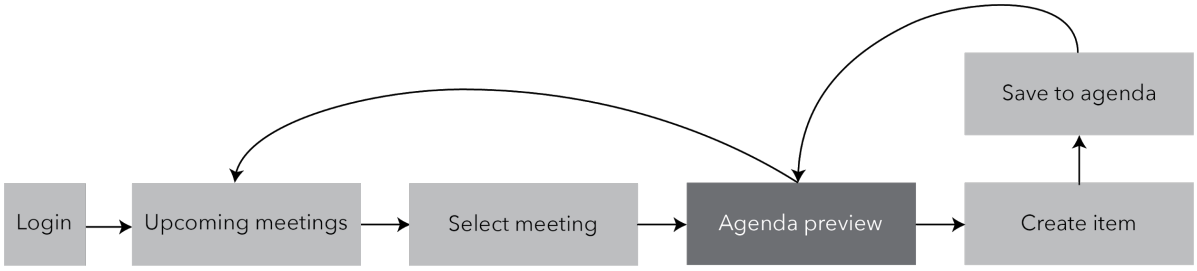


Figure 6: Flowchart (2)

(3) Flowchart (3) shows how to edit an item that already exists and saving it to the agenda.

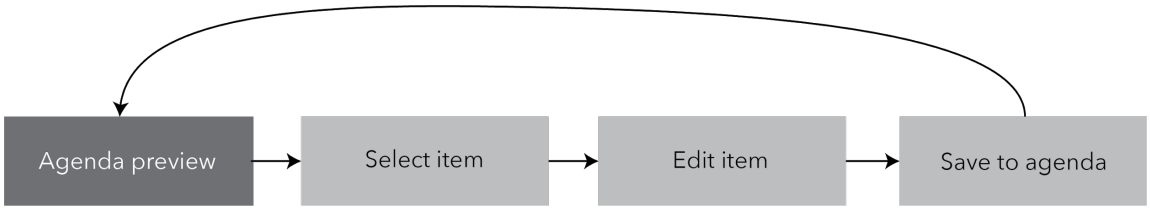


Figure 7: Flowchart (3)

(4) Flowchart (4) shows how users can create an item which they save for later for the meeting they logged in to, or for another meeting.

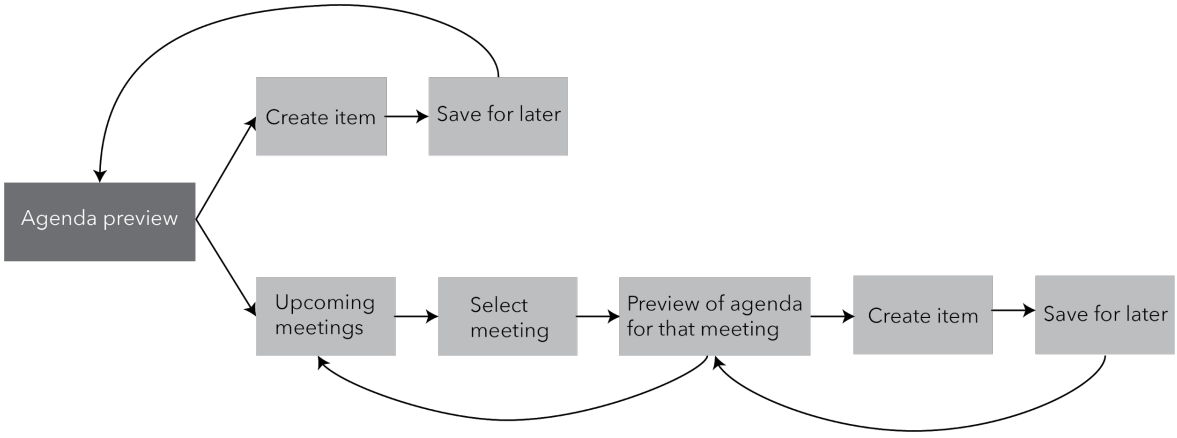


Figure 8: Flowchart (4)

(5) Flowchart (5) shows how to find a saved item, edit it and save it to the agenda.

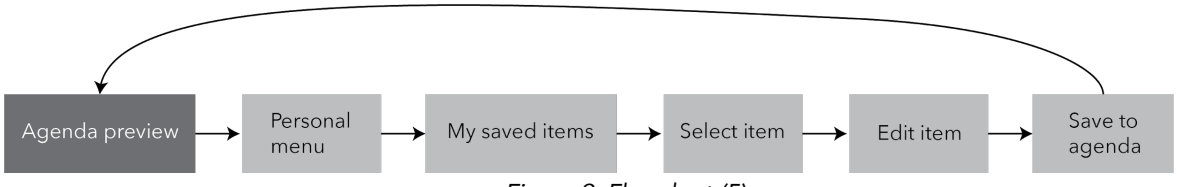


Figure 9: Flowchart (5)

(6) Flowchart (6) shows how to enter a meeting that has started.

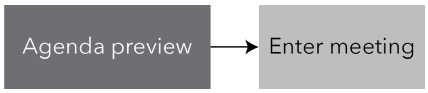


Figure 10: Flowchart (6)

2.4 Entity relation diagram

The entity relation diagram (Figure 11) for the final concept shows how the different elements of the system are related to each other.

The entities are visualised by the boxes and the arrows symbolise the connections. The diagram is built up of meeting participants and project managers who create items belonging to a meeting and a project. All items for a specific meeting build up the agenda preview and when the meeting starts it turns into the agenda. It is also possible to save items for later which makes them "Saved items''. When desired these can be added to the agenda preview. Prior to the meeting it is possible to read the agenda preview and during the meeting the agenda is readable in the meeting view that becomes accessible when the meeting starts.

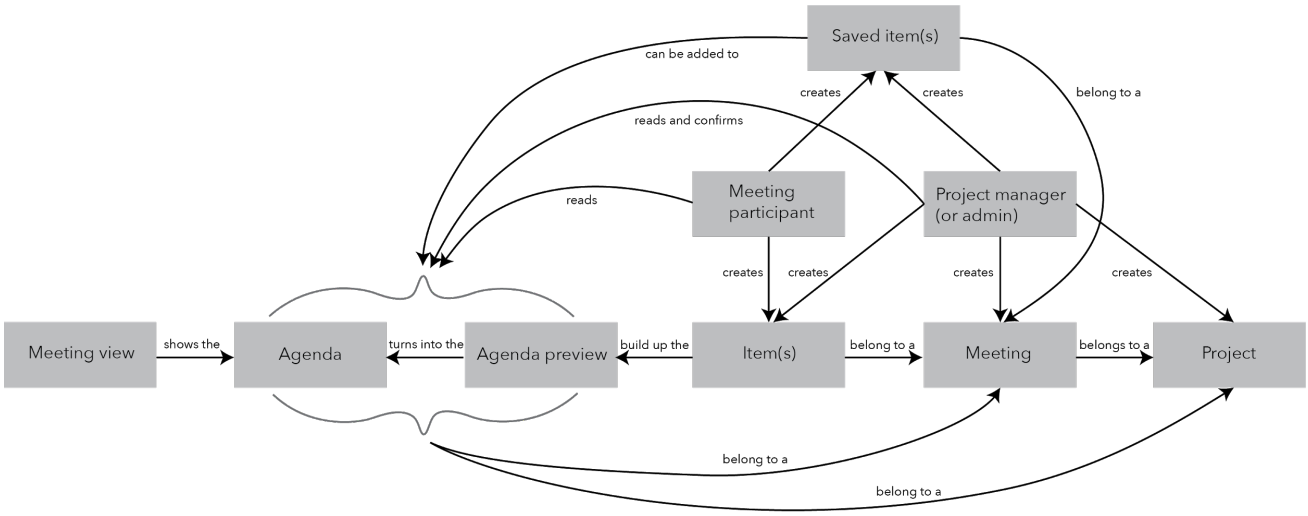


Figure 11: The entity relation diagram for the final concept

2.5 Implementation support

The implementation support is a two minutes long video tutorial in English that explains the "Save for later"-function (see chapter 11) which in usability tests was noted to be the most complicated function in the tool. The video can be accessed through the QR-code (see Figure 12).

Figure 12: QR-code to access the video

The video tutorial offers training and support which helps to create a shared understanding amongst all users of how the tool is supposed to be used. This is important since people's attitude towards a specific software is individual as it is dependent on for example, their experience and age. The choice of music and voice helps to create positive engagement which is important as it helps employees to cope with the change of work routines.

Both FlexLink and Yolean confirm that users of a new software usually do not get sufficient information or enough time to learn. This tutorial provides them with the information and lets them watch it as much as they need. As FlexLink is familiar with using video tutorials for new features it should not be too big of a step watching video tutorials for a new software.

3. Framework

This framework contains relevant theories that are necessary to reach the aim of improving the user interface and develop implementation support to facilitate the adoption of a new software tool in a company.

3.1 Implementation of new software in organisations

The reasons for implementing new software in an organisation can vary, but it is usually done to increase performance. However, there are challenges associated with implementing new software and without a plan for implementation the organisation may not gain the value that the new software provides (Vault, 2019). Hence, there are different strategies to implement new software into an organisation. To successfully implement a new software the organisation or team must identify the goals and objectives that they want to achieve. Thereafter a strategic plan must be defined which may contain a guide for organisational direction or department efforts (Eby, 2017).

As implementation of a new software in organisations means change, it is important to get everyone on board and create a positive engagement around the new software (Guinn, 2019). There are several models for driving change however, the most important is to have a set framework for change as many of these models take time to deploy (Mulholland, 2020). Another way, or a way that could complement a change model, is to select a few employees that are extra comfortable with the new tool to convince and encourage the rest of the workforce. It is also important to create shared understanding of the tool and offer support during the whole implementation process, but also to move important information to the new tool to encourage use. However, this is considered a bold move (Writer, n.d.).

There is a lot of research made on employee engagement and its importance is highly recognised. However, the means to achieve it can vary. One way to do this is power sharing which research has found to be the single most influential aspect for more engaged employees. To reach this, leaders need to engage their subordinates both in everyday decision making as well as in high cost changes. It is important to engage them in all kinds of decisions, not just the positive ones. If people feel ownership of the outcome from a decision it will make both the quality of the decision better and it will also go faster to decide. Leaders who share their power are aware that they do not have all the answers and work more as guides of other people's creativity than just as a leader (Smythe, 2008). It has been found that employee engagement has

a positive relationship with the business outcomes such as employee retention, safety, productivity, profitability and customer loyalty (Markos & Sridevi, 2010).

O'Brien and Toms (2008) identified four stages of engagement when it comes to engagement with technology: point of engagement, period of sustained engagement, disengagement and re-engagement. As people are different and have different interests and experiences, the factors that affect different groups in the stages of engagement vary a lot. However, in general one can say that what engages people in the point of engagement is a goal in mind, social motivation, layout and aesthetics of the interface that caught their attention or that it resonated with the person's interest. What further, leads the user to keep engaged in an interface depends on the concentration of mental activity. It was also observed that the engagement continued if the user's interest was sustained, and if the user experienced that they were in control of the interaction (O'Brien and Toms, 2008) this together with feedback were two important factors to keep the user engaged. Parker et al. (2010) also pointed out that control was a factor for engagement, however only in combination with self-determination.

Factors that caused disengagement were divided in internal factors such as a decision to stop the activity and external factors for example, being interrupted by environmental circumstances. However, there was a good chance for re-engagement, for example the user might not be ready to quit even though they were interrupted or had positive previous experiences with the interface (O'Brien and Toms, 2008).

3.2 The five-stage adoption process

The five-stage adoption process has been around since the 19th century and has been developed and expanded by several researchers (Prieskorn, 2017). One of them was Everett Rogers who, in 1962, broke the diffusion of innovation into five different stages: Knowledge, Persuasion, Decision, Implementation, and Confirmation. In all the stages but the first one, the individual continues to seek out knowledge about the innovation. In the first stage that is called Knowledge the individual lacks information about the innovation but is exposed to it. When the individual is inspired to find out more about the innovation and actively seeks information that is related to the innovation, the individual has reached the stage called Persuasion. However, at some point the individual needs to make a decision about whether to accept or reject the innovation. This step is called Decision and is done by the individual by weighing the advantages and disadvantages against each other. This, Rogers notes, is the most difficult stage due to its individualistic nature and at this stage empirical evidence is needed. If the innovation is accepted, the individual starts using the innovation and determines the usefulness of it and

depending on the situation, the individual uses it to a varying degree. This stage is called Implementation by Rogers and is followed by Confirmation which is the stage where the individual adopts the innovation into permanent use.

In the stage Decision, where the potential adopter of an innovation decides whether to adopt a technology innovation or reject it, Rogers has identified five innovation characteristics that affect this decision making. These characteristics are relative advantage, compatibility, complexity, observability and trialability and are described in the article by Bozbay and Yasin (2008). All characteristics except the complexibility are positively related to the potential users' rate of adoption of the innovation.

The first characteristic is the relative advantage of an innovation and is defined as "the degree to which an innovation is perceived as being better than the idea it supersedes" and has been found to be an important factor when predicting the rate of adoption of innovations. The higher relative advantage the innovation has, the more likely it is that individuals will adopt it.
The definition of compatibility is "the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of potential adopters". The more compatible the innovation is with the potential user and their needs, the easier it is for them to adopt it.

The complexity of an innovation is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" and affects the potential users' ability to adopt the innovation negatively. The more complex it is the smaller is the chance that they will adopt it.

Observability is in the article described as "perceptions of the degree to which the results of using an innovation are visible" which means that if the potential user clearly can see the results of using the innovation, the chance of adopting it is higher.

Lastly, the trialability is defined as "the case with which the product can be used without undue user commitment.". This is positively related to the rate of adoption and means that the innovation will more easily be adopted if it is easy for the potential user to try it out temporarily.

3.3 Technology acceptance model

Another more recent model describing factors which explain users' adoption of new technology is the Technology Acceptance Model (TAM) which was developed in the late 1980s. TAM (Figure 12) consists of several connected parts and describes potential users' adoption of computer

systems. The adoption of technology is dependent on the perceived usefulness and the perceived ease of use which influences whether or not the potential user intends to use it. The intention to use is the factor that will take the user to the end point where they include the usage of the technology in their behaviour (Davis et al., 1989).

The perceived usefulness is defined by Davis (1989) as "the degree to which a person believes that using a particular system would enhance his or her job performance". Davis (1989) found this to be affecting people's intentions to use new technology. The perceived ease of use is defined by Davis (1989) as "the degree to which a person believes that using a particular system would be free of effort". According to Davis (1989) the perceived ease of use is a determinant for the usability of technology. Therefore, these two aspects affect the usability which shapes the intention people have towards using technology and are especially important to consider when it comes to an individual's acceptance of technology. People are interested in getting the job done better and this tends to determine to what extent they use the technology or not use it. At the same time, people may find the technology too difficult to use compared to the performance benefits they gain (Davis,1989). This means that there is a constant weighing between the two factors: perceived usefulness and perceived ease of use going on in people's minds.

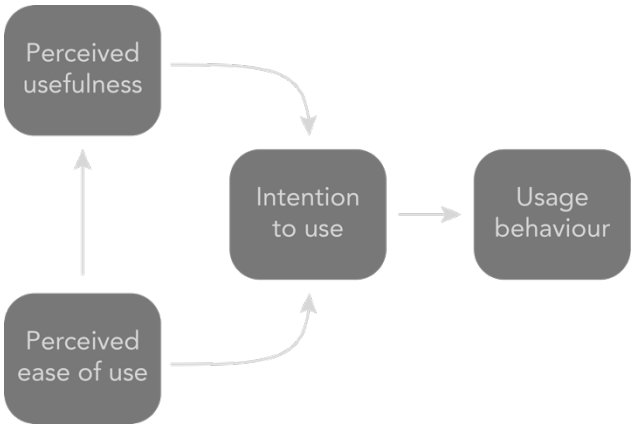


Figure 12: The Technology acceptance model developed by Davis

According to several studies factors, similar to the perceived ease of use and the perceived usefulness, are connected both to attitudes and usage (Davis et al., 1989). Attitude towards using was included in a later version of TAM and is also a central part of The theory of reasoned action (TRA) by Fishbein and Ajzen (Davis et al., 1989). However, the need for the attitude construct was eliminated in a more recent version of the model as perceived usefulness and perceived ease of use were found to have a direct influence on the intention to use (Venkatesh & Davis, 1996).

3.4 Usability

The perceived usefulness and the perceived ease of use affect the usability of a technology which influences people's acceptance of that technology.

Usability is an approach to product development and a measure of product quality. It is an important part of User experience, which also depends on others' opinions, brand, price and trends. The ISO definition of usability is “the extent to which a product can be used with effectiveness, efficiency and satisfaction by specific users to achieve specific goals in a specific environment” (ISO 9241-11) and in this definition the context is important for the usability of an artefact. Patrick W. Jordan has extended the ISO definition of usability and defined five usability aspects (Baber & Noyes, 1999). They are as follows:

● Guessability: The effectiveness, efficiency and satisfaction with which specified users can complete specific tasks with a particular product for the first time.

● Learnability: The effectiveness, efficiency and satisfaction with which specified users can achieve a competent level of performance on specified tasks with a product, having already completed those tasks once previously.

● Experienced user performance (EUP): The effectiveness, efficiency and satisfaction with which specified experienced users can achieve specified tasks with a particular product.

● System potential: The optimum level of effectiveness, efficiency and satisfaction with which it would be possible to complete specific tasks with a product.

● Re-Usability: The effectiveness, efficiency and satisfaction with which specified users can achieve specified tasks with a particular product after a comparatively long period away from these tasks.

3.4.1 Designing for usability

Jordan (Jordan, 1998) has developed ten principles for how to design for usability. They are as follows:

1. Consistency: Within the artefact similar tasks are solved in similar ways.

2. Compatibility: With the artefact, tasks are solved in similar ways to how it is done in the rest of the world.

3. Consideration of user resources: During use, consider how user resources are stressed.

4. Feedback: An artefact should be designed in a way, so it registers a user's actions and gives meaningful information about the result of the actions.

5. Error prevention and recovery: The design of the artefact should be developed in such a way that it minimises the risk of use errors and facilitates recovery of errors.

6. User control: An artefact should be designed in a way so that the experienced control the user perceives is maximised. However, without being overdrawn.

7. Visual clarity: An artefact should be designed in a way so that information can be read quickly without confusing the user.

8. Prioritisation of functionality and information: In an artefact, the most important information and functions should be easily accessible to the user

9. Appropriate transfer of technology: Take advantage of technology that is developed in other contexts to increase the usability in the artefact.

10. Explicitness: Design an artefact in a way so that there are clues on what the user can accomplish with it, and how this is done.

Evaluation of usability can be done in various ways. For example, through user tests where different variables can be measured such as effectiveness (with which result a task is solved), efficiency (e.g. number of errors, time for solving tasks) and satisfaction (e.g. estimates by the user of how easy it was) (Rexfelt, 2017). Further, usability can be evaluated through theoretical evaluations such as Cognitive Walkthrough (Rexfelt, 2017).

3.4.2 Jordan's ten principles for useful design

Patrick W. Jordan has developed ten principles for useful design. They are as follows:

1. **Consistency:** Within the artefact similar tasks are solved in similar ways.
2. **Compatibility:** With the artefact, tasks are solved in similar ways to how it is done in the rest of the world.
3. **Consideration of user resources:** During use, consider how user resources are stressed.
4. **Feedback:** An artefact should be designed in a way, so it registers a user's actions and gives meaningful information about the result of the actions.
5. **Error prevention and recovery:** The design of the artefact should be developed in such a way that it minimises the risk of use errors and facilitates recovery of errors.
6. **User control:** An artefact should be designed in a way so that the experienced control the user perceives is maximised. However, without being overdrawn.
7. **Visual clarity:** An artefact should be designed in a way so that information can be read quickly without confusing the user.
8. **Prioritisation of functionality and information:** In an artefact, the most important information and functions should be easily accessible to the user
9. **Appropriate transfer of technology:** Take advantage of technology that is developed in other contexts to increase the usability in the artefact.
10. **Explicitness:** Design an artefact in a way so that there are clues on what the user can accomplish with it, and how this is done.

4. Exploration

At the beginning of this thesis project an explorative study was carried out, mainly at FlexLink, to gather insights and create a basic understanding for the meeting situation and get an overall understanding for the company. The result from the explorative study became the foundation for carrying out more in-depth user tests and developing a first prototype. This section presents aim, procedure, result and conclusion and design implications for the explorative study.

4.1 Aim

The main aim of the explorative study was to gain understanding for the target group, their meeting situations, habits and routines and what happens in-between meetings at FlexLink. Further, the aim was to gain understanding of how an implementation of new software usually works at FlexLink and Yolean, also, to get an understanding for what can be the obstacles when it comes to adopting new technology in an organisation.

4.2 Procedure

Here follows a description of the procedure of the explorative study.

4.2.1 Data collection

To gain understanding for the target group and their behaviours, routines and social structures, data was collected by means of direct observations by the authors of about one hour each during two online meetings at FlexLink. During the observation events it was noted how agenda points became tasks or decisions, as well as what happened with agenda points and tasks that were not solved and if anyone took responsibility for them. Further it was observed how the attendance of meeting participants was handled and whether it was clear who owned the meeting as well as the different agenda points.

In order to gain more in-depth information and find out emotions amongst the target group, data was collected by semi-structured interviews from three employees at FlexLink and one at Volvo. The interviewees from FlexLink all had regular project meetings and two worked in the negotiation phase and one in Sales but in different projects. They had varying experience in the company ranging from 5-36 years. The interviewee from Volvo AB was a weight architect who had long experience from the Volvo group. To facilitate the interview and support the interviewees' memory, mediating objects (Figure 13) were used in the form of a simplified

representation of CMAP. In this way they could talk about and refer to different functions of CMAP as they were discussed and easier explain what they liked and not.

To understand how new software was adopted into the organisation, an investigation of adoption stages was initiated to find out what typical obstacles there were with implementations at FlexLink. This was done both from the perspective of FlexLink as a company and of individuals working there. To develop this knowledge, data was collected through an in-depth interview with an employee in a management position with experience about past implementations at FlexLink. The interview was semi-structured, and this was a way to get a deeper understanding of past implementation problems and whether different strategies for implementation were currently used or had been used previously, and to what extent they were successful.

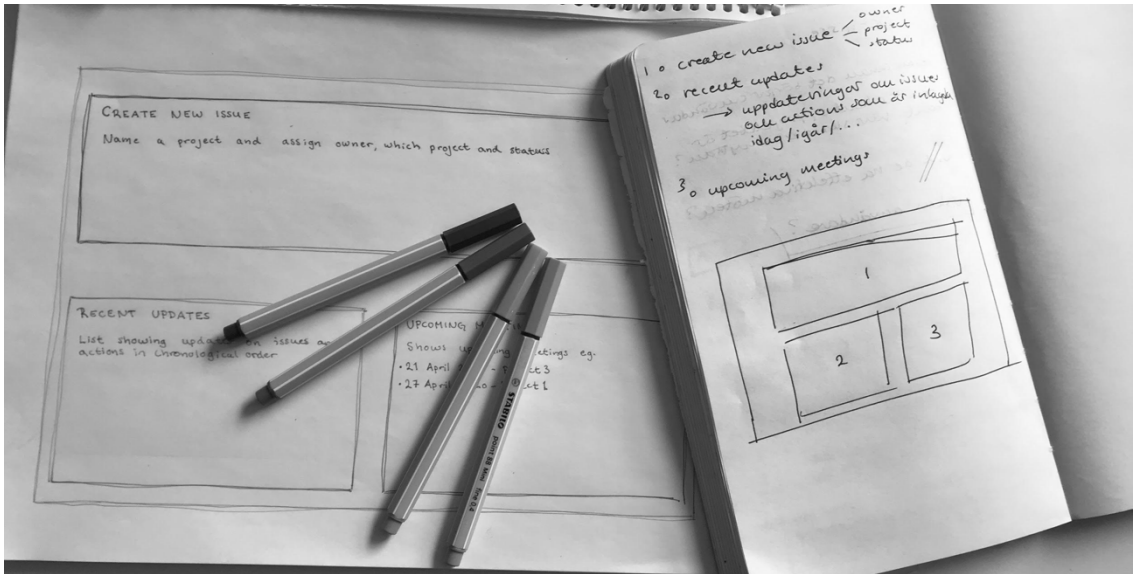


Figure 13: Mediating object for interviews, the simplified representation of CMAP

4.2.2 Analysis

To analyse the data from the interviews and observations the data was compiled in two separate matrices to facilitate comparison between different and answers from interviewees. The data analysed through internal discussion and key statements were extracted. The analysed data about previous implementations were compared to the literature.

With the knowledge about previous implementations, an assumption was made on how a typical adoption process proceeds and the different stages present (see section 4.3.5). This was

discussed with Yolean to gather their perspective on the adoption process as they were familiar with implementing software tools in organisations. At this point, there was a clear image of how adoption of software tools works at FlexLink and which stages are present when individuals adopt technology into their work routine. Hence, it was possible to decide which stages that were possible to target for the thesis project.

In order to create awareness for values, needs and behaviours of the intended user, two personas were developed for this thesis project. Their characteristics and background story were based on the analysed data that were collected from interviews and observations of the employees at FlexLink and Volvo AB. The information about them was written down and then a suitable image was found to make it easier to emphasise with them.

4.3 Results

The results from the explorative study are presented in this section and includes the data from interviews and observations, two personas, implementations at FlexLink, obstacles and facilitators for implementation, identified stages for adoption and conclusion and design implications.

4.3.1 Meeting habits and routines

From the observations it was clear that a formal agenda was rarely used during meetings. This was also confirmed later in the interviews. The lack of an agenda during the meeting made it difficult to follow when one discussion had come to an end and a new started. It also made the appearance of unexpected questions common and that could cause long meetings and unstructured discussions which were experienced as ineffective. When asked about efficiency it was clear that interviewees found a quick meeting with a focused discussion on the agenda points as a desired meeting situation. One of the interviewees experienced the meetings they went to as efficient. Their main goal with attending meetings was to be able to continue with their work afterwards.

On the note of attendance, it was clear from observations and interviews that attendance was random, and the right people were often lacking from the meeting. This meant that many questions did not get an answer since the person with the knowledge was not present. However, different meeting attendees seemed to have an idea who should be attending the meeting and a few minutes from the meeting time went to that meeting attendees announced who should drop in later during the meeting.

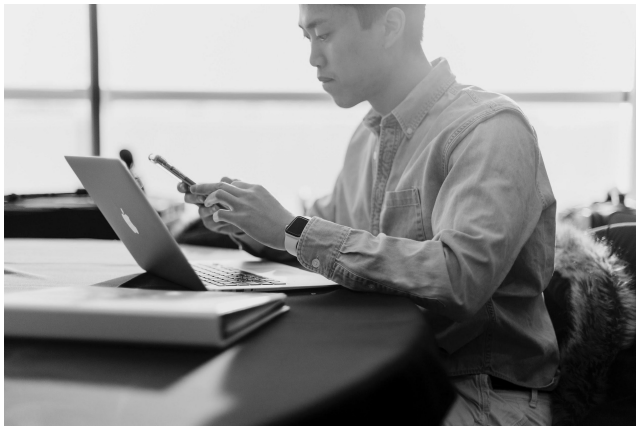
From the interviews it was clear that the context for a meeting varied and physical meetings were held in a room with all participants, occasionally someone could participate over a link. However, during the digital meetings it was observed the set-up varied a lot. Some people were alone with their computer and in other cases two or more people could share a computer.

Finally, it was clear from the interviews that if a tool like CMAP was to be introduced in the workplace, it needed to be easy and quick to use. For example, being integrated with other tools they use such as *Outlook* which was used at FlexLink. The desired effects were that the tool should make the meeting more focused, it should make it clearer what should be done by whom and improve the quality of the answers to the questions. Regarding how comfortable FlexLink employees were with asking questions, it was clear that it was an open office culture where all questions were welcome. This was also confirmed in interviews.

Further functionality from the tool that was desired was to have a mobile version as the employees would like to access it at any time. Questions that they wanted to add to the agenda could come up at any moment during the day. Hence, they saw the mobile as a good tool to quickly add an agenda point.

4.3.2 Personas

The two personas, Tim and Brenda, are presented in Figures 14 and 15. Their characteristics differ but they are both representing two possible intended users of the tool. These personas were later used to explain how the tool should be used (section 12.1).



Name: Tim
Age: 32
Nationality: Swedish
Education: Systems engineering
Profession: IT engineer

Figure 14: Persona number one - Tim. Photo by: Priscilla Du Preez (2020)

Tim previously worked at a start-up and is quite recently employed at FlexLink, therefore he is only involved in a few projects. He has high technical skills and finds it easy to learn new software. Tim takes pride in his work and wants to have control to make sure that he is doing a great job.

Tim likes to use the tool to be able to prepare himself so that he can give high quality input on his colleagues' agenda items. This is especially important to him since he is new and wants to prove that he can do a good job. He also finds it very convenient that if he posts his agenda points to the agenda the other meeting participants will get a chance to prepare to be able to give him input of higher quality as well.

Name: Brenda
Age: 50
Nationality: Irish
Education: Industrial engineering
Profession: Certification and Quality engineer

Figure 15: Persona number two - Brenda. Photo by: Allgo (2019)

Brenda has been working at FlexLink for longer than she wants to admit. She knows how things should be done and follows routines meticulously as the perfectionist she is. Of course, she is aware of that sometimes things must change, but that is not something that she is particularly pleased with. She is the most satisfied when everyone does what they should and does it the correct way.

Brenda coordinates many projects and meetings and does not have any problem with speaking her mind no matter which colleagues that are present. She likes to add her agenda points when they come to her mind but what she usually does is that she saves them for later. Once a week she goes through her saved items and edits them to make them perfect before submitting them to the agenda where the other meeting participants can see them.

4.3.3 Implementations at FlexLink

At FlexLink, every implementation starts with a smaller group that is chosen to test the new tool for a few months before it is presented to the rest of the company or project. This test group has been selected by a lead person for the specific department. The design criterion for such a group is that they should have good connection between group members and be close geographically.

When it came to implementing a software for the big majority in the company or project group, it was clear that a common obstacle was that the people who were going to use it did not have enough time to learn the software or too little information about how to use it and why. Hence, it was recognised that it is important to provide enough information and training when implementing. This was also later confirmed as a key step at Yolean in order to succeed with an implementation. For them, it was equally important to train people in the software as well as the method for using it. From Yolean's side, they usually have a close connection with one or a group of employees at the company where the software is to be implemented. This helps facilitate the implementation.

To facilitate implementations, FlexLink uses a Knowledge base, which stores information used by a computer system, and also supports implementation with videos. The videos were especially efficient when it came to explain new features in a new software. However, when it comes to qualities of the software that facilitates implementation it was clear that a tool that was easy to use and where the user found the value of using it quickly were two key factors. A factor that was identified to decrease the users' satisfaction, also experienced at Yolean, was that they could not see that the quality of their work improved with new software or that they lost control over actions that they were used to be able to do. Yolean experiences the same obstacle at implementations.

There are four identified stages for an individual's adoption of new software at FlexLink. The first one is that the user knows that the software exists, which means that the user is aware of the software but has not yet tried it themselves. The next step is that the user has an idea of what using the software will do for them and has started to familiarise with the thought of using it. After this point the user starts interacting with the software but cannot yet create any real utility from the use. The utility is achieved in the last step where the user, with help of the software, can create utility. After this step the user adopts it into their routine (Figure 16).

The first two stages are similar to those identified by Everett Rogers which are more thoroughly described in section 3.2. However, at FlexLink the decision of continuing using the software does not come from the individual but from higher up in the hierarchy. This is why, in the end, the individual will be able to create utility with the software once they have accepted it into their routine. At FlexLink the user does not necessarily have need for the knowledge search at the same extent as in the stages identified by Everett Rogers as training and support are offered.

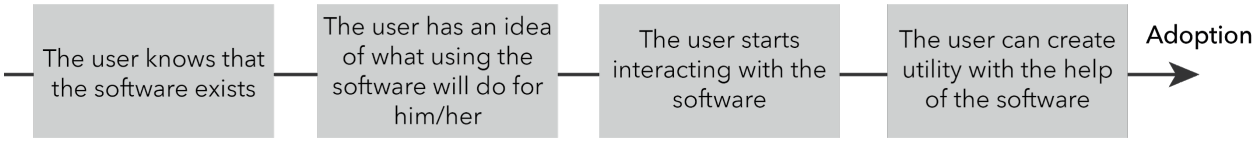


Figure 16: Identified stages for an individual's adoption of new software

4.4 Conclusion and design implications

The explorative study gave a broad understanding about the context and the difficulties with getting individuals to adopt new software in organisations and later to understand the obstacles and facilitators for implementation that existed at FlexLink and Yolean. This section presents the main takeaways from this chapter.

From the interviews and observations at FlexLink and Volvo AB it was noted that the interviewees wanted their meetings to be efficient, quick and with focused discussions about each agenda point. However, formal agendas were rarely used and only one of the interviewees experienced the meetings they attended to be efficient. It was also unclear who was going to attend the meeting and the right person to answer a certain question was sometimes missing, leading to that some questions were not answered or got an answer of lower quality than desired.

At FlexLink the culture was open, and employees had no problem speaking their minds or asking questions, this was used as a starting point in the development once it was decided what information that should be shared amongst project members through the tool. Also, the difference in the context between physical and digital meetings was considered in the development to match both needs.

It was clear that for the new software to become accepted it has to be quick and easy to use and integrated with the other tools used in the organisation, for example *Outlook*. It was also desired to have a mobile version of the tool to make it flexible. These aspects was considered when the development of the tool was initiated to be able to suit the needs of the target group.

There was a clear connection with user satisfaction and flexibility. It had been observed at FlexLink that if a user lost control over actions they were used to being able to do with a tool, their satisfaction and willingness to use the new software decreased. The research of O'Brien and Toms (2008) confirms this and states that the loss of control is a factor that decreases employee engagement.

FlexLink has a plan when it comes to implementing software and the part that was considered in this project was that they used video tutorials to explain new software features to employees.

Both FlexLink and Yolean agreed that training was important when implementing a new software but that it could be difficult to find time to do it. The already common strategies for implementation worked as an inspiration for the implementation work throughout the thesis project. In that way it was likely that the target group would agree to and accept the new tool that was going to be implemented.

From stages for adoption it was decided to start the project from stage two of the model which was "The user has an idea of what using the software will do for him/her". This was because it would be the most suitable for the thesis project to be able to observe how users adopt a new tool into their routine.

5. Interactive prototype 1

The explorative study (chapter 4) was used as a foundation for the development of the first interactive prototype. The aim, procedure, results and conclusion of this development will be presented in this chapter. Something that was important for the development of the first interactive prototype was that agenda points went from being called "questions" to being called "items". The flowcharts and the entity relation diagram hence use the word "item" to make it easier to compare them with the flowcharts developed in later iterations.

5.1 Aim

The aim was to develop an interactive prototype and to evaluate it with the purpose of gaining knowledge and extracting user design criteria for the future iterations where a working prototype eventually would be developed. A working prototype, unlike the interactive prototype, allows the user to enter data into the system and is built upon Yolean's data model.

5.2 Procedure

An overview of the process for creating the first prototype is shown in Figure 17. The process was iterative, and several meetings were held with Yolean to be updated on what kind of information, design criteria and functions were necessary to be able to create a working prototype.

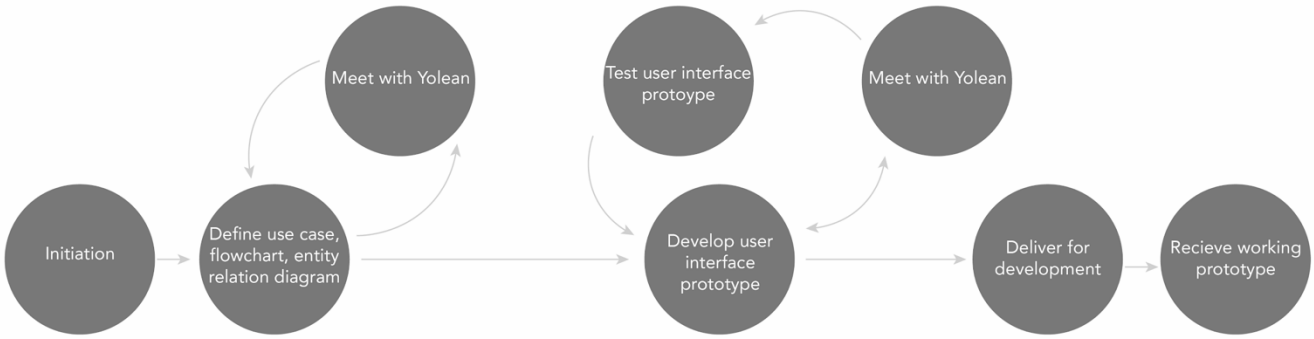


Figure 17: Overview of the process in creating the first prototype

5.2.1 Defining a use case

After an initiating meeting, Yolean requested to receive specific information about what features the working prototype should contain. The first step in building it was to create a basis that could be taken to developers. A use case was chosen as the best way to start establishing the basis. A use case considers the user's point of view and how they will perform tasks interacting with an interface (Usability.gov, 2020). A suitable use case that was relevant for the study was defined and captured how users would perform tasks with an interface as well as outlined the system's behaviour when it responded to a request made by the user. The use case was defined as:

"To add a question to a collaborative agenda prior to a meeting"

and targeted employees at FlexLink. This was chosen as it is the most important task for the usage of the collaborative meeting tool and targets the context between meetings. Later, when developing the prototype only the functions from CMAP that were necessary to complete the use case were to be considered.

After having defined the use case, necessary functions and structure for the prototype were acknowledged. This was done by creating flowcharts of the user's possible interactions with the tool to see what functions and sequences that were crucial for the prototype. These functions were based on the CMAP.

5.2.2 Developing a basis for a working prototype

As the aim states, a working prototype was going to be developed. Hence, consideration needed to be taken to the data model that was going to be used. These were things such as terminology and how functions were related to each other. It was also important to choose a maximum number of characters in the question headline to make sure that it would look clear in a list. The number of characters were based on how many characters that are visible in the Yolean tool today when a question is asked, and this was relevant since the Yolean tool uses the same data model.

To present relations between different entities in the tool, an entity relation diagram was created. In this case the entities were Agenda, Item list (previously called question list), Meeting participant, Meeting, Item(s) (previously called question), Project and Project manager. Throughout the development of the use case, the flowchart and entity relation diagram were iterated several times with representatives from Yolean to make sure to create a solid foundation and solve as many issues as possible before initiating the development of the tool.

From the explorative study it was clear that there was a need for a mobile version of the agenda tool. After speaking to Yolean, it was concluded that the natural step was to create a mobile version first as this is easier to convert into a desktop interface later, compared to the other way around (Olsson, personal communication, 4th March 2020). The explorative study concluded that it was important that the tool was easy and quick to use, hence a lot of work has been put into streamlining the flow through the interface and deciding what information should be pre-filled in when entering the tool.

It was decided to create a prototype to be able to evaluate the usability. Prototyping can be used to create a tangible form of the tool that can be tested with users (Dam & Teo, 2020). The development of the prototype was first made on paper to explore basic functionality and create logical sequences (Figure 18). Later the development continued in *Adobe XD* as it is a good tool for creating interactive user interfaces and prototypes (Adobe, 2020) and it increased the prototype's fidelity. The placement of different elements were based on CMAP as no obvious reason to change it was found during the explorative study. However, a customised login page was made to make it recognisable for FlexLink employees and in that way gain their trust for the prototype. At a meeting with representatives from Yolean it was concluded to be an important part that could really make a difference for the acceptance of the tool (Olsson, personal communication, 6th March 2020).

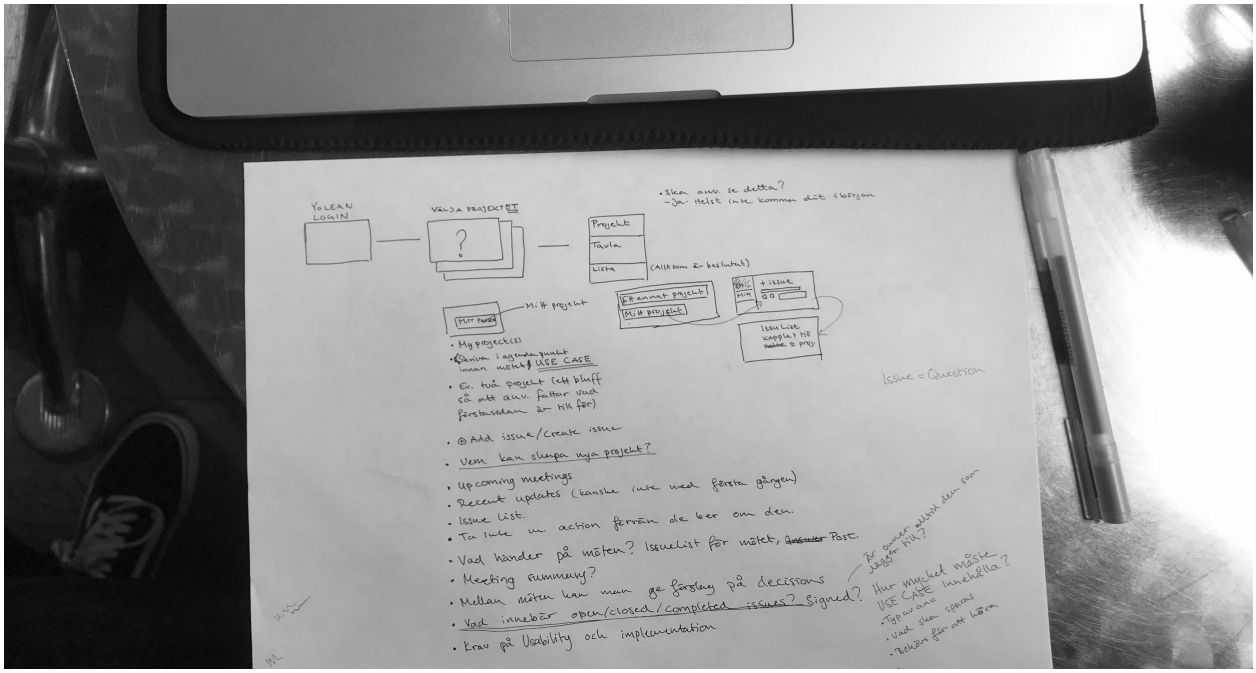


Figure 18: The first part of the development of the prototype was made on paper

5.2.3 Testing the first version of the prototype

When the first interactive prototype (Figure 19) was developed, user tests were carried out to investigate to what extent users understood the purpose of the tool and how to interact with it. This was done by showing six people the interface and then asking a few questions about it. They were asked to explain what they thought the prototype tool would help them accomplish and what it does.

Also, A/B testing of the text in the text box (Figure 19) in the interface was performed to gain insights about optimisation and understand what different opinions there were on the "instructions" written inside of it. This was considered relevant as the text box was an unexplored element from CMAP but regarded as important for the function of creating an item for the agenda hence, it was important to evaluate whether participants knew what they should write in it. The screens from the interactive prototype were shown to six participants (three for each version) and questions about the text in the text box "Information"/" Tell us more" were asked. The A/B testing was a way of getting a first indication of opportunities for development of the tool. The participants in these tests were not the primary users of this tool but university students nevertheless, their input was interesting as they could be regarded as new employees at FlexLink who were not yet used to the terminology and way of working.

5.2.4 Evaluating and analysing data

To further evaluate the prototype a Cognitive Walkthrough (Bligård, 2016) and Predictive Human Error Analysis (Bligård, 2016) (appendix A) were carried out to evaluate potential usability problems and potential use errors with the interaction between the user and the interface. A template with the both the CW and PHEA was used for each of the three steps of the interaction that were evaluated: login, add a new question and edit the question. These three steps were chosen since they cover the main parts of the use case for this thesis project which is to get users to add questions in the tool prior to meetings.

With input from tests and previous iterations with Yolean, the findings were presented to Yolean where details in terminology were further adjusted in the prototype. To develop the working prototype design criteria also needed to be developed. They were created based on the work done with the flowchart and interactive prototype. After this the design criteria were developed together with Yolean to be taken to developers so that they could use them as a basis for creating a working prototype.

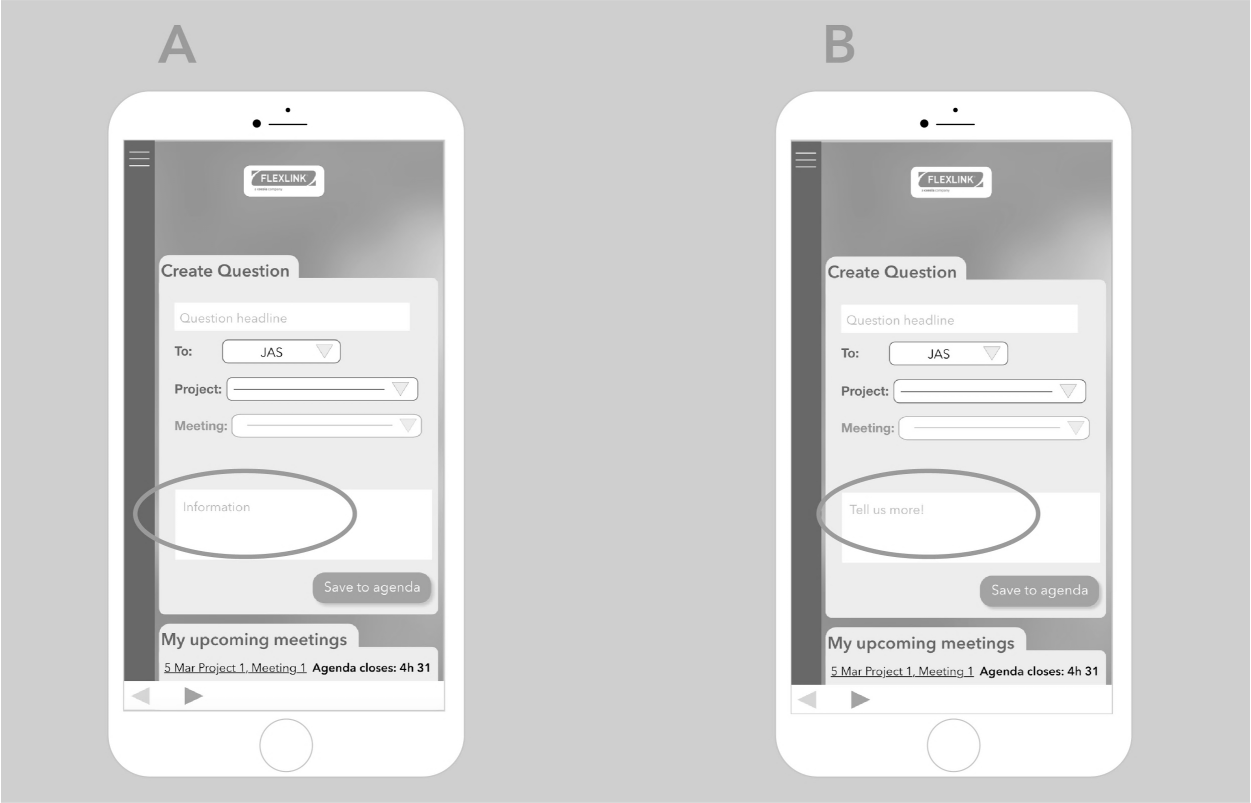


Figure 19: The first interactive prototype, A/B testing of the text in the text box

After the A/B testing, development of design criteria, estimation of use errors and further discussions with Yolean, the input was analysed and a new interactive prototype was developed. This was the prototype that was tested in and, this prototype only held the necessary functions for completing the use case. The prototype was developed in *Adobe XD* and the flowchart was used to develop the necessary connections in the prototype.

5.3 Results

In this section, the flowchart, entity relation diagram, list of design criteria, CW, PHEA, A/B testing and the interactive prototype that was the result from this chapter will be presented.

5.3.1 Flowchart

The flowchart shows the possible ways of interaction the user has with the tool. To make it more understandable it was split in six parts depending on the time of interaction and how the login sequence was; (1) Before the "Item list" is completed (Figure 20), (2) Before the meeting when the "Item list" is completed (Figure 21) and (3) When the meeting starts and the completed "Item list" turns into the meeting agenda (Figure 22). Number (4), (5) and (6) (Figures 23, 24 and

28) make use of the same three points of time but differ regarding how the user logs in and how the rest of the interaction is affected by that.

The interaction always starts with that the user logs in. The first login option (numbers 1-3) is to click on the general link to the tool and get to the first page which consisted of two boxes; "Create item" and "Upcoming meetings". The second login option (numbers 4-6) is to click on a meeting specific link sent the user directly into the "Item list" for a specific meeting. After logging in the interaction differs and this is explained in this section:

(1) Before the "Item list" has been completed 24h before the meeting is scheduled to start, there are two possible ways of interaction. First, it is possible for the user to fill out a form to create an item and save it to the agenda. The information needed to create an item is: headline, information, to (receiver), project and meeting. Projects and meetings can only be created by the project manager or admin, but this was not a task for this thesis project. Meetings always belong to a project so before a project is chosen it is not possible to select a meeting. Second, the user can view the "Item list" for a specific meeting by going via "Upcoming meetings" and click the meeting of interest. The "Item list" contains all items assigned to that specific meeting. As long as the "Item list" is open the items could be edited, deleted and new could be added.

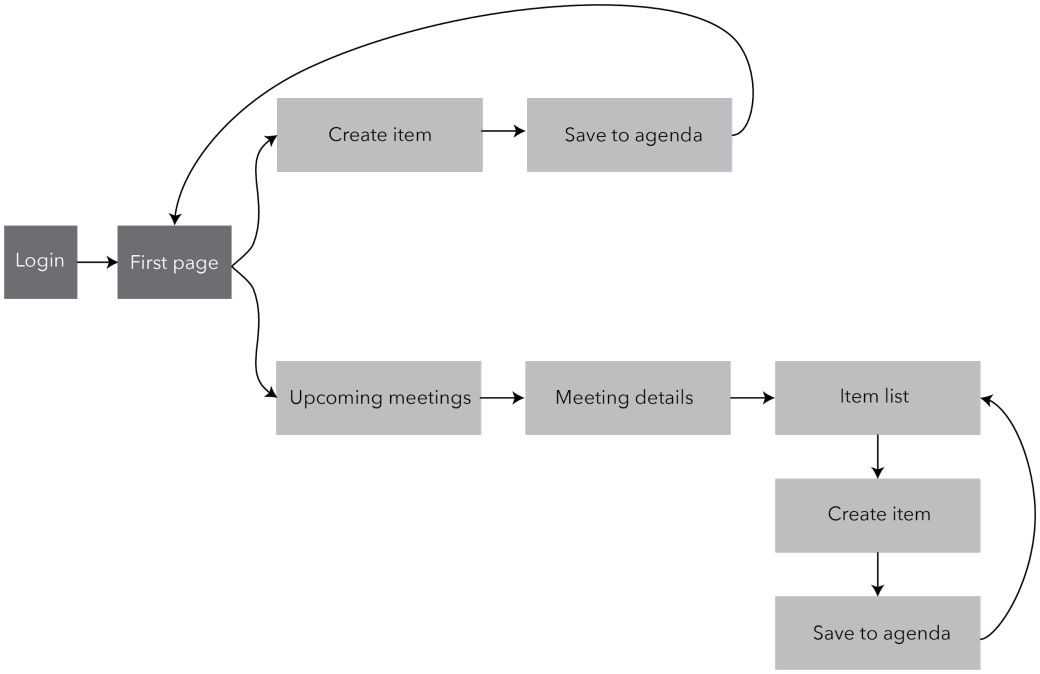


Figure 20: Flowchart (1) showing the two possible ways to add an item to the agenda and how to view the unfinished "Item list

(2) The "Item list" close 24h before the meeting is scheduled to start and from the moment it closes it is no longer possible to edit or add items. When this happens, a new clickable link appears in the "Upcoming meetings''-page, next to the meeting details, saying "View item list". By clicking it the user comes to the complete "Item list".

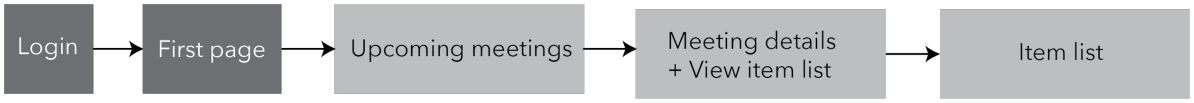


Figure 21: Flowchart (2) showing how to view the completed "Item list".

(3) When the meeting has started, the complete list turns into the meeting agenda for that meeting and it is no longer possible to view the original "Item list". Where the clickable link used to say "View item list" is now another link saying "Go to meeting view" which sends the user to the agenda which is the "Item list" that is used during that meeting. The meeting view was unnecessary for this iteration.

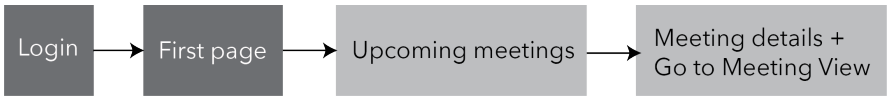


Figure 22: Flowchart (3) showing how to view the agenda in meeting view

(4) When the user has a link leading to a specific meeting they get directly to the "Item list" for that meeting where all current items are viewable, and it is possible to add an item by clicking the floating plus-button. This action opens a pop-up window containing the same form as the "Create item"-form on the first page when logging in to the general tool. When all information is complete it is possible to save the item to the agenda.

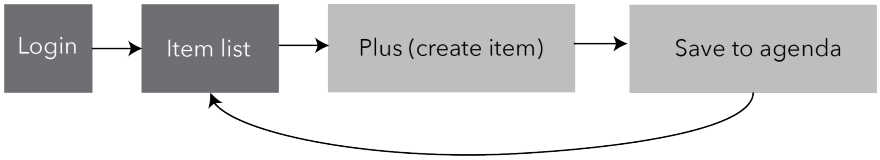


Figure 23: Flowchart (4) showing how to add an item to the agenda and how to view the unfinished "Item list" when logging in with a meeting specific link

(5) With only 24h or less left until the meeting starts it is not possible to edit or add items. However, it is still possible to view the completed "Item list" and when logging in with a link the user will be sent directly to the "Item list" for that specific meeting.

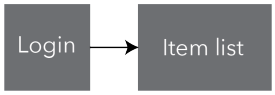


Figure 24: Flowchart (5) showing how to view the completed "Item list" when logging in with a meeting specific link

(6) Once the meeting started the button "Go to meeting view" is activated in the "Item list". By clicking it the user gets to the meeting agenda for the specific meeting of the link they logged in with.

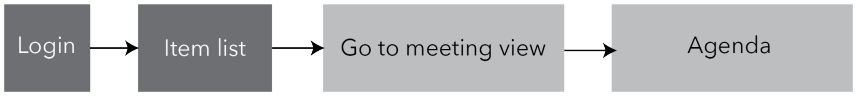


Figure 25: Flowchart (6) showing how to view the agenda in meeting view when logging in with a meeting specific link

5.3.2 Entity relation diagram

The entity relation diagram in Figure 26 shows how different elements in the system relate to each other. The entities are visualised in the boxes and the arrows symbolise the connections. The diagram is built up of meeting participants and project managers who creates an item belonging to a meeting and a project. Meetings and projects can only be created by project managers or an admin. All items for a specific meeting built up the "Item list" for that meeting and when it starts the "Item list" turns into the agenda. The project manager confirms the "Item list" prior to the meeting to make sure it was accurate. Prior to the meeting it was possible to read the "Item list" and during the meeting the agenda was readable.

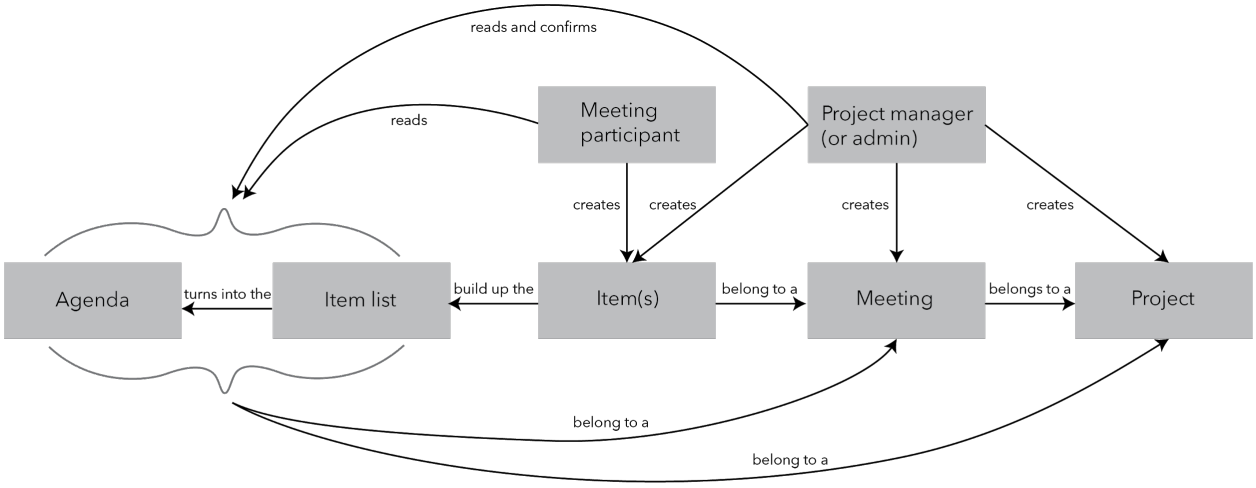


Figure 26: The entity relation diagram for the first interactive prototype

5.3.3 Cognitive Walkthrough and Predictive Human Error Analysis

The main results from the CW and the PHEA (Appendix A) were that it was likely that the user would understand how to interact with the tool. There were some potential use errors that could be made by accident or due to that the user forgot what to do and some others due to that some functions were not visible on the first page. Common to most of the errors were that they were easy to be discovered and can be recovered. For example, a user could forget to fill in all the information when logging in.

5.3.4 A/B test

The A/B testing gave a first indication of the choice of terminology and input in the text box. One comment that was reoccurring concerned the terminology, specifically about calling the agenda points "questions" and that one do not only add questions to an agenda but other input as well. Hence, "question" was changed to "item" for the first version of the interactive prototype that was used in evaluations as it is a more general and neutral word. The use case was then updated to "To add an item to a collaborative agenda prior to a meeting" and it was also updated in the prototype and for the tasks that were used during the first evaluation.

When it came to the text box, people had no problems with understanding what to fill in, regardless of the written "instructions" that were inside of the box. Hence, it was decided to call it "Information" as previously decided.

5.3.5 Interactive prototype

The interactive prototype was largely based on CMAP however, the development of the first interactive prototype was also based on the results from the user test, the A/B-testing and the combined CW and PHEA (Appendix A). The concept was developed in *Adobe XD* (Figures 27 and 28). It consisted primarily of the "Create item"-form (previously "Create question"-form) which included Item headline, to (receiver), project, meeting and information. It was not possible to select a meeting before having selected the project. On the same screen the heading "Upcoming meetings" was shown. The thought was that when a user had created an item, it ended up in the "Item list". It was possible to expand an item in the "Item list" to see more information about it. At this stage it was also possible to edit an item.

There were two possible ways to login to the tool as there were two likely scenarios. The first scenario, which was considered as the most likely, was that one could access the tool from the meeting invitation. Here the user would have come directly into the "Item list" for the meeting and may edit an existing item or add a new one. The other scenario was a general login that was

accessible from the tool itself. Here the user directly would have come into the "Create item"-form (Figure 27) and could create an item or see their upcoming meeting.

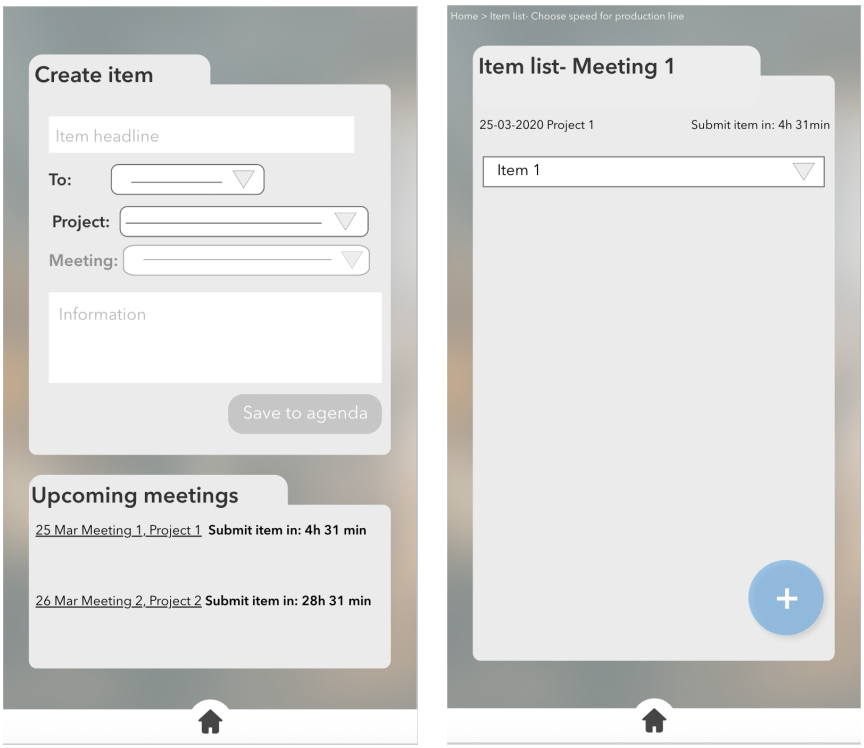


Figure 27: The two login views depending on whether the user logs in via a meeting specific link (right) or not (left)

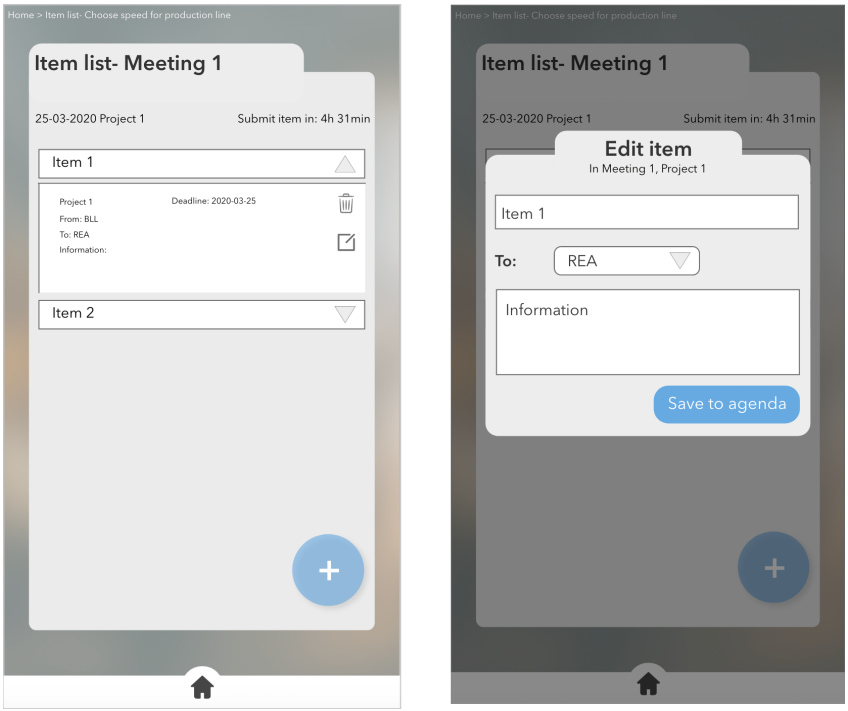


Figure 28: The unfinished "Item list" (left) and the "Edit item"-form (right).

5.3.6 List of design criteria

Based on the flowcharts and entity relations diagram a list of design criteria was developed to support and work as a basis for developers when developing a working prototype. The list covers the necessary functions and constraints that are necessary to facilitate user interaction.

- Create a meeting
    - The tool should enable an admin or a project manager to create meetings
    - Meeting details should contain time and date for meeting, name of meeting (headline) and what project it belonged to
- Item list
    - The tool should contain an item list
    - The tool should enable a project member to add items to the item list/agenda
    - The tool should enable users to see that their items ended-up in the item list.
    - The tool should enable users to see what items that were addressed to them (so they could prepare for the meeting)
    - The tool should enable users to see what items were posted already
    - The possibility to add items should close automatically 24h before set time with the exception from weekend if meeting on a Monday (then 72h before)
- Create an item
    - The “Create an item”- form should contain: Headline, "To" that is chosen, what project the item belongs to, a "free-text" field where additional information could be (if wanted) added by the user for further explanation of the item
        - The number of headline-characters should be restricted to 50
- The field for “Upcoming meetings” should contain: list the upcoming meetings that the user had and to each meeting have a link to the "Item list”/meeting view for that meeting

5.4 Conclusion

The development of the first interactive prototype included choosing a use case regarding the time between two meetings: “To add an item to a collaborative agenda prior to a meeting”. The use case was used throughout the project as a basis for the evaluations and the functions that were selected from the CMAP were chosen to fit the use case.

The placeholder text in the free text box in the “Create item”-form was evaluated and it was clear that the user understood what to write there irrespective of what the options of placeholder text were. From this it was concluded that as long as the text is relevant, and the text field is clear the user understands what to do. Hence, the importance of using a recognisable structure

in the interface, with commonly used elements and placement of text and functions was considered throughout this thesis project.

An entity relation diagram and flowcharts were designed to be able to understand the flow of interaction and how different entities move within the interface in order to create an efficient interaction. The purpose of them was to be a base for the development of the working tool.

The conclusion from the CW and PHEA was that most errors occur due to forgetfulness or by accident for example, due to a slip (Bligård 2019) or a lapse (Bligård 2019) and that they are easy for the user to discover and recover but more difficult to entirely prevent. However, for the thesis project maintaining a low level of use error will be considered.

6. Usability evaluation 1

To evaluate the users' understanding of how to interact with the tool they were told scenarios and given tasks to solve in the interactive prototype. The evaluation was built up of several iterations where the interactive prototype was updated between each of them and then tested and evaluated to better fit the needs of the user. This chapter describes the aim, procedure, result, conclusion and design implications of the first usability test where the first interactive prototype was evaluated. The usability tests throughout this thesis project were all focused on interaction.

6.1 Aim

The aim of the first usability evaluation of the interactive prototype was to find factors making the interaction difficult in order to create better conditions for implementation in the coming iterations.

6.2 Procedure

The usability tests (Figure 29) were conducted with nine participants with backgrounds varying from students to employees at Boeing and HiQ. All participants that participated in tests were in their twenties.

The desired use context for the test and intended place of use was an office environment with some noise and people moving around the user. This context was simulated by conducting the test in public indoor areas with people around, for example, cafes and restaurants.

Figure 29: One of the nine usability tests. The participant is filling out a semantic differential scale

A scenario (see Appendix B) was presented to the test participants with the intention to put them in the right mindset. This scenario was chosen since it is probable that participants of a meeting would have a specific meeting in mind when thinking of an item to add to the agenda.

The three tasks given to the participants were chosen to evaluate the interaction connected to the chosen use case; "To add an item to a collaborative agenda prior to a meeting". The tasks were:

1. Log in to the meeting called 'Choose Speed for Production Line' in the project 'Juice Factory' via the invitation to attend the meeting.
2. Add an item to the meeting 'Choose Speed for Production Line' in the project 'Juice Factory'. Your item is going to be about pros of fast speed and the receiver of the item should be REA. Since you are not able to attend the meeting in person you want to add additional information regarding your item to make it clear to the meeting participants.

Once this task was completed a new task was added:

3. You just realised that your item was meant for another person. Enter your item and change the receiver to JAS.

Test participants were given a note with the relevant information about the project and meeting as well as the tasks they were to complete. This was to reduce the need for them to keep information in their working memory so they could focus on the test.

During the tests, both objective and subjective factors were measured to. The objective measurements were the number of errors and the number of times the participant was given support. This was noted in a list, both when they asked for it and when the researchers noticed that they would not be able to proceed without assistance. To facilitate the measuring the screen of the computer on which the test was conducted was recorded.

The subjective measurements were the reactions and comments from the test participants, collected through a semi-structured interview directly after each test. The topics addressed were for example difficulties with understanding the tool, the user's attitude towards it and to what extent they were aware of what their actions would result in. During the interview, participants got a piece of paper with three different views of the interface to support their recollecting their experiences. They also got to fill out a semantic differential scale including seven expressions

with the chosen antonyms designed to fit the considered user in the considered context (cf. Wikström, 2016). The desired expression in each pair is underlined:

- Organised - Cluttered
- Annoying - Enjoyable
- Attractive - Unattractive
- Inefficient - Efficient
- Clear - Confusing
- Predictable - Unpredictable
- Obstructive - Supportive

These adjectives were chosen for the test after analysing the outcomes from the explorative study (chapter 4) where it was noted that the interaction must be as simple and straightforward as possible and that the tool needs to make the interaction clearer. In this thesis project the results from the semantic differentiation scales were based on that every step in the scales was provided with a number from zero to four and participants could also choose half steps. A high number was considered positive and the total score of all qualities together shows to what extent the interface matches with the users' desired qualities of the interface in that specific context.

The analysis of the evaluation was conducted by making an affinity diagram based on the interviews and comments on the semantic differential scale. All problematic factors regarding the usability of the tool were written down on post-its and sorted into categories to create the affinity diagram. The results of the semantic differential scale were compiled into a diagram in order to compare the results for each participant and the results for each of the adjective pairs.

6.3 Result

The result from the analysis of the affinity diagram (Appendix C) and semantic differential scale are presented and described in this section.

6.3.1 Identified problems

The usability evaluation of the first interactive prototype resulted in ten categories describing the problems that participants experienced when interacting with the prototype. These categories were the main result from analysing the affinity diagram that was based on the interviews and comments from the test participants. They are presented and explained in this section.

- Desired functions (when creating an item in the "Item list"): The desired functions mainly concerned the amount and type of information that is possible to assign to an item.

- Visual problems with the "Item list": The main problems in this category were that some of the participants mistook the already existing item in the "Item list" for a drop-down menu with options (Figure 30) and that they did not understand or notice the "+-button" which opens the form for creating an item. However, for other participants none of these were a problem at all.

- Where did I end up? (when logging in via the link and getting to the "Item list" for the meeting): The participants did not understand where they were after logging in or the purpose of the page they came to.

- What I expected to happen when I logged in, did not happen: The main problem in this category was that the participants did not think that the "Item list" looked like a typical first page and did not understand where they were.

- What is in the "Item list"?: The participants thought that it was not clear that the items in the "Item list" were items.

- What is an item/" Item list"?: The participants did not understand the purpose or functions of the "Item list" and items.

- What is included in this item?: The participants claimed that it was not clear from who added the item was and what kind of information the item did contained.

- What do you do on the page for" Create item"?: There was a confusion regarding what "to" and "from" means and also regarding the placement of "Upcoming meetings" just below the form for creating an item (Figure 31).

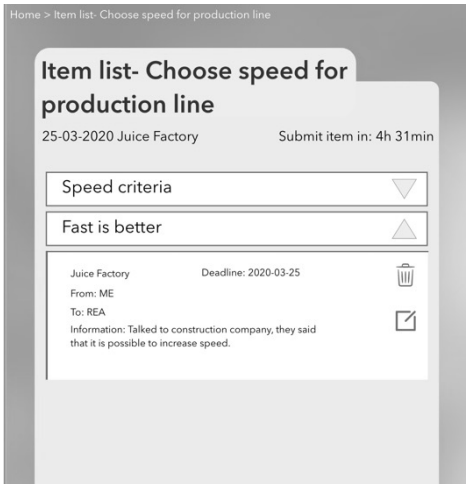


Figure 30: The information box in the "Item list" mistaken for a drop-down menu

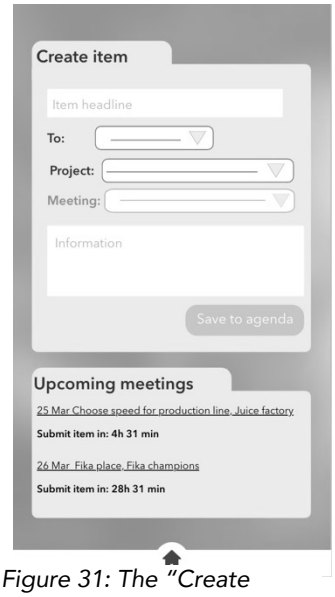


Figure 31: The "Create item"-form with "Upcoming meetings" right below

- I need control/ how much control do I need?: The problems in this category were about how much information the participant wanted to see in different phases of the interaction.

- Visual remarks in general: The participants commented on colours, size of different elements and in what order they are placed.

6.3.2 Assessment of subjective and objective factors

The result from the semantic differential scale is summarised in Table 1. It shows the actual scores of each participant and that the two areas most in need of improvement are how enjoyable the tool is to use and how attractive it is to the user. The average total score per person is 20.1. The maximum would be 28.

For the objective measures, there was only one interaction error and one time a participant asked for help during the tests.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	TOTAL:
organised-cluttered	3.5	1.5	3.5	1	3.5	3.5	3	3	3.5	26
enjoyable -annoying	2	2	2.5	3	1.5	3.5	2.5	3	2.5	22.5
attractive-unattractive	2.5	2	2.5	1	2.5	3.5	2.5	3.5	3.5	23.5
efficient -inefficient	3.5	3	3	1	3.5	3	3	3.5	2.5	26
clear-confusing	3.5	1	3.5	2.5	2.5	3.5	4	4	3	27.5
predictable-unpredictable	1.5	2	3.5	3	3.5	4	2.5	2.5	3.5	26
supportive- obstructive	3.5	3	2.5	2.5	3.5	4	3	3.5	3.5	29
TOTAL:	20	14.5	21	14	20.5	25	20.5	23	22	180.5

Table 1: The result from the semantic differential scale for the first evaluation.

6.4 Conclusion and design implications

Common for all the problems observed during the first evaluation was that even though there were some difficulties with understanding the tool and its purpose, the participants could in general always perform their given tasks during the evaluation. This was based on the fact that there was only one interaction error and one time that a participant asked for help during tests involving altogether nine participants. It was also clear from the semantic differential scale that users scored high on most of the expressions however, the two areas that most needed improvement were that the tool should be more enjoyable and attractive to the user.

The most severe problem was that the user did not know where they were in the prototype, especially when they were in the "Item list" since they did not understand what it was. Hence, it was important to both make them aware of what the item list was and to make sure that they knew where in the prototype they were. It was also observed that some information was confusing the user, for example, when there was a lot of information in the headline. In the following developments it was important that the information was clear to the user and easy to comprehend.

Based on the participants' reactions during the test and the interviews after it was decided to not continue with the mobile version of the prototype after the first evaluation as most test participants expressed that they would rather use the tool on their computer.

Furthermore, from the evaluation it was clear that the participants thought it was difficult to assign a person to the "to"-field when creating an item. When discussing this matter with Yolean, it was found that in some cases it is not possible to know who is the most suitable to be assigned to an item before the meeting. Hence, it was concluded to move the assigning of an item responsible to the actual meeting. However, this was outside the use case and it was not considered in the next iteration.

7. Interactive prototype 2

After having gathered insights from the first usability test, the development of the second interactive prototype was initiated. The aim, procedure, results and conclusion are described in this chapter.

7.1 Aim

The aim was to, based on the results described in chapter 6, develop an interactive prototype in order to evaluate it with the purpose of establishing knowledge and extracting user design criteria for the coming iterations where a working prototype eventually would be developed.

7.2 Procedure

In section 6.3.1 an affinity diagram was presented and categories for different problem areas identified. As a start for the second iteration, some specific categories were chosen to address. The categories were chosen on the basis of frequency and severity. All problems that users spoke of were noted, however, how many that uttered these or similar problems varied. Hence, it was important to sort the categories on frequency so that the 'right' problems could be targeted. However, all problems that arose were not severe, hence an estimation of their severity was made to develop a clear scope for the iteration. Many of the problems concerned the "Item list". There were problems understanding what it was, how to add new items to it and what all the information meant. These issues were considered in this second iteration. It was also clear that users had a problem understanding "to" when creating an item. Problems had also emerged with the start page that contained "Create item" and "Upcoming meetings" as well the fact that the user could access two different start pages depending on how the user logged in.

7.2.1 Defining design direction

Once the problems had been selected and noted, the creation of an Expression Board (Wikström, 2016) started to be able to have a starting point and an inspiration for the design work as well as being able to communicate and visualise the meaning of the user interface. For this process, FlexLink's webpage was studied and analysed to find the core values of the company. The values were taken into consideration together with input from the previous test (see chapter 6) when the image search started. Different image options for the different categories: form, artefact, metaphor and material were found and discussed before one image for each category was selected. For the category: colour, a colour palette was developed as it was clear from the first evaluation that the users found the interface boring due to the lack of

colour. Hence, there was an opportunity to develop a new colour scheme that could be used to highlight functions as well as making the interface more fun and delightful. As a starting point, colours from Yolean's Brand Guidelines & Identity Manual (Yolean, 2020) were used and a green colour was chosen to create a calming atmosphere as the software tool will be used in a rather fast paced environment. There was also a need for a colour that could draw users' attention to it. Hence, the colour yellow was used. However, this colour was decided to be used frugally and only when needed.

7.2.2 Ideating

When a clear direction had been developed for this iteration, the ideation process started with Braindrawing (Figure 32) to develop a large quantity of ideas. Different ideas for solutions for the problems were sketched down on paper and developed in different rounds. One issue was handled at time to maintain a strong focus. There was no specific time limit used as the process of the ideation naturally slowed down and ended. Once there was a large quantity of ideas the selection of the best solution was initiated. The selection was based on how well an idea solved the problem and discussion were held to evaluate their probability of success. Some of the selected ideas were then further developed to better solve the specific problem. Alongside the ideation, quick studies of existing interfaces were made to get an idea of how placements and problems are commonly solved in interfaces. Both apps and desktop interfaces were investigated. Mainly websites like *Outlook*, *Gmail* and *Spotify* were looked into as they are commonly used.

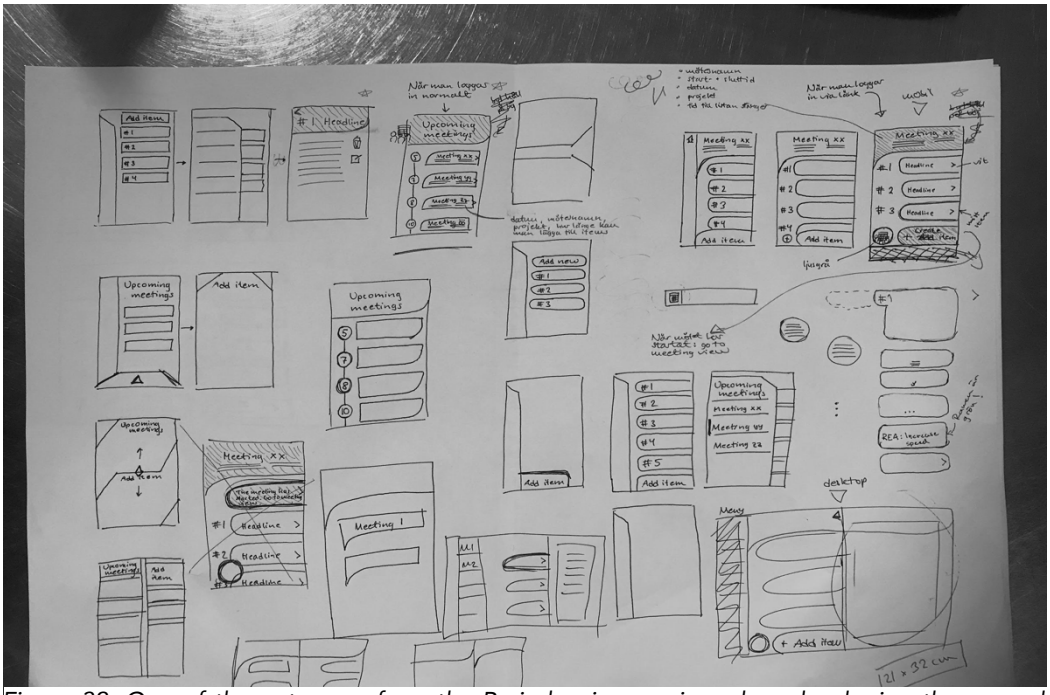


Figure 32: One of the outcomes from the Braindrawing session when developing the second prototype

The flowcharts for the concept were updated to match the way a user interacts with the prototype. Not all interaction sequences from the first set of flowcharts were included at this stage, only those relevant for the second set of tasks (section 8.2) that was going to be evaluated when evaluating the concept. The entity relation diagram was also updated to match the new way entities in the tool depend and rule over one another. Further, an updated list of design criteria was also developed at this stage.

When there was a clear idea of how the new interface should look, prototyping in *Adobe XD* was initiated. For this iteration a desktop version of the software tool was developed. A test version of the desktop prototype was also developed. This was done to be able to evaluate the usability of the user interface. At last the prototype was evaluated through a CW and a PHEA to get an idea of potential problems with the usability and possible use errors of the interaction between the user and the interface (cf. Bligård, 2016)

7.3 Result

The interactive prototype that was developed is presented, along, with an updated list of design criteria, flowcharts, entity relation diagram and CW and PHEA.

7.3.1 Interactive prototype

Figures 33, 34 and 35 shows the result from the second design iteration. The interactive prototype consisted of a list with "Upcoming meetings" (Figure 33). Here, all meetings were visible and ordered after the date that they occurred. From "Upcoming meetings" it was possible to access a preview of the agenda for every specific meeting (Figure 34) and this opened in a new window.

The agenda preview provided a list of all items that were added up until then. It also showed the name of the meeting, date and time for the meeting, which project the meeting belonged to and also how much time there was left for submitting items to the agenda. In the agenda preview it was possible to open an item and delete or edit it. Anyone who could access the meeting could also edit the item information or delete the item. In the agenda preview page, new items could be created. This function opened a form at the right side of the screen (Figure 35) where the one could type in an item headline and optional information or upload files and then save it to the agenda. After the item was saved it appeared in the agenda preview. Every item was numbered to make the purpose of an item clearer as it now looked more like a list.

Once the time for submission had ended, which was 24h before the meeting started, it was no longer possible to add new items. One could, however, still see the agenda preview. First when the meeting had started, the agenda preview was not visible, but the user would be directed to a meeting view where the agenda was shown. The meeting view was, however, not relevant for this iteration.

In this iteration it was no longer possible to assign a receiver ("to") when creating or editing an item. The reason for removing "to" was because it was concluded that users were confused about what it meant. There was also an apparent risk if an item had both a "from" and a "to" that there would be problems knowing who was actually responsible for the item, since two persons were mentioned.

From the first evaluation it was clear that the interface had good learnability and that it was easy for the participants to learn by themselves without help from test leaders. However, to improve the experience for first-time users the guessability was improved by providing more information in headings, supporting the "Create item"-button with text and developing an icon for accessing all upcoming meetings. Since an improved guessability would make the interaction for first-time users easier this would also help to facilitate the implementation of the tool into a company as the user would experience less difficulties with it.

In the work with creating the desktop version of the user interface, several desktop interfaces were studied to consider. Hence, it was concluded that the most appropriate placement of the "Create item"-button was at the top of the page in the desktop version (Figure 34). It was probable that this consistency would support mental models that users may have about a software tool and also meant that important functions were easily accessible to the user. Prioritisation of functionality and information has also been considered, not only for the button, but also for the headings in every page.

Visual clarity was considered in the way that all boxes that contained information were different depending on what information they held. For example, the boxes in Figure 33 had one rounded corner whereas the boxes in Figure 34 had two. This intended to help the user to understand that they not only held different kinds of information but also belonged to different parts of the user interface. The boxes also had an arrow on the right side to provide the user with a clue that it was possible to see more information about a meeting or an item.

From the study described in 6.3.1 it was clear that users desired a better understanding of which items were created by themselves. Hence, this was supported by showing from whom the item

was in the boxes and also colour code items that were created by them with a green encirclement (Figure 35). The "Create item"-button was also supported with a "plus sign" to give a hint that the item will be added to the agenda preview. To understand which item was open, this was colour coded with a light green colour (Figure 34) similar to when an email is opened in *Outlook* (Figure 36). Further, the interface was clear with no disturbing elements or colours to enhance visual clarity.

When an item was saved, feedback was provided that stated that the item was successfully saved. The feedback was placed just below the "Save to agenda"- button since it was probable that the user's attention still would be directed to that area. The message was shown for one second, which was observed in the previous test (chapter 6) to be enough for the user to comprehend the message but not too long so that the user starts to worry whether their action has been completed or not. When the feedback appeared, the new item immediately appeared in the agenda preview. Since that item was the one that was open the item had the light green colour from the start (Figure 34).

The green accent colour that was chosen for the interface gave a calming effect for the user and was considered as the colour that was easiest for the eye to accept (Nilsson, 2009). The yellow colour is considered to be an effective colour for attract attention (cf. Nilsson, 2009). It was used for the button to access "Upcoming meetings" from the agenda preview. It was the only yellow element on the page which made it stand out from the rest of the interface. The symbol on the button resembled a calendar and a group of people and was visible to make the user understand that they would be sent to the page for "Upcoming meetings". On the "Upcoming meeting"-page, the dates on the left side (Figure 33) were also yellow to indicate familiarity between the button and the "Upcoming meeting"- page and the same symbol was visible next to the headline.

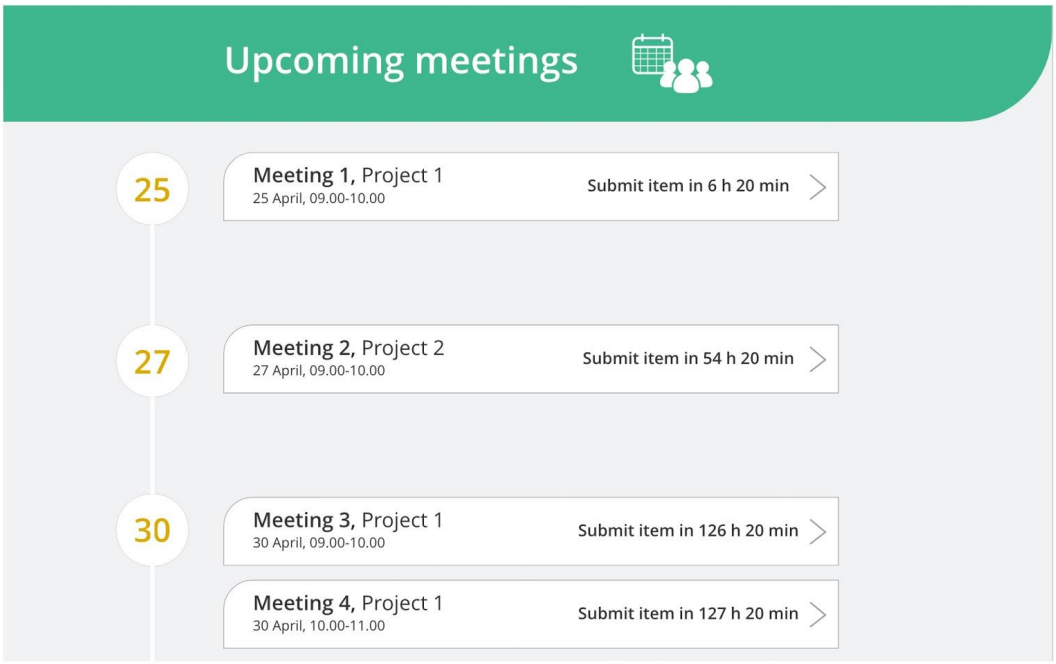


Figure 33: The "Upcoming meetings"-page for the desktop version of the second interactive prototype.

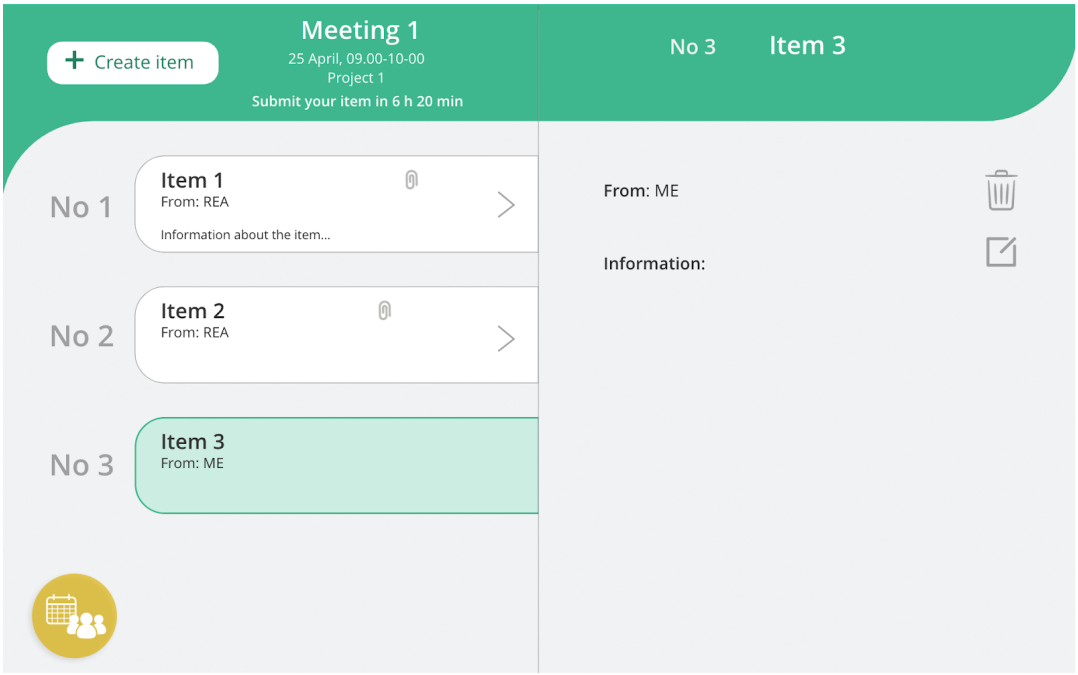


Figure 34: The agenda preview of Meeting 1 for the desktop version of the second prototype.

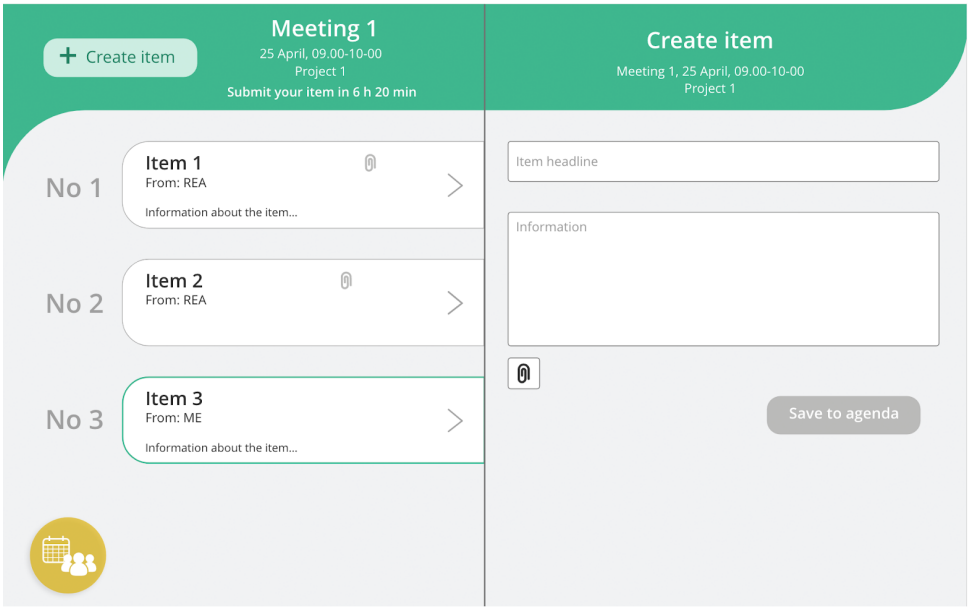


Figure 35: The "Create item"-form for the desktop version of the second interactive prototype

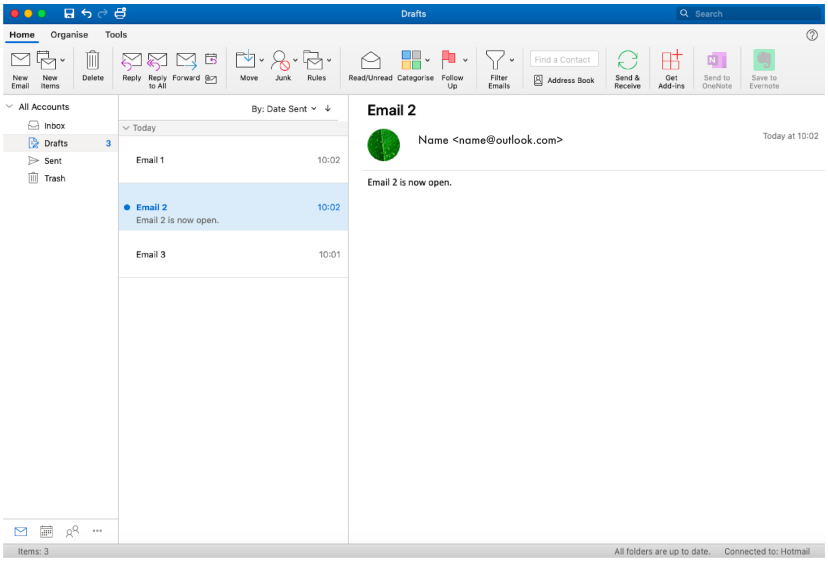


Figure 36: The opened email in Outlook is marked in light blue.

7.3.2 Updated list of design criteria

The updates in the design criteria list are listed in this section. The purpose of the design criteria was to work as a guide for developing the software that was going to be used to build the tool.

Agenda preview

- The tool should contain a preview of the agenda
- The tool should enable users to see what items are posted already
- The maximum number of character visible of an item headline should be 30
    - If an item is longer it is interrupted by "..."
- It should be clearly stated if an item contains an attached file
    - This is marked by a symbol
- All items in the preview of the agenda should be numbered
- The tool should enable users to create items from the preview of the agenda
- The tool should enable users to see that their items end up in the preview of the agenda
- The tool should enable users to see clearly what items that were created by them
    - This is marked by text and a colour code
- The tool should automatically add the name of the creator of an item to the item
    - This is visible for everyone viewing the item
- The latest created item ends up in the bottom of the list of items
- The active item is marked by colour

Create an item

- An item is created into a meeting which belong to a project
- The "Create item"-form should contain: Headline field, a free text- field where additional information can be (if desired) added by the user for further explanation of the item, a possibility to attach files
    - The number of headline characters should be restricted to 50
- To be able to save an item into the agenda preview it should contain a headline

Edit an item

- Anyone can edit an item that is saved to the agenda preview

"Upcoming meetings"

- The upcoming meetings should be visible in a list
    - The upcoming meetings are sorted according to the date for the meeting
    - The visible information of a meeting in the Upcoming meeting list should be: meeting name, the name of the project that the meeting belonged to, date of the meeting, start and end time, how much time was left for submitting items,
- The user should be able to click on any meeting and access the agenda preview

7.3.3 Flowcharts

The flowcharts for the second iteration show three possible ways of interaction between the user and the tool and are presented in this section. They were chosen since they matched with the tasks for the upcoming usability evaluation which were mainly (3) to edit an item (Figure 37) and then ((1) and (2)) create a new one (Figures 38 and 39). The user would always begin by logging in, either via a link from a meeting invitation or directly into the tool. Since both ways were possible, they are represented in one flowchart each. After saving an item to an agenda the user would always come back to the preview of the agenda for the meeting they saved the item in.

(1) After the user has logged in via a meeting specific link and entered the agenda preview the users has two options to create an item. Either they can click the "Create item"-button and the item will be created into the meeting when they save it to the agenda. Or they can click the symbol for "Upcoming meetings" and go via the page where all upcoming meetings are listed. This way was suitable when the user wants to create an item in another meeting than the one the user entered when logging in. They do this by selecting which meeting they wanted to create an item in, and they come to the preview of the agenda for that meeting. There they can create an item by clicking the "Create item"-button and saving it.

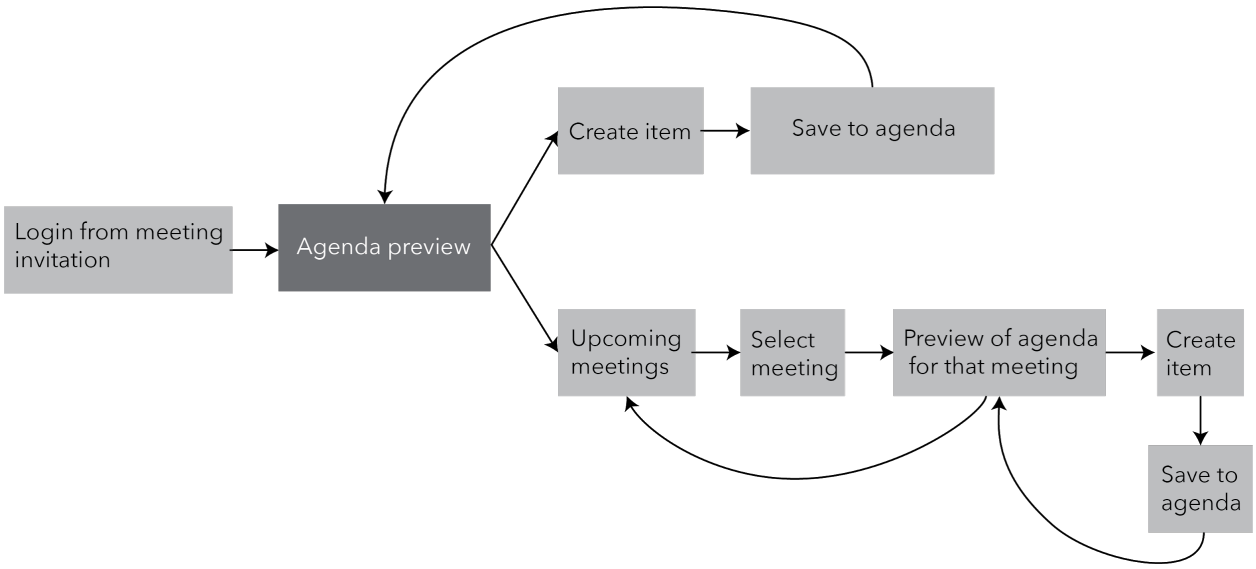


Figure 37: Flowchart (1) showing how users can create an item to the agenda for the meeting they logged in to or to an agenda for another meeting

(2) When the user has logged into the tool without a link to a specific meeting they get to the page for "Upcoming meetings" where all upcoming meetings are visible. They can select a meeting by clicking it and that action brings them to the agenda preview for that

meeting. On the preview page they can click the "Create item"-button and save it to the agenda for the chosen meeting.

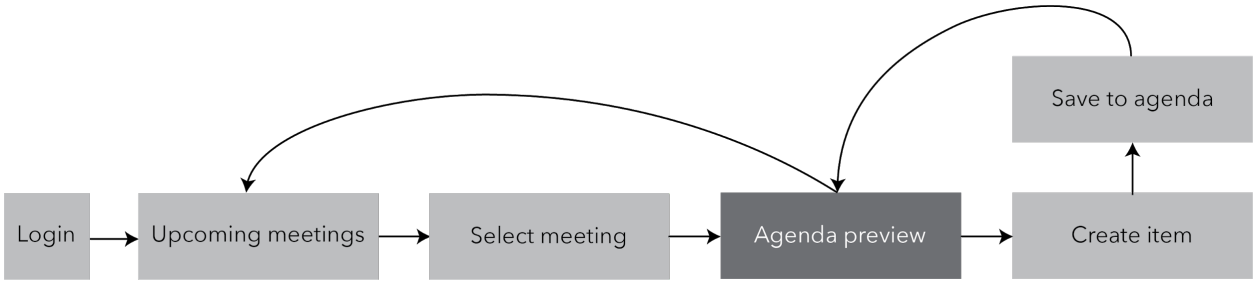


Figure 38: Flowchart (2) showing how to create an item to the agenda when logging in without a link to a specific meeting.

(3) When the user is in the agenda preview for a meeting it is possible to select each of the items to see more information. When an item is opened an "edit"-symbol is visible next to the headline and information. When clicking it the visible item becomes editable and the users can make their changes and then save it to the agenda for that meeting.

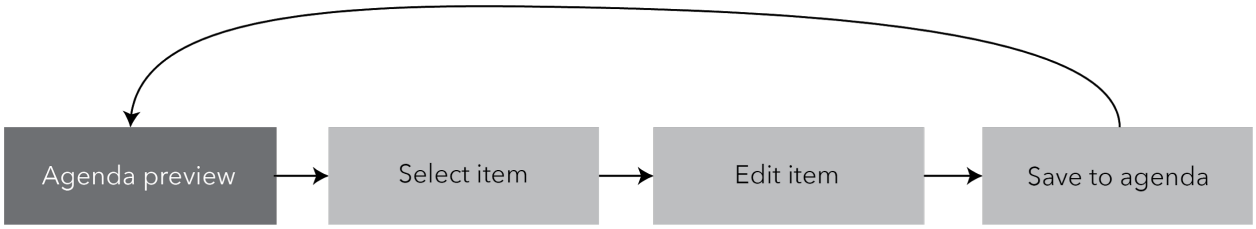


Figure 39: Flowchart (3) showing how to edit an item that already exists

7.3.4 Entity relation diagram

The entity relation diagram is shown in Figure 40. The only difference compared to the entity relation diagram from the first iteration (section 5.3.2) is that the "Item list" was replaced by a preview of the agenda to not make the users believe that the "Item list" and the agenda contain different things when they actually contain the same items.

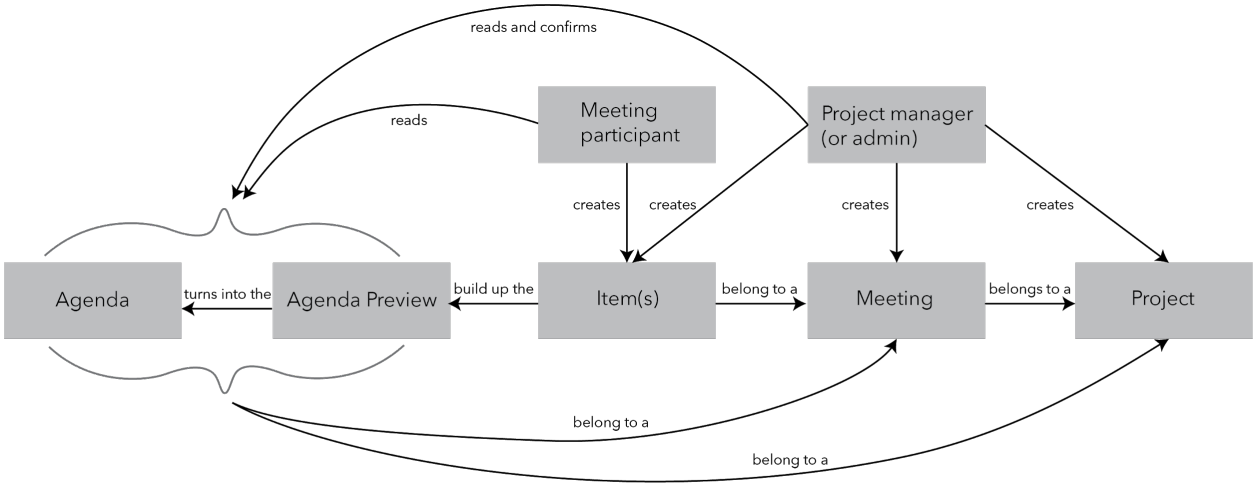


Figure 40: The entity relation diagram for the second iteration

7.3.5 Cognitive Walkthrough and Predictive Human Error Analysis

The complete results of the CW and PHEA are presented in Appendix D. The errors that could occur, were judged to occur mostly by mistake or that the user was distracted which was assessed as something difficult to avoid. Instead there was a large focus in the development on recovering mistakes and providing information whether a task is fully completed and providing clear feedback if it was not for example, by showing a warning message that the user was about to exit the creation of an item.

7.4 Conclusion

The entity relation diagram and the flowcharts were updated for the development of the second prototype to fit their purpose of making it easier to understand the flow during interaction and working as a base for the development of the working tool. The main update for the entity relation diagram was that the “Item list” was from now on called agenda preview to make sure that the user understands the purpose and the content of that entity.

From the CW and PHEA it was probable that most use errors are mistakes which might be difficult to prevent. Hence it was seen as important that it was possible to easily recover them. This was focused on during the development of the second prototype and it was possible to continue with that focus also in the following prototype.

8. Usability evaluation 2

The second interactive prototype developed (described in chapter 7) was evaluated and it is described in this section. The tests were performed with the desktop version of the interactive prototype since this was considered as the most important to develop at this stage. The aim, procedure, result and conclusion and design implications of the second usability evaluation are presented in this chapter.

8.1 Aim

The aim of the second usability evaluation was to identify usability problems and factors making the implementation of the tool difficult.

8.2 Procedure

The usability tests were conducted with ten persons with varying backgrounds, from students to employees at SKF, Boeing and HiQ. For these tests a desktop version of the interface was developed and tested. Some test participants were chosen from the previous tests (chapter 6) and the tests described in this chapter therefore included within some subjects-tests, which was a good way to gather insights as this allowed a comparison between the different interfaces. The number of recurrent participants were four.

Also in case, the desired use context for the test and intended place of use was an office environment with some noise and people moving around the user. The context was simulated, and tests were performed in public indoor areas with people around for example, cafes and restaurants. However, for this test round some tests were performed digitally as well. This, however, was not believed to have affected the result too much as a desired level of surrounding distractions was achieved in the digital tests as well as the test participants were at their home or in another office.

The scenario presented was the same as in the previous test (Appendix B) but the date and meeting name had changed. After the presentation of the scenario, test participants got four tasks which were presented one at the time. The participants were asked to indicate when they believed to have completed the task. The tasks were:

1. Log in to the meeting: Bottle distance in the project: Juice Factory.
2. You have previously added an item. You want to add some information to it.

3. Add an item to the meeting: Bottle distance. Your item is a question to the meeting about what types of bottles that should be allowed. You also want to add some additional information about your item.
4. You are responsible for planning an After Work for your project group Juice Factory, but you have forgotten the date for the planning meeting. Find the meeting and the date for the meeting.

To relieve load from participants' memory so they could focus on the test, they were given written notes with the relevant information about the project and meeting as well as the tasks they were to perform. This was, however, not possible during the digital tests.

To save the data from participants' interaction, the computer screen on which tests were performed was recorded. Further, subjective and objective factors were measured to get a broad data collection. Objective measurements consisted of the number of errors and the number of times the participant asked for support or were given it by test conductors as they noticed that the participant would not be able to proceed without assistance.

The subjective factors were collected by semi-structured interviews after each test. They questions were similar to the questions asked during the first usability evaluation (chapter 6) but, adjusted to the new interface. Mediating objects, that were sent to the participants, to support their memory was also used in this test. The participant got a paper with three views from the interface to easier be able to think back at their experience. Furthermore, the test participants got to fill out the same semantic differential scale (Figure 41) as in the previous evaluation.

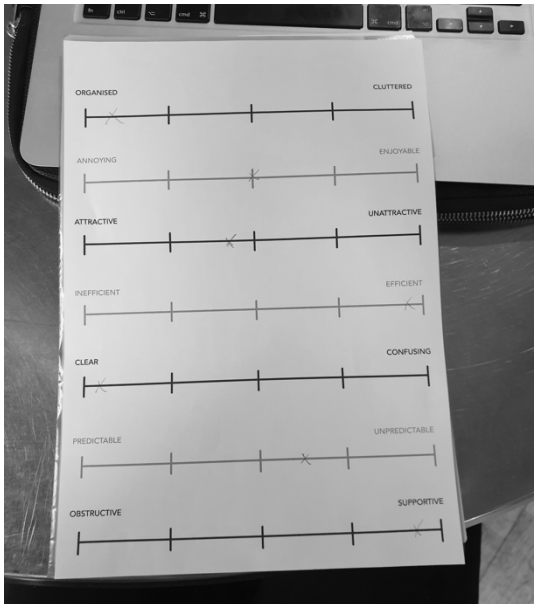


Figure 41: The semantic differential scale filled out by a participant during the second evaluation

The tests were analysed by making an affinity diagram based on the data collected. All relevant statements were written down on post-its and paired with similar statements to create categories of problems. The ratings in semantic differential scales were put together into a table to be able compare the results from each participant and the results for each of the adjective pairs.

To ensure that the tool provided a good use experience for as many users as possible, the contrast between the text and the background was evaluated. This was mainly done by testing

the prototype with potential users but due to a lack of users with decreased eyesight the *Adobe XD* plug-in software *Stark* was used as an add on (cf. Stark, 2020). The areas of the screen that were tested were the most critical areas. These areas were selected based on the fact that they were the ones containing the longest pieces of text as this requires a higher contrast for the user to have a good experience while reading. The chosen areas were:

(1) The button for creating an item (Figure 42, left)
(2) The green board with information about the meeting (Figure 42, middle)
(3) The information text about the item (Figure 42, right)

The chosen areas of background and overlaying text were selected one at a time and ran through the *Stark* software. A ratio of the contrast between the selected background and text was presented. The software also showed which of the ratios that were approved or not which is dependent on whether or not it reaches the lower one of the two levels for contrast checking; AA and AAA. AA is the lower level and requires a ratio of 4.5:1 for normal text and 3:1 for large text. AAA requires 7:1 for normal text and 4.5:1 for large text (Noone, 2020).

8.3 Result

The results for the second usability evaluation are presented in this section.

8.3.1 Contrast check

The tests with potential users showed that the contrast between text and background was good since no one had difficulties discovering or reading the text in the prototype. The result from the contrast check with the *Stark* software is:

(1) The button for creating an item: The contrast is 4.81:1 (Figure 43) which means that it is sufficient for all text sizes on the AA level and for large text on the AAA level.
(2) The green board with information about the meeting: The contrast is 2.52:1, hence not approved by *Stark*.
(3) The information text about the item: The contrast is 11.27:1 which means that it is sufficient for all text on both levels.

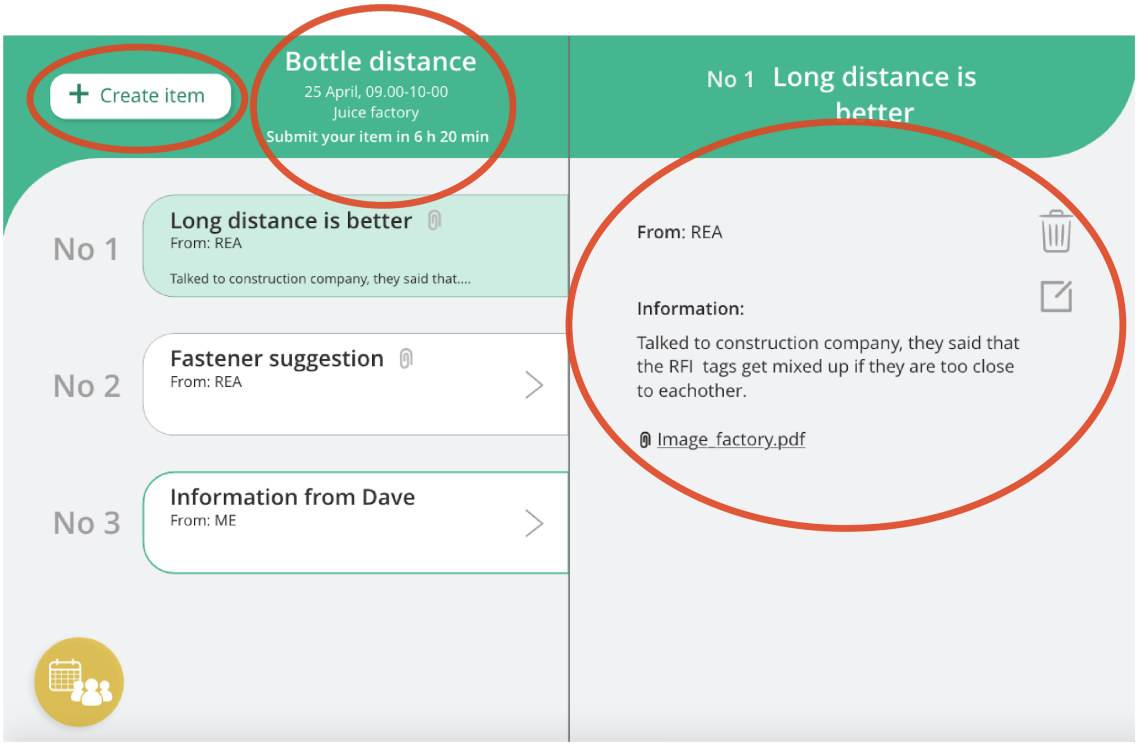


Figure 42: The three areas of the prototype that were chosen for the contrast test

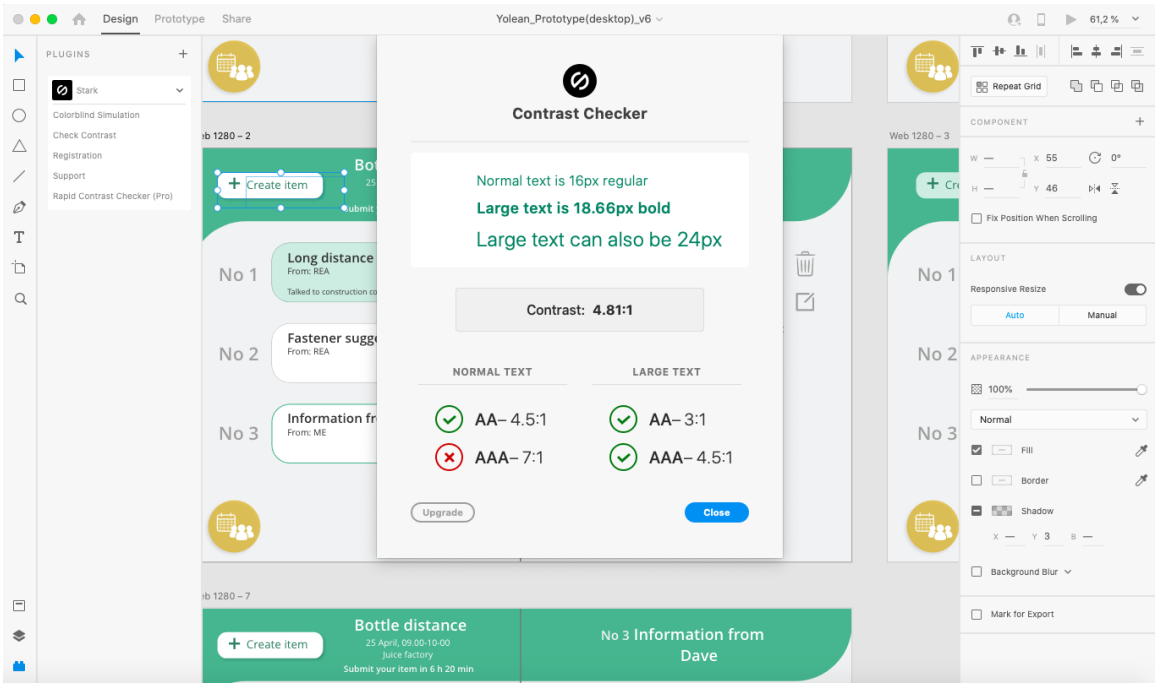


Figure 43: The result of the contrast check for the first area; the "Create item"-button

8.3.2 Identified problems

In this section, a summary of the findings from the analysed the data is presented. It was done using an affinity diagram (see Appendix E).

- Not sufficient or clear enough information: Participants thought that there was too little information in the agenda preview and wanted to be able to access some kind of overview of the meeting. Also, a few participants still had trouble understanding from whom an item was when seeing it in the agenda preview. No one understood directly what the green frame meant. They also desired to see the month on the left side of the "Upcoming meetings"-page and that it should state the day in the meeting information. This was since it was difficult to get a quick overview.
- Time for submitting item: Participants had trouble comprehending a big number when figuring out how much time they had left for submitting an item.
- Calendar view: Participants desired a variety of ways to see their calendar. They wanted to be able to switch between different views and specifically requested a matrix calendar view.
- Comments on the visuals: A lot of comments from participants were about the interface not looking finished, immature or that they felt locked in due to the lack of functions. They also found elements in the interface too large, such as the white box for items.
- Interface hierarchy: Participants wanted the meeting headline to take up more space than the items.
- Desired functions and notices: Other input from participants concerned how the tool should be integrated with already existing tools and how transitions between pages should work. The participants also highlighted that they wanted the tool to be the only tool for meetings. One participant said that if they had uploaded a *PowerPoint* file to the item they did not want open *PowerPoint* on their computer to show it, but it should lay directly in the tool or be possible to open from there.

8.3.3 Assessment of subjective and objective factors

The result from the semantic differential scale is summarised in Table 2. The table shows the actual score per participant. The participants who are marked with an "x" also participated in the first evaluation.

The result shows that what was most in need of improvement was to make it more enjoyable for the user to use the tool. Those participants who also participated in the first evaluation gave a

higher score for the second evaluation. The average total score per person was higher than for the first iteration; 22.3 compared to 20.1.

	P1	P2x	P3	P4x	P5	P6	P7	P8	P9x	P10x	TOTAL:
organised- cluttered	3.5	3	4	3.5	3.5	3.5	2.5	3	3.5	3.5	33.5
enjoyable- annoying	2.5	2	4	3	3.5	3	3.5	2.5	3.5	3	30.5
attractive- unattractive	3.5	3	3.5	3	3	2.5	2.5	3.5	4	3	31.5
efficient- inefficient	3	3	4	3.5	3.5	3.5	3.5	2.5	3.5	2	32
clear- confusing	2.5	3	3.5	3.5	3.5	3	2.5	3	4	3	31.5
predictable- unpredictable	2	4	3.5	2.5	3.5	4	2.5	2.5	4	3	31.5
obstructive- **supportive**	2.5	2	4	3	4	3.5	3.5	3	3.5	3	32
TOTAL:	19.5	20	26.5	22	24.5	23	20.5	20	26	20.5	222.5

Table 2: The result of the semantic differential scale used in the second usability evaluation.

For the objective measures, there was two interaction error that the user succeeded to recover. There was no case when the participants asked for help.

8.4 Conclusion and design implications

The results of the evaluation were overall positive. The participants appreciated the colours and they thought that the tool was visually appealing and easy to learn and use. The previous problems about the users not understanding where they were in the tool and what the agenda preview was, were now largely solved. Now, test participants desired to know who was participating in the meeting, where the meeting would be held and from whom the item was, so this was something that was considered in the following parts of the project.

The contrast of the screens was tested with the *Stark* software for the most critical areas and for one of them the result indicated that the contrast might need to be adjusted to not risk discomfort for people with less good eyesight. This specific area was the green board with white text presenting the meeting details (Figure 42 in section 8.2). However, as none of the test participants commented that the readability was poor this was not considered as a strong enough incentive to change the colours of the text and background in the next prototype.

A common issue during the second evaluation was that the participants had trouble understanding how much time that was left before the item submission closed. This was because

the time was presented in hours which led to that the number which represented the time left for submission became very high when there were several days until a meeting would take place. This made it difficult to relate to for the users. For the following prototype the time has to be presented so that users easily understands it.

Another frequent topic that came up during the second evaluation was the calendar view. Even though it was highly requested from the participants to be able to switch between different calendar views it was concluded, after analysis, that this would compete too much with other calendars that were already used by employees. This would not be beneficial for the acceptance as it was important that the purpose of the tool was kept clear. Hence it was not considered in this iteration.

It was requested from the users to make the interface look more finished as it was considered immature due to the large and few elements in the prototype. This should be considered when developing the third prototype as well as making the hierarchies between text elements clearer.

From the analysis of the results it was clear that most participants succeeded to easily locate an item they had created. However, the reason for understanding this was because they could read "From ME" in the item. It was requested from participants in the first evaluation (chapter 6) that which items were from themselves should be clear. However, most participants did not comment on the green frame encircling their items in the second prototype, and it did not support them in understanding which item that was theirs. In the cases they noticed the frame they could interpret the meaning after giving it some thought. Hence, how to present items that were created by the user in a clear way should be considered when developing the next prototype.

According to the semantic differential scale, it was noted that "enjoyable" still got a lower score than the other expressions. However, it was concluded that this was due to the chosen adjective as the participants said that a tool will never be enjoyable to them no matter how good it was. Also, it might not be good for it to be too enjoyable since it is a tool that will be used in a work environment and could easily become an unwelcome distraction.

Lastly, it was requested by users and by Yolean to explore how a meeting view would look like. This input was considered in the third prototype and is a good opportunity to explore another perspective of the use case.

9. Interactive prototype 3

The insights from the second evaluation were taken into consideration in the development of the third and final interactive prototype. This chapter contains the aim, procedure, result and conclusion for that development.

9.1 Aim

The aim was to, based on the results from the second evaluation (chapter 8), develop the third interactive prototype that could work as a basis for developing a working tool.

9.2 Procedure

With the result from the second evaluation (see section 8.3) as a starting point the third interactive prototype was developed. The first step was to choose problem categories identified in the affinity diagram (Appendix E). The categories were chosen based on severity and frequency so that the most important problems could be targeted. This was decided based on how much the problems hindered the use case from being performed efficiently and had worked well in the previous development as a way of targeting the right problems. In a few cases for example, regarding the calendar view internal discussions by the authors of the thesis were held to determine its value for the concept and then either accept or leave it.

9.2.1 Defining design direction

There were many suggestions to increase the fidelity of the prototype by introducing more functions. It was internally concluded that the development was mature enough to introduce further functionality in the scope and the function "Save for later" was introduced and developed. As a natural consequence of this, a way to find and see saved items was required and was developed during this iteration. Further, a meeting view was brought in as this was requested by participants as well as by Yolean. It was concluded in internal discussions that this was a good idea as it would close the loop of the use of the tool. In the meeting view the possibility to assign an owner was brought in as this function was already decided (see section 7.3.1). The last functions that were added to increase the fidelity of the tool were the possibility to log out from the tool as well as offer the user to make some personal settings.

9.2.2 Ideation

Once the new changes and additions had been decided the ideation started. For this ideation process, Braindrawing was used (Figure 44). The issues were written down on paper and possible

solutions were suggested and drawn to explain them. Some problems were handled in parallel as they affected each other to such a large extent that it was deemed more efficient to ideate on them at the same time. There was no specific time limit set for the Braindrawing as the process naturally slowed down and it was decided within the group to move on. When a large quantity of ideas had been achieved, the method Scamper was used to further explore the ideas. There are certain questions connected to the Scamper method (Wikberg Nilsson et al., 2015), they were asked on different aspects of the user interface and the ideas were further developed. Finally, the best ideas were selected. They were chosen based on how well they solved the problems and discussions were held internally to evaluate how successful they would be.

Figure 44: Braindrawing during the third iteration.

Quick studies of existing interfaces were made alongside with the ideation. The purpose of this was to get an understanding of where functions such as settings and profile were usually placed in an interface as well as other important functions. In particular, desktop interfaces such as *Outlook*, *Gmail* and *Spotify* were studied as these are used by a large number of people. The next step was to update the flowcharts, entity relation diagram and the list of design criteria to keep up to date with the changes that were made in the user interface.

When a clear image of what the new interface should look like and how the screens should be linked had been established, the prototyping in *Adobe XD* was initiated. At this stage some further development was made and Braindrawing actions were held as new questions arose during the work for example, what should happen after an item that was saved for later was saved to the agenda. For this iteration a desktop version was developed and also a test version of that prototype. The test version of the prototype was evaluated by means of a CW and a PHEA and later used to evaluate the usability of the third user interface with people.

9.3 Result

This section covers the result for the development of the third interactive prototype. The results consist of the prototype, updated list of design criteria, flowcharts, entity relation diagram, CW and PHEA.

9.3.1 Third interactive prototype

In this section the third interactive prototype will be explained. As a lot was similar to the second interactive prototype (section 7.3.1) only the updates will be explained here, all other parts were assumed to work the same way. The final concept will be explained in chapter 12.

Figures 45, 46, 47 and 48 show the result of the third iteration. The prototype consisted of a list with the "Upcoming meetings", agenda preview, "Create item"-form, "Edit item"-form, "My saved items"-page and a meeting view. What was added was an upper border where functions connected to settings and personal profile were placed to the right hence, it was likely that it would match with the users' mental models since this is consistent with interfaces the users are familiar with. In the border the user could navigate back and forth between pages, access the "Upcoming meetings" page and a personal menu. From the personal menu the user could navigate to a settings panel, "My saved items" or the possibility to log out. What settings the user could perform was not defined as it lied outside the scope of the thesis project. However, the "My saved items"-choice opened the "My saved items"-page.

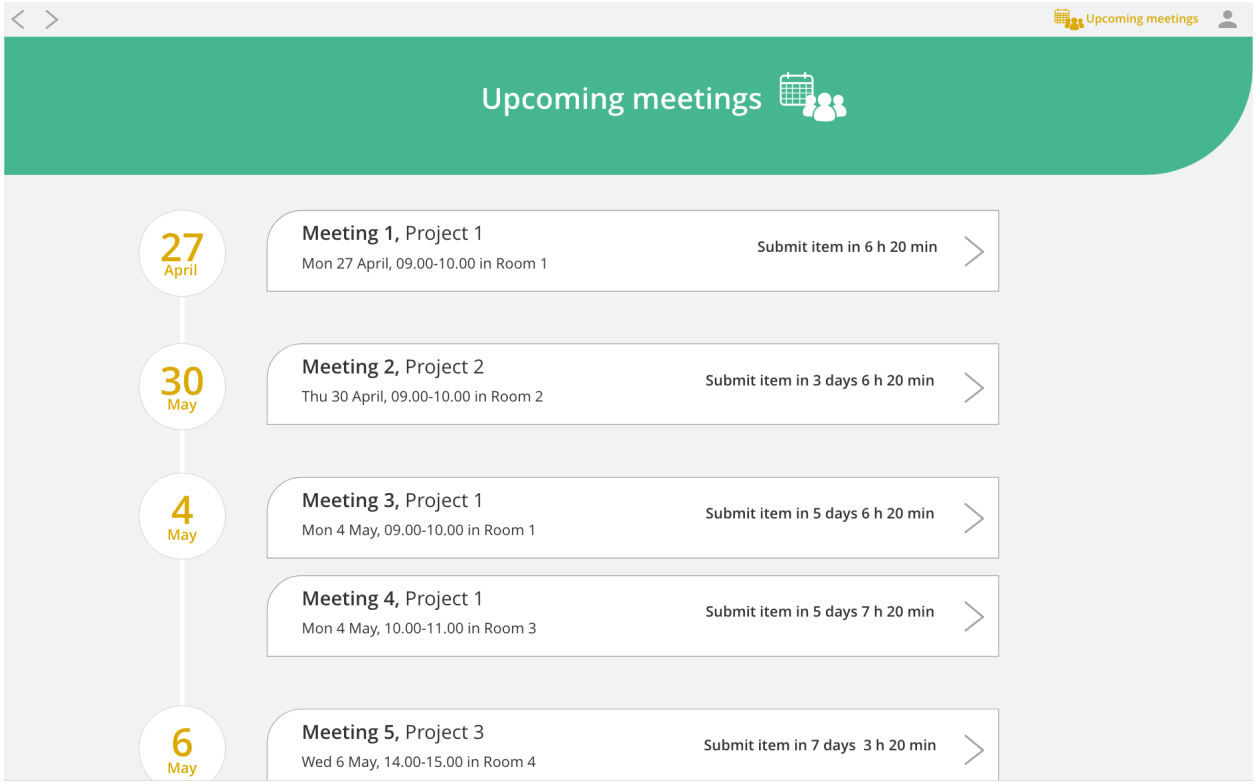


Figure 45: The "Upcoming meetings"-page for the third interactive prototype

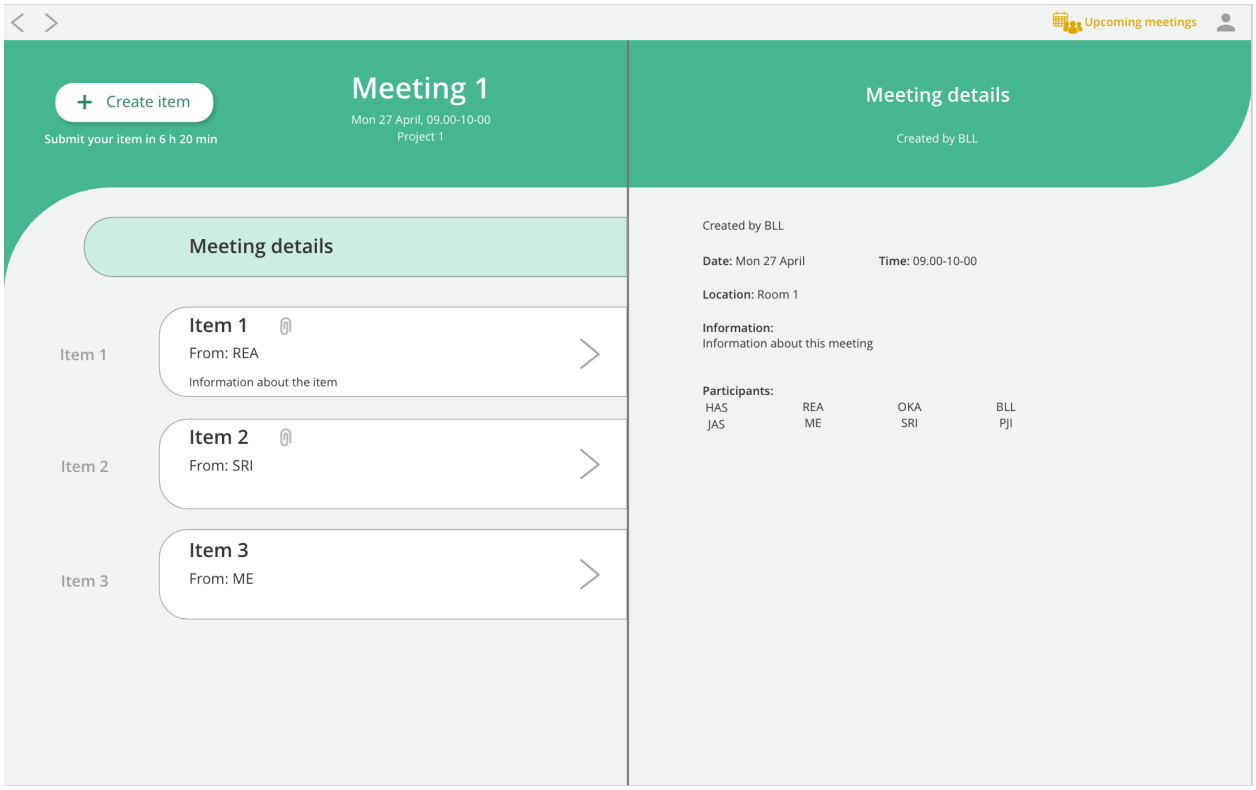


Figure 46: The agenda preview for Meeting 1 and the meeting details for the third interactive prototype

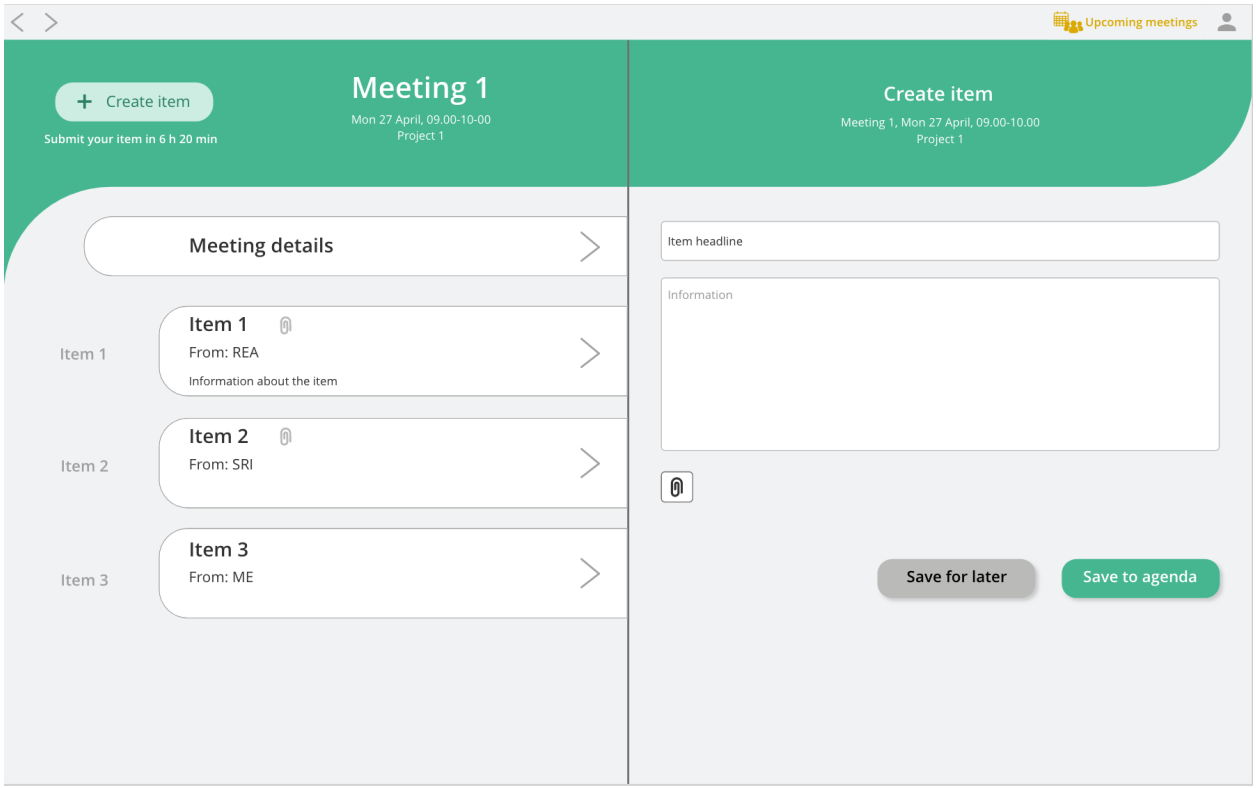


Figure 47: The agenda preview for Meeting 1 and the "Create item"-form for the third interactive prototype

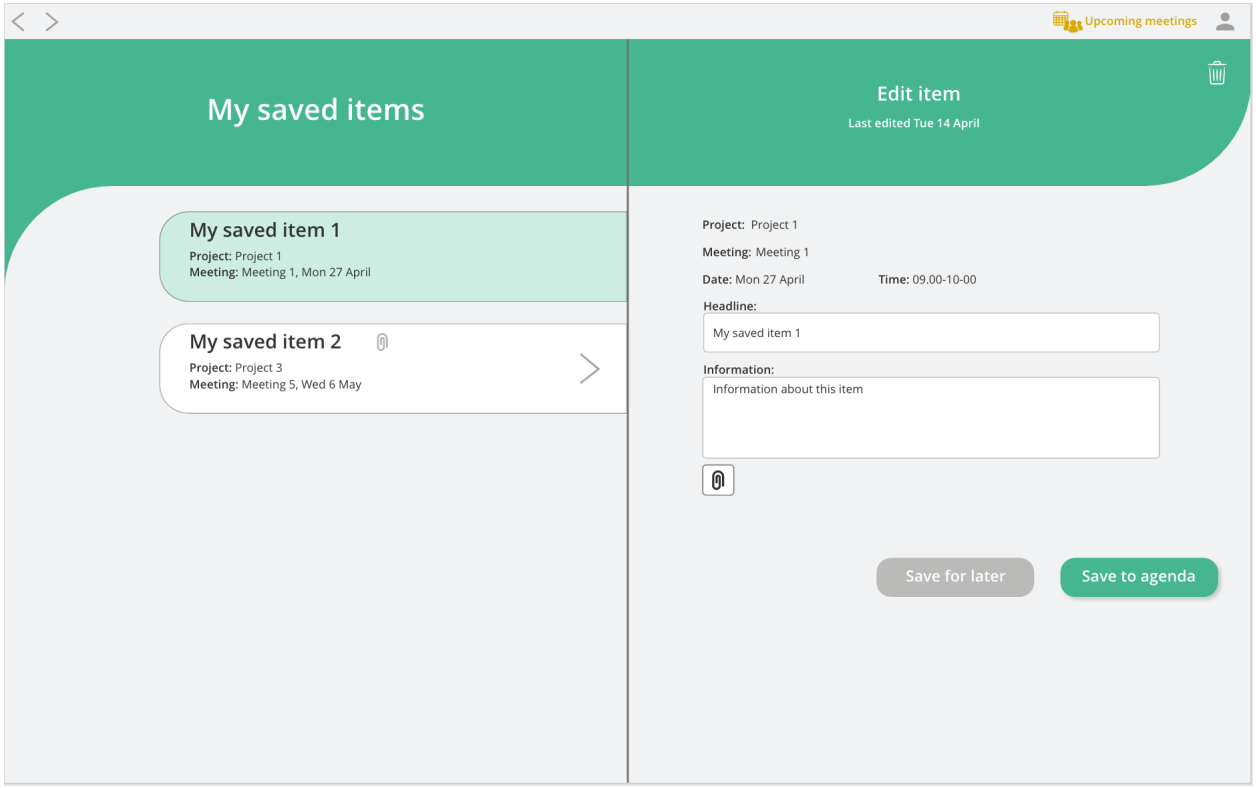


Figure 48: The "My saved items"-page for the third interactive prototype

The look of the "My saved items"-page was similar to the look of the agenda preview page but, at this page all the user's saved items were listed to the left instead of the items from every project member. At the right side an expanded view of the selected saved items was shown. The expanded view showed the item's headline, date when it was last edited, which project it belonged to, which meeting it belonged to, the day and date for the meeting, the start and end time for the meeting and potential information and attached files. Here, the user could also edit the item headline and information or delete the item. The purpose of the "My saved items"-page was that the user could enter it and edit and save items into different agendas depending on which meeting they belong to. As they were listed in one list the user could easily work with their saved items. When the has user saved the item to the agenda it would appear in the agenda preview for the specific meeting. The "My saved items" - page was personal to the user, which means that only the user could access the page and manage the items in its list.

Since there was now a possibility to save items for later, a button for doing so was added to the "Create item"-form and placed next to the "Save to agenda"-button. An item that was going to be saved for later had to minimum contain a headline. This was a constraint so that the user should not accidentally save an empty item. When an item was saved for later the user was provided by feedback in two ways (see Figure 49). The first was the same as when an item was saved directly to the agenda, namely a message just below the "Save for later"-button that states that the item was successfully saved. In the second usability test (see chapter 8) the feedback was shown for one second and this solution was used for this feedback message as well. When an item was saved for later, the item was saved to another page that was not immediately visible for the user when they created an item. Hence, it was desired to give an indication of where the item ended up. The feedback used for this feature was that the personal menu icon was lit up for one second. In this way the user would draw the connection between their saved item and the personal menu. When the user opened the personal menu to access the item they would see text and a symbol telling the user that their saved item would be on a page in that menu.

In this iteration, what happens after the possibility to submit items to the agenda closes, was explored. As previously when the time for submission had ended, the user would no longer be able to add new items. It was still possible for the user to see the agenda preview but the "Create item"-button was replaced with an "Enter meeting"-button and a text under it that told the user that the agenda was closed for submission. The button had a constraint so that the user should not accidentally enter the meeting too early and hence, the action was not executed if it was clicked on. This was clear to the user as its appearance looked the same as when the function for creating an item was not available (Figure 50). When the meeting had started the button looked interactable again and the text below the button told the user that the meeting had started and

that it was possible to enter the meeting. This is consistent with Jordan's design principle on consistency (see section 3.4.2).

The meeting view as a concept was also explored. What was concluded, was that the meeting view would only be accessible when the meeting had started. Once the user had entered the meeting they would be able to see the agenda items and it would be possible to assign an owner to an item. The meeting view would be in real time as the meeting proceeded, for example, when an owner was assigned this would appear immediately for all users that were in the meeting view. It would also be possible for the user at any time to exit the meeting and come back to the agenda preview.

It was clear from the tests described in chapter 8 that the "Upcoming meetings"-symbol and the yellow colour worked well for the participants. Hence, this was considered when the "Upcoming meetings"-button was moved to the upper border. In this iteration the symbol was also supported by a text saying "Upcoming meetings" to help users to find it as the symbol was smaller than it was in the previous prototype (section 7.3.1).

When entering the "Upcoming meetings"-page the user saw more information about the meeting directly and the time left for submission was easier to comprehend. This was requested by the participants in the second usability evaluation (section 8.3.2). Also, in the agenda preview users wanted to see more information about the meeting. So, for the third prototype, at the top of the screen there was a tab where meeting details were listed. The meeting details also improved the guessability of the user interface as it was clearer that the user had entered an agenda. This tab was different from how an item tab looked, it was slimmer and longer and was not numbered. In this way the user could easily separate the two types of tabs in the agenda preview. The meeting details were prioritised and contained information that was important for the user to know why, it was placed at the top where it was more easily noted.

Further, the green frame indicating that an item was from the user was removed in this prototype. During the second usability evaluation (section 8.3.2) test participants had problems understanding what it meant. It was also unnecessary since when participants were asked to locate their own item from the list all recognised their item from the text "From ME". Another update participants requested was to be able to see who last edited an item. Hence this feature was added and placed just below the item headline to the right (Figure 51) so that the information was easily available to the user.

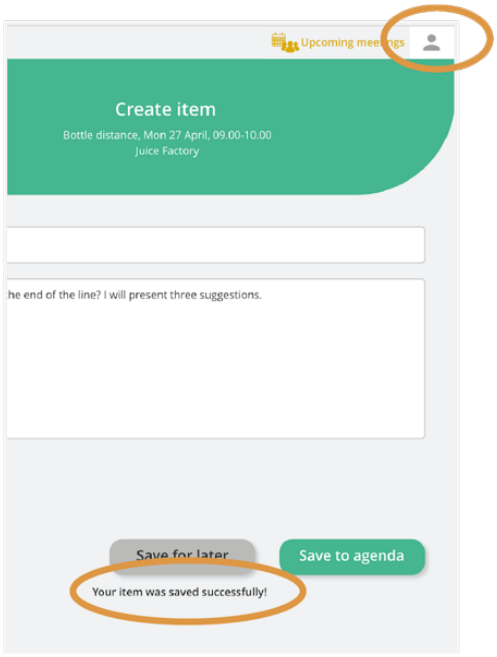


Figure 50: Feedback was given both in text and visuals when saving an item for later

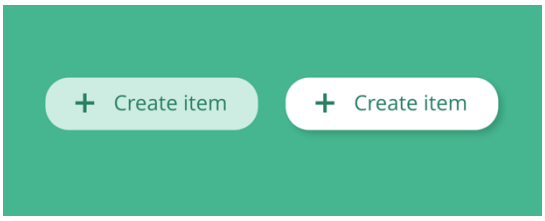


Figure 49: The "Create item"-button when it was deactivated (to the left) and activated (to the right)

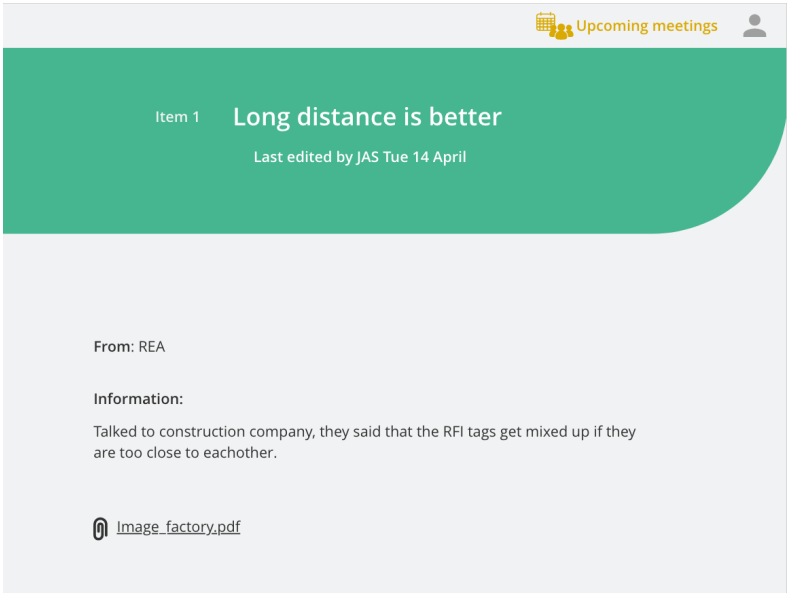


Figure 51: The person who last edited an item was shown below the item headline. For this example, it was JAS.

9.3.2 Updated list of design criteria

The new updates of the list of design criteria in section 7.3.2 are stated in this section. A few updates have been made on the basic pages and function but for this iteration the function "Save for later" was added and hence a "My saved items"-page. The purpose of the list of design criteria is to work as a basis for developer when the tool is developed.

Upcoming meetings

- "Upcoming meetings" should show day and date and location for the meeting
- Once the meeting has started it should be possible to access the meeting view directly from the meetings in "Upcoming meetings"
- If the time for submitting items is longer than two weeks, the time left for submission should say "More than two weeks to submission closing"

Agenda preview

- When entering agenda preview the meeting details should be immediately visible
- Meeting details should include: creator of meeting, day and date for meeting, start and end time, location or whether it was digital or not, information about the meeting, meeting participants.
    - An open item in the agenda preview should show: item headline, item number, the person who edited the item last and when it was edited last (day and date), the creator of the item, information (if it exists), attached files (if they exists), options to edit or delete the item

Create an item

- It should be possible to save an item for later
- To be able to save an item for later it must contain a headline
- When an item has been created, the creator should be stated after "From"

"My saved items"

- Should contain a list of the users saved items
    - An item that was saved for later should contain: the date it was last edited, which project it belonged to, which meeting it belonged to, day and date for the meeting, start and end time for the meeting, item headline, item information (if it exits), attached files (I f they exists)
- Should provide options to edit or delete an item or to save an item to the agenda or save it for later
    - It is only possible to edit: the item headline, item information, attached files
- An item in the "My saved items"-list should contain: item headline, project it belonged to, meeting it belonged to, day and date for the meeting

Edit an item

- If an item has been edited the name of the latest editor should be visible in the expanded view of the item.

Upper border

- Should contain
    - Step back and forth
    - "Upcoming meetings"-button and a personal menu
    - A personal menu which contained: settings, "My saved items", "log out".

Meeting view

- The meeting view should open when the meeting started
- It should consist of a list of all items that has been created into the meeting beforehand
- When opening an item, the item information should be visible
- It should be possible to assign an owner to an item
- It should be possible at any time to exit the meeting and come back to the agenda preview

9.3.3 Flowcharts

For the third interactive prototype the flowcharts were updated to fit the tasks for the upcoming evaluation. The tasks were to (1) create an item and save it for later (Figure 52), (2) find the saved item (Figure 53), add an image to it and save it to the agenda and (3) enter a meeting that would soon start (Figure 54). The two ways of logging in to the tool and how to create an item and directly save it to the agenda remained the same as in the second prototype therefore these steps were not included in the three new flowcharts. For these flowcharts it was assumed that the user logged in via the link from a meeting invitation and hence got the agenda preview for that meeting as their first page (dark grey).

(1) When the user wants to create an item but not yet post it to the agenda it is possible to save it for later in a list of items that was personal to that user. The steps until the item is created are the same as for the second prototype (see flowchart (1) in section 7.3.3).

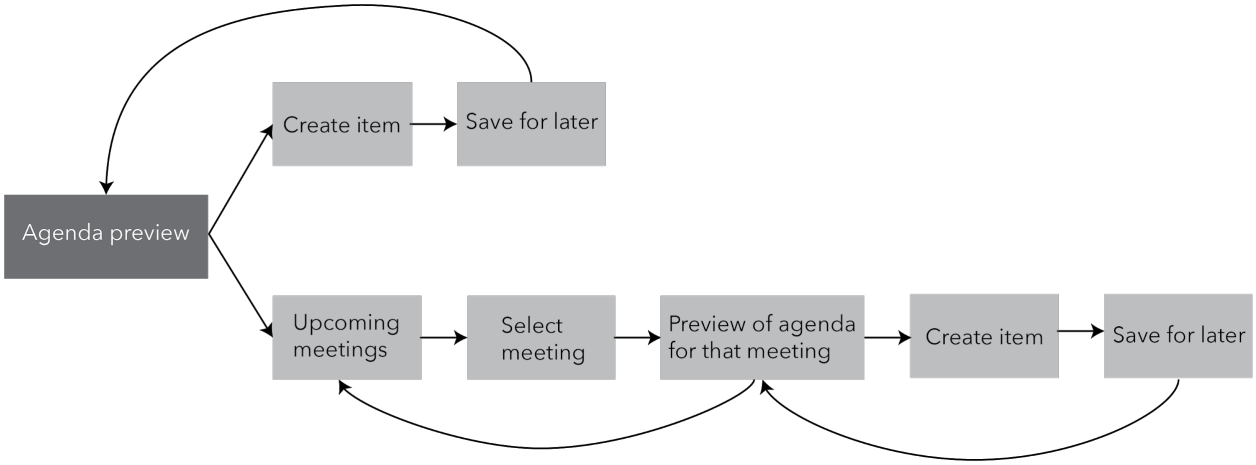


Figure 52: Flowchart (1) showing the two possible ways of how to save an item for later

(2) If the user wants to add a saved item to the agenda they can go to their personal menu in the top right corner and select "My saved items". They then get to a page with all items they have created and saved for later. When selecting one of them they get the possibility to edit it and then choose between saving it for later once again or saving it to the agenda.

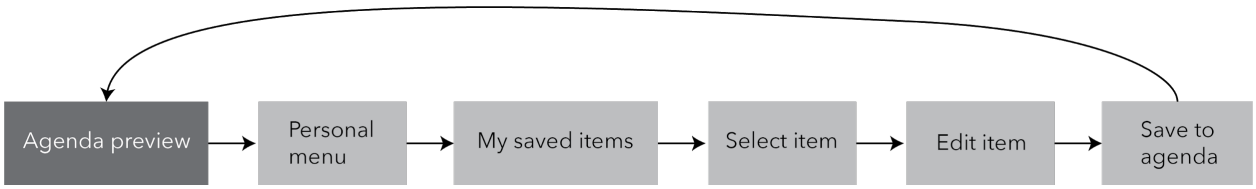


Figure 53: Flowchart (2) showing how to find a saved item, edit it and save it to the agenda.

(3) When the agenda for a meeting close, 24h before the meeting was scheduled to start, a new button appears where the button for creating a new item was. The new button says "Enter meeting" but is not clickable until the meeting actually starts and it is possible to enter it. Inside of the meeting view the user sees all items that would be discussed during the meeting and information about them.

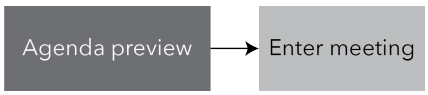


Figure 54: Flowchart (3) showing how to enter a meeting that had started.

9.3.4 Entity relation diagram

The entity relation diagram for the third and final interactive prototype got two additional entities compared to the previous diagram (section 7.3.4). These were "Saved item(s)" and the meeting

view. The remaining entities and connections are the same as for the second entity relation diagram. How the different elements of the system are related to each other was explained in this section and shown in Figure 55.

When the meeting participants and project managers created items, it is possible to save them for later which makes them into "Saved items". As well as for a regular item "Saved items" do also belong to a meeting and a project. When desired it is possible to add a "Saved item" to the agenda preview which will turn into the agenda when the meeting has started. The agenda shown in a section of the tool is called meeting view, which is only accessible when the meeting had started.

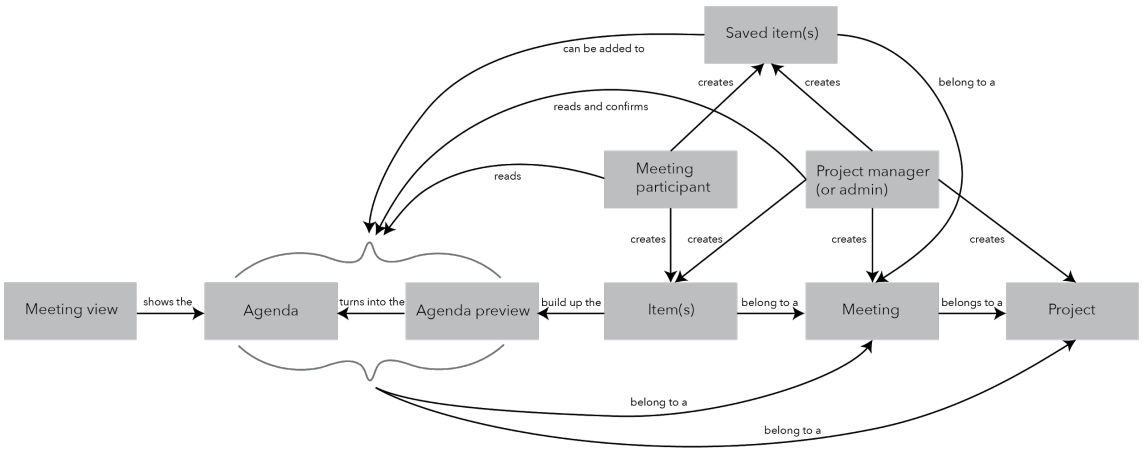


Figure 55: The entity relation diagram for the third iteration

9.3.5 Cognitive Walkthrough and Predictive Human Error Analysis

The full documentation of the CW and PHEA for the third iteration can be found in Appendix F. Some errors were, from what was observed during the first and second usability evaluation (section 5.3.3 and 7.3.5), not likely to happen but could occur during the interaction with prototype number three as well as with the first or second prototype. These errors were not included in the third CW and PHEA since they had already been noted previously in the first and second version. An example of such errors could be to close down the page with the tool.

9.4 Conclusion

As desired by users and by Yolean, a meeting view was developed for the third prototype. However, this iteration only provided a loose idea of what it could look like and how it would work. What was more important in this iteration was to understand the reaction from the user when transitioning from the agenda preview to the meeting view, hence this should be tested.

The flowcharts and the entity relation diagram were updated to fit the new prototype and they were to work as a base for the development of the real prototype. What was new for the third prototype was the "Save for later"-function and the meeting view which would both be tested in the third evaluation.

What was new for the third version of the CW and PHEA was mostly errors that were results of that the user did not completely understand the method of how the tool was supposed to be used. For example, that the user could save the item directly to the agenda when they were supposed to save it for later and that they did not understand that they should enter the meeting view, hence they stayed in the agenda preview.

10. Evaluation 3

In the third and final usability evaluation the desktop prototype developed in chapter 9 was tested. The aim, procedure, result and conclusion and design implications are presented in this chapter.

10.1 Aim

The aim of the usability evaluation of the final interactive prototype was to find out weaknesses both with the usability of the tool and the method of use which will work as a basis for the implementation support that will be developed in the next part of this thesis project.

10.2 Procedure

The third round of usability tests were conducted with seven persons. The test participants had varying backgrounds, from students to employees at SKF, Boeing, Trivec, HiQ but this time also FlexLink. The number of recurrent test participants was three.

The desired context and the intended place of use was throughout the thesis an office environment with some noise and people moving around the user. For the third evaluation the context was simulated, and all tests were performed digitally via Skype, WebEx or Microsoft Teams hence, the context for the digital tests could not be controlled.

The scenario presented was the same as in the previous test (see Appendix B) but the date had changed to one that laid in the future. After the presentation of the scenario the test persons got four tasks which were presented one at the time and the participants were asked to indicate when they believed to have completed the task.

The tasks were:

1. Log in to the meeting: Bottle distance in the project: Juice Factory.
2. Create an item named End of line and add some information.
    a. You also want to attach an image...
    b. ...but you have not got the image yet. What would you like to do with your item now?
3. Now you have the image! Find your saved item, add the image and save the item to the agenda.
4. Your meeting Bottle Distance will soon start. Go to the agenda for the meeting.

The purpose of the second task was to make the participant reason about whether they wanted to save the item to the agenda or save it for later and why they preferred one over the other. For task 2a they would realise that it was not possible to click on the attachment symbol. It was a conscious choice to make that button unclickable at this stage to make it easier for the test leader to pause the tasks and bring the participant into a discussion for task number 2b without risking that the participant would continue. It was seen during the first and second evaluation that some participants were eager and tried to guess what to do next by clicking around in the prototype or that they assumed that they knew what to do next before the test leader had given them the next task. A few times this kind of behaviour led to the test having to be restarted since it was not possible to take a step back in the prototype, thus it was desired to prevent this from happening during the third evaluation.

The tasks for the first and second evaluation were more similar to each other than the tasks for the third evaluation where the tasks were made somewhat more advanced in comparison as the interface had become more advanced. This decision was made since the result from the second evaluation was showed that many problems were solved which indicated that the prototype was ready for a bigger challenge.

10.2.1 Measurements during tests

During the tests both subjective and objective factors were collected to be able to evaluate the efficiency, effectiveness of the interface as well as users' satisfaction. Objective measurements were the number of interaction errors and the number of times the participant asked for support or were given it by test leaders as they noticed that the participant would not be able to proceed without assistance. To facilitate this, the screen on which the test was conducted was shared with the test instructors. The subjective factors were collected by semi-structured interviews after each test. Mediating objects were used also for this test to support the participant's recollection. This was a piece of paper with three views of the interface to make it easier for the participant to think back at their experience. Further, the test participants got to fill out the same semantic differential scale as in the previous evaluations. The same scale was used to make it possible to compare the results; both between the tests and between individuals. The scale is described in section 6.2.

10.2.2 Analysis

The tests were analysed by making an affinity diagram based on the data collected to gather insights and understand problems with the user interface. All relevant statements were written down on post-its and paired with similar statements to create categories of problems. The result

of the ratings were put together into a table to be able compare the results from each participant and the results for each of the adjective pairs. As there were many problems concerning the application of saving items for later, all the statements collected involving that part were arranged on a timeline. In this way it was possible to get a clear overview of users' concerns and feelings during the use of this function.

10.3 Result

In this section the result from the third usability evaluation will be presented. The results consist of summary of problem areas and semantic differential scale.

10.3.1 Identified problems

In this section, a summary of the problem areas is presented. For the full diagram see Appendix G.

- Visual issues: Participants had trouble spotting some of the elements in the tool; the "Enter meeting"-link in "Upcoming meetings", the menu bar and the meeting headline. They wanted to have the identity of the interface visible (for example a logo).
- Functions of meeting view: Participants said that it is important to be able to take notes and edit things during a meeting and were worried that this would not be possible since the meeting view opens in the same window as the one they were currently in. They also wanted to see who else was in the meeting when they were in the meeting view.
- Preferred way of saving an item: Some participants thought that the tool should require them to finish their item so that they could save it to the agenda and not give the option to save it for later. Other participants said that they appreciated having the option to save it for later.
- Save item for later: Four sub-categories were identified when it comes to save an item for later. Those are:
    - Feelings before saving an item for later: Participants worried about not finding their item if saving it for later and that they might forget that they have a saved item.
    - Feelings immediately after saving for later but remaining in the agenda preview: Participants thought that they would somehow be notified that they now had an item, belonging to that meeting, that was saved for later and thus stored somewhere else.
    - When participants were searching for their saved item: They had trouble locating the "My saved items"-page.

    - When having found the "My saved items"-page and saving the item to the agenda: They thought that they would come back to the agenda preview after having saved an item that was located in the "My saved items"-page.
- Meeting view: Participants were not aware that the meeting view existed hence they did not look for it. When finding it they did not understand its purpose.

10.3.2 Assessment of subjective and objective factors

The result from the semantic differential scale from the second usability evaluation is summarised in Table 3 and shows the actual score of each participants. The antonyms were the same as for the first evaluation and the participants who are marked with an "x" also participated in the usability evaluation in the first and/or second iteration. Participants number six and seven (P6 and P7) are employees from FlexLink.

The result shows that the three areas most in need of improvement are to make it more enjoyable for the user to use the tool, make the tool more predictable and to make it clearer. The average total score per person is equal to the score for the second evaluation, which was 22.3.

	P1x	P2x	P3x	P4	P5	P6	P7	TOTAL:
organised-cluttered	3.5	3.5	3	3.5	3.5	3.5	3.5	24
enjoyable- annoying	2.5	3.5	2.5	2.5	3.5	3	2.5	20
attractive-unattractive	4	3.5	3	3.5	3.5	3.5	3.5	24.5
Efficient- inefficient	3.5	3.5	2	3.5	3.5	3	3.5	22.5
clear-confusing	3.5	3.5	2.5	2.5	3.5	3	3.5	22
predictable-unpredictable	4	2.5	2	3.5	2.5	2.5	3.5	20.5
supportive- obstructive	2	3.5	2.5	4	4	3	3.5	22.5
TOTAL:	23	23.5	17.5	23	24	21.5	23.5	156

Table 3: The result from the semantic differential scale from the third evaluation.

For the objective measures, there were no interaction errors. During eight times the participants asked for help during the tests and the events all concerned the entering of the meeting view.

10.4 Conclusion and design implications

The reactions on the third prototype were overall positive however, there was still room for some improvement. For this evaluation, comments were mostly on details in the interface and a desire to expand the functionality, which would go outside of the use case and hence were not considered in this thesis project. Participants also suggested other ways of managing items that were saved for later and showed signs of being worried doing so. Thus, it was decided to develop an implementation support for managing the "Save for later"- function. However, it was seen that training could be needed for other functions and the method of use as well. This is something that should be developed in the future.

It was observed that when users switched between the agenda preview and meeting view they did not understand the difference between them and therefore not the purpose of having a meeting view. Developing the functionality of the meeting view is something that should also be considered in the future.

The result from the semantic differential scales showed that the increased complexity of the functions in the third prototype did not affect the overall use experience. This implied that it would be possible to expand the use case and include more functions from the CMAP. This is also something that should be looked into in future development of the tool.

During the three rounds of evaluations both within subjects- and between subjects testing was carried out. Out of the five persons who participated more than once (within subject) it was only one who, in the third evaluation, gave a lower score than before (see Table 1, Table 2 and Table 3). The rest became more satisfied with the prototype the more it was developed. This indicates that the risk of making the participants bored after a few times was not an issue in this thesis project. Some of them expressed that it got more fun after already having participated in one or two tests. For first time participants (between subjects) the average total score per person increased the more the prototype was developed. 20.1 for the first one, 22.3 for the second and 23 for the third.

11. Support for implementation

It was noticed throughout this thesis project that implementing new software in companies can be difficult since there are many steps in the adoption process and people in general do not like change. With the purpose of making the implementation as easy as possible the usability of the tool has been developed however, some difficulties with the interaction still remain. These are explored in this chapter to come up with a suitable solution for an implementation support. The aim, procedure, result and conclusion for this work are presented in this chapter.

11.1 Aim

Based on the third evaluation of the prototype (chapter 10), the aim was to develop a video tutorial as a support for implementing the tool at FlexLink.

11.2 Procedure

The first step in creating an implementation support was to analyse the problems from the third evaluation (section 10.3) and deciding which problem was the most important one to find a solution to.

It was found that the function that was the most difficult to understand and use was the "Save for later"-function and to manage the items that were saved for later. Even though participants had no problem with understanding what "Save for later" meant they were concerned that they would not be able to find their saved items afterwards. This problem was different than what had been observed before as it was connected to feelings of worry and hence a possible reject. It was observed that participants were reluctant about performing the operation in the first place as they were unsure that they were not going to find the item once they had saved it for later. Another issue was that, once the participants had located their items that were saved for later they did not understand why they remained in the "My saved items"-page after saving the items to the agenda, instead of transferring to the agenda preview of that meeting. As these problems were closely linked it was concluded that this would be the target point for the implementation support.

For this type of problem, it was discussed and decided that a video was the most efficient way to show and explain the function. In interviews at FlexLink it had become clear that they previously have used videos when presenting new functions in software to make the employees aware of and familiar with them. This has been a successful way of doing it, thus it was probable

that a video would be possible for FlexLink employees to easily understand and accept since it is something that they are used to. As there are many ways to create informational videos some research was made on what makes a good tutorial and how to best communicate a message in a comprehensible way.

As a next step the goal for the video tutorial was formulated as "The result should be a short, easy to understand video about how to use the "Save for later" and "My saved items" functions in the tool. The video should also give an explanation to why these functions work as they do." Also, the target audience was decided and determined as all employees at FlexLink who have received training about the method of use. It targets mainly those who have not used these functions before, but it should be possible for anyone to watch.

Subsequently a storyboard (cf. Studiobinder, 2019) was created (Figure 56) where the key frames were sketched down and notes were made below with the most important information belonging to this screen. This laid the foundation for finding a simple explanation to the target group about the steps which was later formulated in a script. Then the sequence of saving an item for later, finding it in the tool, editing it and saving it to its agenda was filmed in the prototype. At this point it was clear that the best way of communicating the information would be through voice. Hence, the script was sent to a voice-over-narrator who recorded it in a professional way.

Figure 56: The development of the storyboard used for the video tutorial

Once the voice recording had been received and the clip was recorded they were edited in iMovie by editing the two media together. The voice recording was adjusted to fit the pace of

the clip and some music was added in the background to make the experience of the video tutorial more pleasant. Lastly, short texts starting and ending the tutorial were added.

11.3 Result

The result from developing the support for implementation will be presented in this section.

11.3.1 Video

The implementation support is a two minutes long video tutorial in English that explains the "Save for later"-function. It goes through how the user saves an item (Item A) for later and then finds it in the "My saved items"-page and from there saves it to the agenda. To wrap it up the tutorial shows the viewer how to find Item A in the agenda. The video can be accessed through the QR-code (Figure 57). The video targets all employees at FlexLink who have received training about the method of use of the tool that was developed in chapter 9. It targets mainly those who have not used these functions before, but it should be possible for anyone to watch.

Figure 57: QR-code to access the video.

11.4 Conclusion

Based on the result from the third evaluation it was seen that more training than explaining the "Save for later"-function could be needed to make the user understand the tool completely. Hence the video tutorial presented does only explain the sequence of use regarding how to manage the "Save for later"-function and not so much about the overall method of use. Hence, more tutorials, and possibly also other kinds of implementation support, should be developed in the future.

12. Final concept

In this chapter, the final concept Prep will be explained as a whole. The concept will be presented by scenarios, a more thorough description of the elements that is part of the prototype, usability aspects and the complete list of design criteria. This chapter also presents and describes the implementation support that was developed.

12.1 Scenarios

Two scenarios will be presented to communicate two different but intended interactions with the tool on an easy to understand level. The scenarios are based on the personas created in section 4.3.3.

12.1.1 Problems that arise that needs to be discussed

Tim is working on the task he was assigned on the latest project meeting. After about two hours he encounters a problem that he cannot solve himself. After a while, weighing different options against each other, he realises that this needs to be discussed at the next meeting on Thursday. So, he logs in to Prep from a link that is found in the calendar on the day for the meeting. He gets directly into the agenda for the Thursday meeting which he finds very beneficial. Tim begins with scanning the agenda preview to see if anyone else already has the same issue. After a few seconds he realises that this has not come up, so he creates the item using the pre-stated fields in the form. This is easy and Tim feels like he has contributed a lot to his company. Now, he is sure that he will get a good answer at the next meeting as his colleagues have a good chance to prepare.

12.1.2 Working with “My saved items”

Every Wednesday after the coffee break, Brenda sits down at her desk to manage the items that she has saved for all the meetings she has the following two weeks. She logs in and quickly finds the “My saved items”-page. This is really efficient and as she is a “neat freak” she likes to make the items perfect before submitting them to the agenda where everyone can see them. This Wednesday Brenda has three saved items and she edits by filling in more information and attaching files where it is necessary. When she is pleased with her work she submits them to their respective meeting agenda. Brenda is satisfied knowing that her “Saved items”- list is now empty and that the three items she submitted are in perfect order. Brenda also has a meeting on Thursday morning, so she reads through the agenda preview for that meeting to see if she needs to prepare herself to be able to give high quality answers, which is something she always aims

for. She checks the items in which she has extra insights in more thoroughly. Now she feels confident to go to the meeting on Thursday morning and feels good about doing this. It is something that everyone should do before a meeting in her opinion.

12.2 Prep

The prototype for Prep is presented in Figures 58, 59, 60, 61, 62 and 63. It will explain the parts of the user interface that has been developed throughout the thesis project.

12.2.1 Agenda preview

The preview of the agenda (Figure 59) is accessed from a meeting invitation, that takes the user directly into the preview or it is possible to log in and then find the agenda preview from the list of upcoming meetings. From here it is possible to create items and edit items that are currently in the list.

In general, it is possible to create an item until 24h before the meeting starts. After this, the agenda closes for submission and gives users the opportunity to read through the agenda and prepare for the meeting. When the meeting has started it is possible to enter it from the agenda preview.

12.2.2 "Create item"

To be able to save an item it must minimum contain a headline. Further, it is possible to add information in a free text field and attach files. Then it is up to the user to decide whether to save to the agenda or save the item for later (Figure 60).

12.2.3 "My saved items"

"My saved items" (Figure 61) can be accessed from all pages except the meeting view. It is accessed through the profile icon in the upper bar. This page is personal for the user and holds all items that the user has saved for later. The purpose of the "My saved items"- page is to allow the user to finish their items and add them to their agenda. The goal is to have an empty page which is why all items that have been saved for later appear in the same list. In this way the user may tick off all items at the same time without needing to check every upcoming meeting.

The main difference between saving an item directly to the agenda and saving it for later is that if you save it for later it will end up in your private "My saved items"-page. This can be useful for example when the user wants to create an item but not yet post it to the public agenda.

12.2.4 “Upcoming meetings”

The “Upcoming meetings”-page (Figure 61) can also be accessed from all pages except the meeting view. Here, all upcoming meetings are listed and ordered by the nearest upcoming date. The “Upcoming meetings”- page is the first page the user sees when logging in the general way and not via a meeting invitation.

12.2.5 Meeting view

The meeting view (Figure 63) opens when the meeting starts and is accessed from the preview of that agenda. Here all items for that meeting are listed and there is an expanded view which shows more information about the currently open item. At the moment it is possible to scroll through the list of items and open them. For every item it is possible to assign an owner.

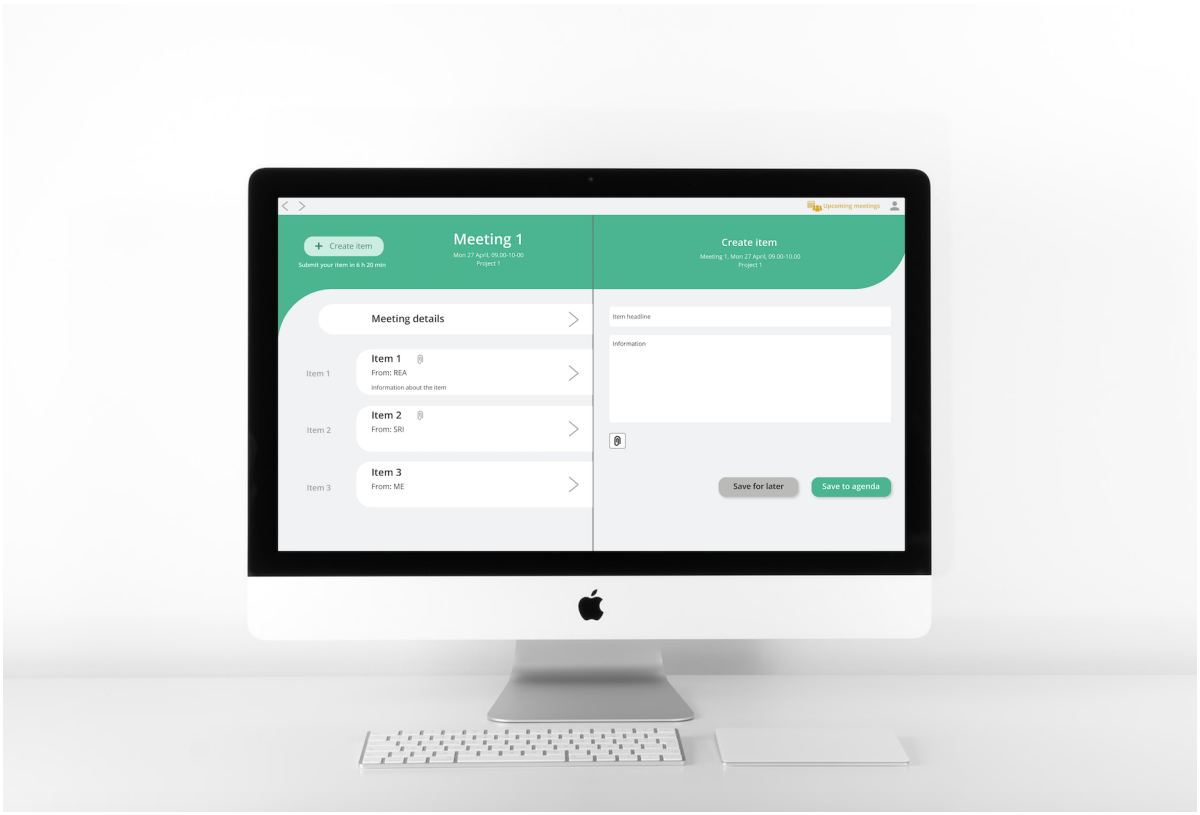


Figure 58: The final concept Prep

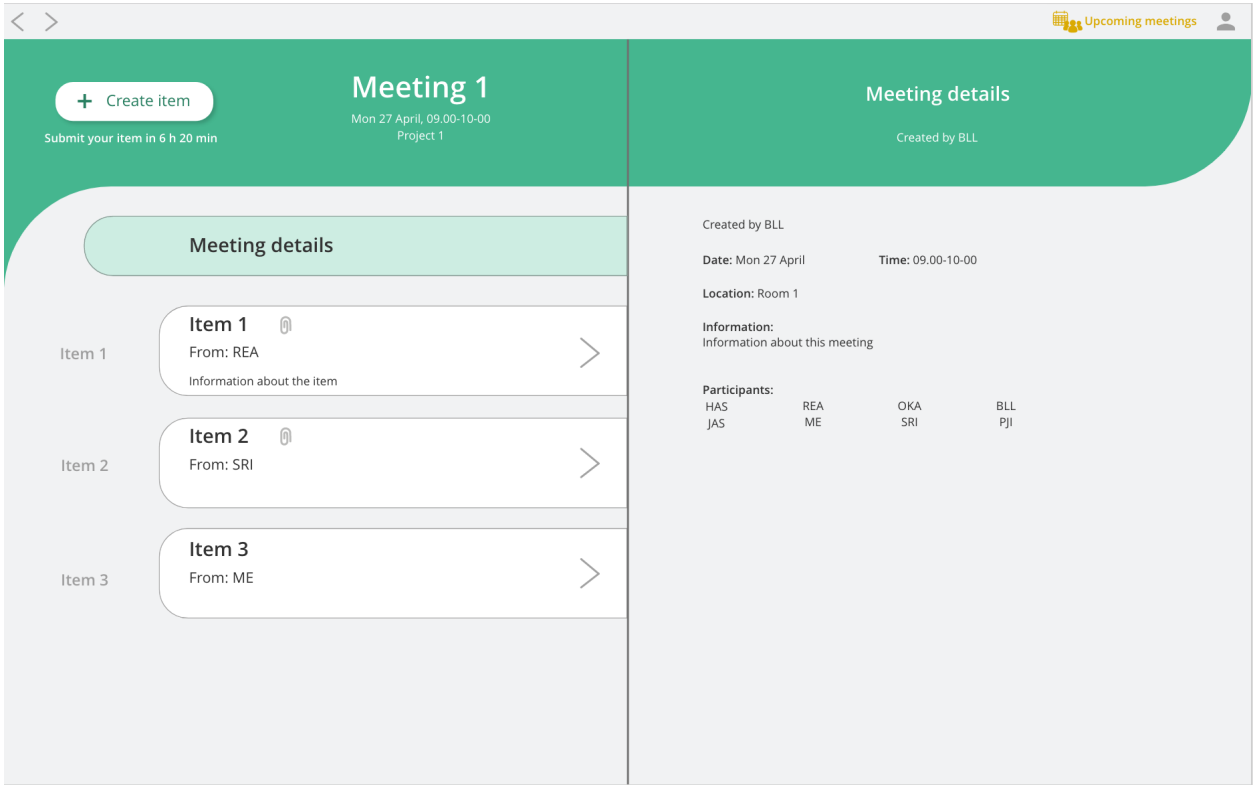


Figure 59: The agenda preview for the final interactive prototype

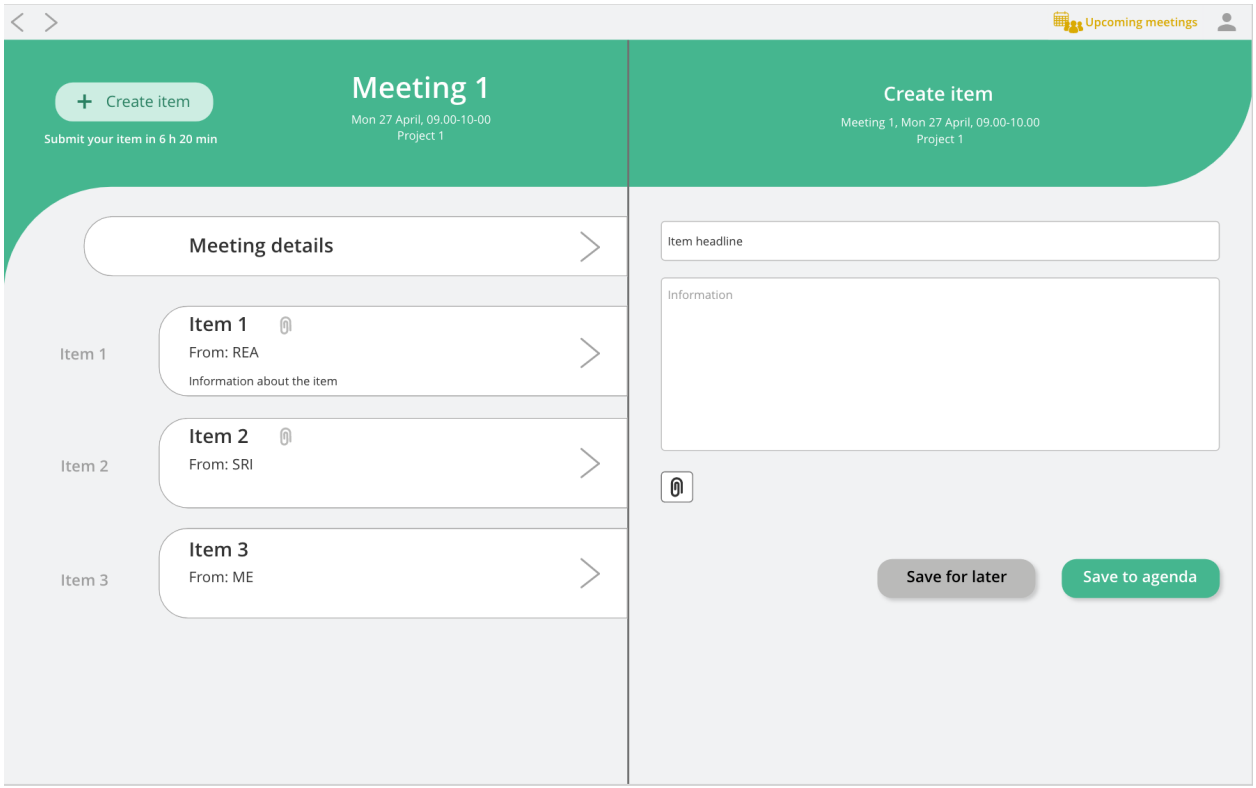


Figure 60: The "Create item"-page for the final interactive prototype.

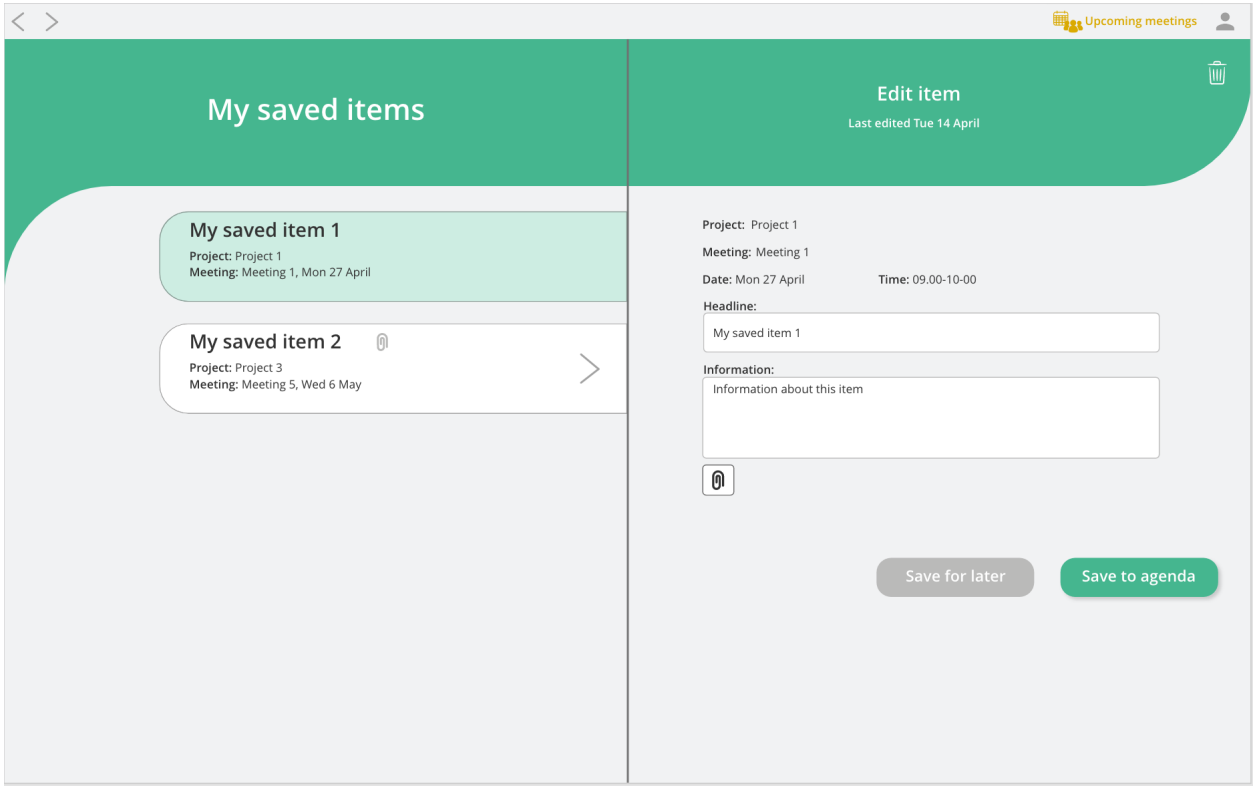


Figure 61: The "My saved items"-page for the final interactive prototype.

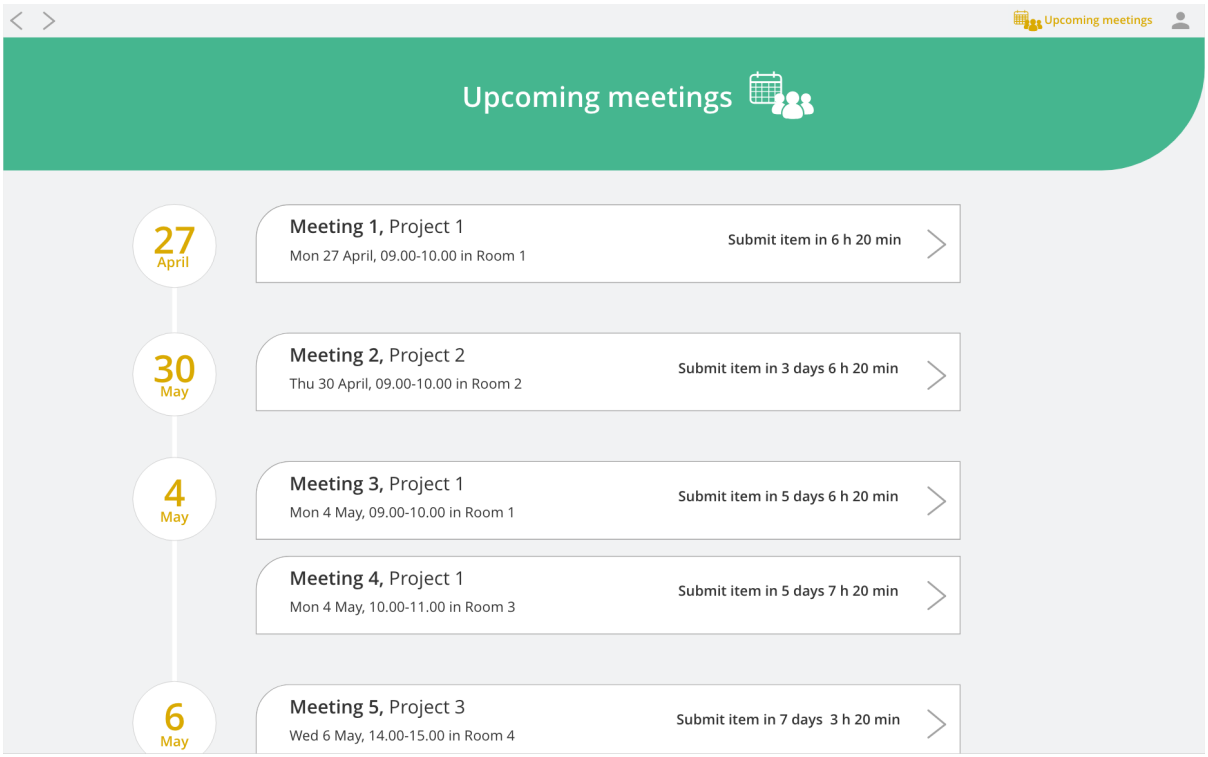


Figure 62: The "Upcoming meetings"-page for the final interactive prototype.

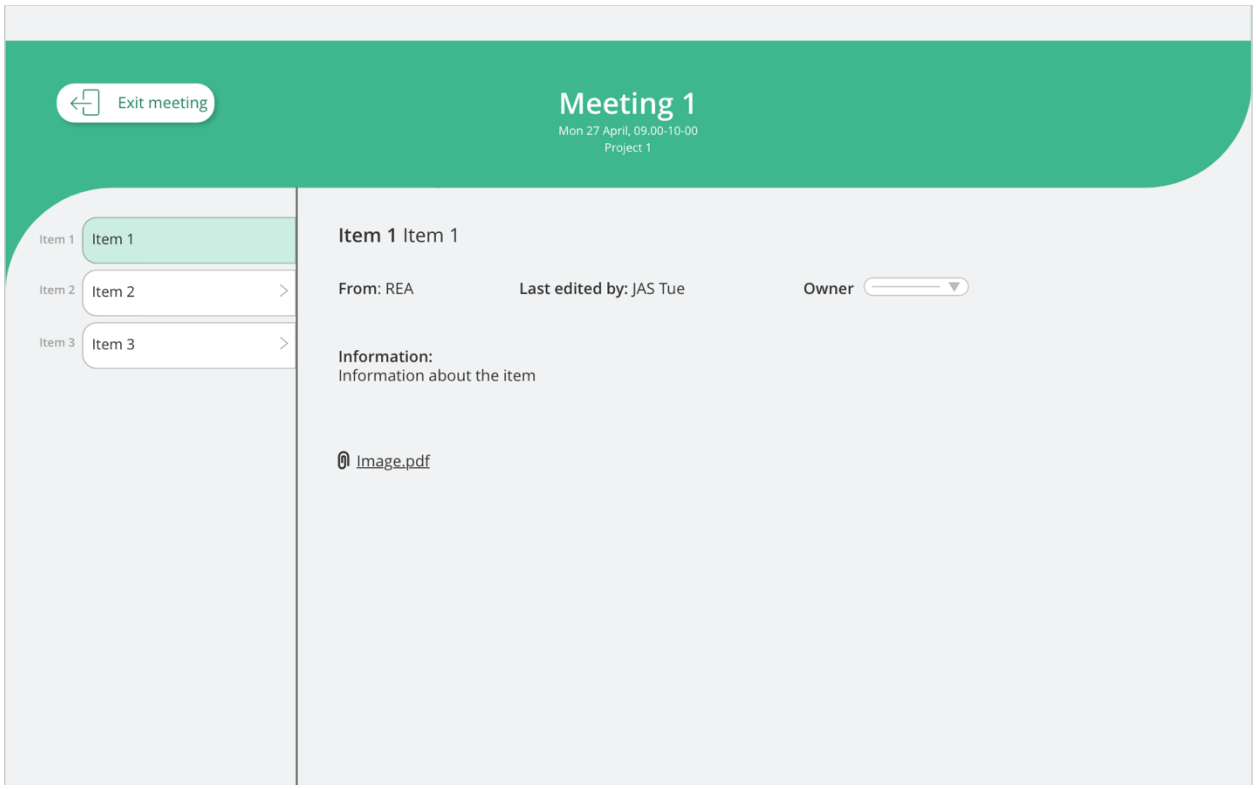


Figure 63: The meeting view for the final interactive prototype

12.3 Usability aspects

Early, it was clear from the usability tests that the user interface fulfilled prerequisites for learnability. This was an important aspect to emphasise as it is a tool that is expected to be used often and many times by users. However, to emphasise the aspect of guessability was also important as there may be new users of the interface for example, recently employed at the company. Throughout the final iteration it was clear that the guessability had improved for example, during the final evaluation (see chapter 10) it was clearer for first time users that they had entered the agenda preview after logging in than what had been observed in previous tests. However, it was concluded that it is important for all users to understand the purpose of the tool to be able to maximise the benefit from it.

When designing the interface, the usability principles and guidelines described in section 3.4 have been considered to create an interface that can be used with efficiency and with minimal risk of use error. There has been a focus on creating an interface that is quick to get a correct overview of, gives proper and sufficient guidance, allows the user to be in control and that has a predictable structure to fulfil these demands.

12.3.1 Simplicity

Creating a minimalistic interface that is easy to get an overview of and that does not overload the users' cognitive resources has been important. This has been achieved by structuring information in a logical way, using few elements, clear icons and a simple colour scheme. Different looks of boxes that encircle text have been used and this makes it easier for the user to differentiate between them and understand that they hold different types of information for example, a meeting or an item. The looks of buttons are also different depending on if they are intractable or not. This makes it easy for the user to understand if the function is available or not.

"Absolutely clear, it was organised and not too much information" (P7, test 3)

"Easy on the eye" (P6, test 3)

To create an easily understandable interface the way of prioritising functions and information has been considered. Hence, the "Create item"-button is located at the top left of the screen and with the colour selection and shadowing it stands out from the rest of the interface. At the top left it is easily noted for a user and since it is built on consistency it is probable that it will match the mental model the user has of such a function as it is how it is done in many interfaces. Further,

there is a "plus sign" before "Create item" which gives the user a hint of what to accomplish which means that the user will most likely succeed with the task.

In "Upcoming meetings" and the agenda preview, there are also hints about further functionality as there are arrows at the right showing the user that there is more information to be found. In the agenda preview the meeting details are located at the top of the list of items which enables the user to quickly comprehend the information which is a good way of structuring the information. Furthermore, since there is a hierarchy between the meeting headline and the items in form of differences in font size and placement it is clear that the items are subordinated to the meeting.

"Now, after looking at it [the interface] just after one time, it's much more comprehensible" (P4, test 3)

12.3.2 Interface guidance

Proper and sufficient feedback has been created to facilitate use and give the user a clear indication of what their action has resulted in. It has been applied when saving an item in the way that the user receives a message saying that their item has been saved successfully. In the tests it was concluded that one second is enough for the user to read and understand the message when a user has saved an item. They also easily found their created item in the list as it appeared directly where they could see it. When an item is saved for later, this is also indicated by text feedback and also by the profile icon, whose background changes colour so that the user gets a hint of where their item ended up.

"'Your item has been successfully saved' then I knew that I was finished" (P6, test 1)

As a constraint, items without a heading cannot be saved into the agenda or saved for later. This is to prevent users from saving empty items by mistake which will fill up the agenda. To prevent an item from getting lost during creation (e.g. if the user accidentally clicks somewhere else) a warning message appears that asks the user to take a stand whether they want to continue creating the item or discard it. This prevents the item from accidentally being deleted. Further, it is not possible to click the "Enter meeting"-button before the meeting has started. Hence, the user will only be able to access the meeting when it has started.

The feedback and error prevention work has been shown to be successful in tests. The work has guided the user in a good way that felt supportive and in the way that that the user still experiences enough options.

It is supportive since it [the interface] is like it says to me 'I understand that you don't find your image now, but you can add it later.'" (P4, test 3)

12.3.3 User control

An aspect that was found important to enhance was the control the user experiences when navigating through and using the tool. Having the user experience control was one of the key factors identified to keep users engaged. Hence, the user is allowed much control over how to manage items and the content of them. That is why there is a possibility to edit any item that is visible in the preview of the agenda and also save items for later. To save items for later was found important in tests (see chapter 10) as there could be times when a user found it more comfortable to save items for later and edit them privately until they were happy with it. It is however up to an administrator to create meetings and organise the finalised agenda.

"I would probably more often use 'Save to agenda'. But if there are new stakeholders, I don't want to save directly to the agenda. I think both are useful!" (P5, test 3)

12.3.4 Mode of application

It has been critical to create good prerequisites for an easy workflow for the user and also to make the usage predictable. That is why the interface has been created using layouts that show familiarity from other popular user interfaces for example, *Outlook* and *Gmail*. In this way it is more probable that the user will be able to carry out an operation and find the right function to do it. For example, when the user wants to create a new item, that button is placed in the upper left corner. This is similar to many email applications when one wants to start writing a new email.

Further it has been important to work with consistency in the interface in the way that similar operations are performed in the same way and that it is easy to distinguish different kinds of information. Hence, the function of saving to the agenda and saving for later looks the same whether one is creating or editing an item. Also, the white boxes that encircle items always look the same regardless what screen the user sees. In this way the user understands that these are items.

"Wasn't a 1000% obvious but more on the clear end. If I would have used this for a day I think that I would find it more predictable!" (P6, test 3)

"All as expected!" (P7, test 3)

12.4 Final list of design criteria and design guide

In Appendix H the complete list of design criteria is presented. The purpose of the list of design criteria is to work as guidelines and requirements for developing a working prototype. Hence, it is directed to developers. In Appendix I, a design guide is presented to further help developers creating the tool. The final list of design criteria is based on the flowcharts developed in section 7.3.3 and 9.3.3 and the entity relation diagram developed in section 9.3.4.

12.5 Implementation support

The implementation support is a two minutes long video tutorial in English that explains the "Save for later"-function (chapter 11). It goes through how the user saves an item (Item A) for later and then finds it in the "My saved items"-page and from there saves it to the agenda. To wrap it up the tutorial shows the viewer how to find Item A in the agenda. This tutorial is projected to be one out of many, hence it only explains the mentioned sequence of use. The video can be accessed through the QR-code (Figure 64).

Figure 64: QR-code to access the video.

According to the Technology Acceptance Model (section 3.2) the perceived usefulness and the perceived ease of use determines why people would choose to use a certain type of technology or not in a work context. Their general attitude towards the specific software is highly individual as it is dependent on each individual's experience. The video tutorial helps to create a shared understanding of how the tool is supposed to be used among all users by offering training and support about one of the use sequences. The music and the voice give the movie a positive tone which helps to create positive engagement. This is important as it facilitates the change for the employees (section 3.3).

Both FlexLink and Yolean confirm that users of a new software usually do not get sufficient information on how to use the software and why nor do they get enough time to learn it (section 4.3.5). This video tutorial will give them that information and they will be able to watch it more than once if needed to make sure that everyone is on board. As FlexLink is already familiar with explaining new software features in videos, it should not be a big step watching video tutorials about a new software.

13. Discussion

It is clear that COVID-19 has affected the process of the thesis project to a large extent. However, despite this, a user interface has been developed with a focus on interaction and with a tutorial explaining and providing training for users about the use which will support the implementation of the tool. However, circumstances have affected the result and they will be discussed in this chapter.

13.1 Developing the prototypes

The original plan was to develop a working prototype early in the project that could be tested and observed in meetings at FlexLink for a period of time. The starting point for developing the first interactive prototype (chapter 5) was Yolean's data model. However, due to COVID-19 it was not possible to carry out the original plan as the intended meetings were cancelled and there was no chance of finding other meetings. Despite this, Yolean's data model with its opportunities and limitations was still used as it was not possible to say when or if it would be possible to carry out the original plan or parts of the plan.

The reason for using Yolean's data model in the first place was that it was easily accessible, and it was possible to create the necessary functions for the use case that was developed (section 5.2). However, it was not possible to replicate all functions from the CMAP, hence the list of upcoming meetings shows *all* upcoming meetings that are available in the system and not only those specific to the user. Would it have been possible to, in a good way select meetings or filter them, this would have been the preferred way to develop the tool.

Using Yolean's data model has meant that the concept of CMAP was altered for the first test. For example, a mobile version of the interface was developed as this is the easier way to go with developing an interface rather than starting with a desktop. Even though the final concept does not work as the CMAP, valid results and development have been made to improve the usability of the interface.

13.2 About implementation support

The reason for focusing on the second stage in the stages for adoption (section 3.1) was that it would not have been possible to observe the process of people getting aware of the tool. Hence, it was initially concluded that the best way was to introduce the tool to a group and observe the first interactions and then more long-term use. However, due to COVID-19 the way of working

with implementation had to be changed as it was not possible to observe an adoption process since a project group with meetings could not be accessed. Hence, an implementation support in the form of a video explaining a function was developed. It is likely that there will be need for more support in the form of training on the method of working, but the video provides valuable information and guidance about the feature that was found to be the most difficult one to understand. Hence, the tutorial is believed to facilitate the implementation for individuals.

13.3 About test participants

For the evaluations it was desired to carry out tests with FlexLink employees as they were the intended users of the tool. However, due to COVID-19 it was only possible to access two which is why other categories of users have been included. This meant that the tests were more focused on interaction than usage of the tool and thereby creating utility which was the initial intention with the thesis project. What was significant for the tests was that the main part of the participants were young and had experience of technology which may have affected the results of the test. What was desired to have users with different experience at FlexLink as well as variation in age and education but due to COVID- 19 this was not possible to obtain to such a large extent as desired.

There are fewer test participants in the last test than in the previous two. The reason for this was that it was difficult to find participants due to COVID-19. However, it was noticed in the previous tests that saturation was achieved quickly which decreased the need for many more participants. Also, CW and PHEA were used before every evaluation. For these evaluations no participants are needed but they give a good indication of any limitations with the usability design of the interface.

As the test participants were rather young and without any obvious visual impairment it was difficult to determine how good visual contrast the interface should have, to be acceptable. As no participant complained that it was hard to see or read the information shown on the screen there was no incitement to change the contrast of the interface even though the contrast check software advised to do so. Hence, this is an aspect that might need further development.

Due to COVID-19 making it difficult to find test participants the three test groups were not equal in number, age or experience etcetera. This might have affected the result of the between subjects-tests where only first-time participants were considered. The number of first-time participants was different for each test, age and other factors were not equally distributed among the three groups. Even though overall test result improved with every prototype, but it is not

possible to determine whether this has also something to do with the test groups or if it only has to do with the improvements of the prototype.

13.4 About the test

A few users from FlexLink could finally be found, but most participants were not from FlexLink why it was important to give test participants enough background about the tool and use context. This might have resulted in a mental overload in some cases which meant that the test participants forgot information about the background they were told. For example, it could sometimes be hard for participants to remember which meeting that they should find. It was also clear that the notes with the instructions that were given to participants were forgotten by them and not possible to use when the tests were digital. However, this problem got smaller as the interface developed and with recurrent test participants who had learned the basic information and who were able to better focus on the tasks.

For the semantic differential scale, the adjective "enjoyable" was not the optimal choice, since it became clear that people generally did not think that this type of tool could be described in that way. This decreased the overall score on the semantic differential scale, but participants expressed that it was no problem in using the tool and could see themselves use it in a workplace.

Due to COVID-19 all tests for the third evaluation were made digitally. Hence the context could not be controlled which may have affected the result. However, this is not believed to have affected the result too much since half of the tests from the second evaluation were made digitally as well, and no obvious difference in result could be seen between these and those in the simulated use context.

In general, the participants managed to solve the tasks well. However, they needed more support for the third evaluation compared to the first two. This could be explained by that it was decided to expand the tool by adding new functions to the prototype used for the third evaluation as the result for the second test was good. Also, the tasks were on a more advanced level for round three compared to the first two evaluations to try the new functions out. Hence, any comparison between the number of interaction errors and given support does not indicate anything.

As most test participants were not from FlexLink, this means that the results have generated a more general usability development for the tool. However, the two users from FlexLink were the last participants for the third evaluation and it was clear that they behaved and performed the

tasks similarly to other participants. However, to get a more valid result more tests need to be performed with FlexLink employees.

13.5 Future work

There are a few aspects that would be interesting to look into in the future. The first one is that a working tool should be developed to test long term use with FlexLink employees to possibly discover new problems and also test what kind of training and perhaps other implementation support that are necessary. The implementation support developed in this thesis project also needs to be evaluated to determine if it is a suitable method for teaching functions in the tool.

The meeting view needs to be developed and functionality needs to be added to it. For example, in this thesis project it was desired that it should be possible to switch between windows to be able to plan other meetings when being in a meeting and it was also requested to see who is present if it is a digital meeting. It is also necessary to evaluate the method of working with the tool as this was only briefly explored in this thesis project, for example, defining a way that makes sure that all users understand the purpose with the meeting view and how to use it.

Further it needs to be defined how to include more functions from the CMAP. For example, the possibility to assign actions to people. This came up as a wish from test participants in the last evaluation in this thesis project but lay outside the scope as it was not possible to achieve with the data model that was initially planned to build a working prototype on. Another important function from the CMAP was the possibility to assign owners to items. This needs to be researched more to determine whether an item should be assigned to an individual or a role.

14. Conclusion

The final concept fulfils the aim and provides an answer to the research questions. The obstacles preventing the adoption of the tool were explored through interviews, to find out what has previously worked and not worked (chapter 4) when implementing new tools into organisations. To find out what obstacles there were with the CMAP, usability tests were performed which were then analysed (chapters 6, 8 and 10). The user interface that was developed fulfils the need for simplicity, guidance of the interface, gives the user control and provides an easy to use and learn workflow. It also proved to have prerequisites for learnability as many test participants expressed that the tool became easier to use only during the first test session.

It has become clear throughout the thesis project that there is a need for training of the method of working with the tool to completely fulfil the objective about necessary support for adoption. In this thesis project an implementation support was developed that explains the most challenging function found.

Finally, it is clear that this concept consisting of a user interface proposal, implementation support for that interface and a list of citera for developers, has improved the CMAP and will facilitate the adoption of it for individuals in an organisation.

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Appendix

Appendix A: Cognitive Walkthrough and Predictive Human Error Analysis 1

CW och PHEA: Login to the meeting "Choose Speed for Production Line" in the tool.

	J/N	Varför?	Problem	Anteckningar
1. Kommer användaren försöka uppnå rätt effekt?	Yes	They expect that they need to write their username and password to get into the tool.	-	
2. Kommer användaren att notera att rätt handling finns tillgänglig?	Yes	There is a field for username and password and a button saying "login".	-	
3. Kommer användaren att associera korrekt handling med rätt effekt?	Yes	The layout of the login page matches with their mental model.	-	
4. Om rätt handling är utförd, kommer användaren att se att handlingen har för uppgiften närmare målet?	Yes	They will get to the first page of the tool and see their meeting.	-	

- Vilken handling kan användaren göra fel vid rätt tillfälle?
- Vilken handling kan användaren göra rätt vid fel tillfälle?
- Vad händer om användaren utför en ej fullständig handling eller utesluter en handling?
- Vad händer om användaren utför handlingarna i fel ordning?

Fel	Orsak	Konsekvens	Upptäckt	Återhämtning
Closes the email with the link.	Does it by accident.	The email window will close.	Cannot see the email and the link anymore.	Open the email again.
Opens the link to another meeting.	Does not know the name and/or date of the meeting.	The login page for another meeting will open.	The item will not be discussed in the expected meeting.	Add the item to the correct/next meeting.
Does not fill in username and/or password or does not click "login".	Forgets to do it.	Does not login.	Stays on the login page.	Fill in username and/or password and click "login".
Clicks "login" before filling in username and/or password.	Forgets to fill it in.	Does not login.	Stays on the login page.	Fill in username and/or password and click "login".

CW och PHEA: Edit an item to change the receiver.

	J/N	Varför?	Problem	Anteckningar
1. Kommer användaren försöka uppnå rätt effekt?	Yes	They expect that they need to do something to edit the item.	-	
2. Kommer användaren att notera att rätt handling finns tillgänglig?	Yes	There is a drop-down menu next to every item containing an "edit-symbol".	-	
3. Kommer användaren att associera korrekt handling med rätt effekt?	Yes	The symbol matches with their mental model.	-	
4. Om rätt handling är utförd, kommer användaren att se att handlingen har för uppgiften närmare målet?	.Yes	A pop-up window saying "edit item" will appear.	-	

- Vilken handling kan användaren göra fel vid rätt tillfälle?
- Vilken handling kan användaren göra rätt vid fel tillfälle?
- Vad händer om användaren utför en ej fullständig handling eller utesluter en handling?
- Vad händer om användaren utför handlingarna i fel ordning?

Fel	Orsak	Konsekvens	Upptäckt	Återhämtning
Clicks "delete" instead of "edit".	Does it by accident.	Pop-up window with question if they want to delete the item.	They see the pop-up window.	Click "no" and then "edit".
Saves the item to the agenda without editing anything.	Clicks "save to agenda" by accident.	The item was not edited.	The item looks like before.	Click "edit" and try again.
Does not click "save to agenda".	Forgets to do it.	The edits are not saved.	The pop-up window does not close.	Click "save to agenda".
Does not find "edit".	It is placed in a drop-down menu.	They cannot edit the item.	They know that they did not edit the item.	Ask for help or try to find it.
Creates a new item.	Does not find the "edit-symbol".	A new item is added.	The previous item looks the same.	Delete the new item and click "edit" to edit the previous one.

CW och PHEA: Add an item to the meeting agenda.

	J/N	Varför?	Problem	Anteckningar
1. Kommer användaren försöka uppnå rätt effekt?	Yes	They expect that they need to fill in information to add a new item.	-	
2. Kommer användaren att notera att rätt handling finns tillgänglig?	Yes	There is a "+"- button visible next to the item list.	-	
3. Kommer användaren att associera korrekt handling med rätt effekt?	Yes	Creating something new by clicking "+" corresponds to their mental model.	-	
4. Om rätt handling är utförd, kommer användaren att se att handlingen har för uppgiften närmare målet?	Yes	Feedback will show on the display and there will be one more item in the list.	-	

- Vilken handling kan användaren göra fel vid rätt tillfälle?
- Vilken handling kan användaren göra rätt vid fel tillfälle?
- Vad händer om användaren utför en ej fullständig handling eller utesluter en handling?
- Vad händer om användaren utför handlingarna i fel ordning?

Fel	Orsak	Konsekvens	Upptäckt	Återhämtning
Clicks another item instead of "+".	Does not understand that the item in the list is an item or does not see "+".	The item opens.	There is no new item added.	Click "+" to add the item.
Clicks "home" instead of "+".	Does not see "+".	Gets to the general first page.	There is no new item added.	Add the item on the general page or click the desired meeting and then click "+".
Closes pop-up window when "create item" is open but not filled out.	Does it by accident.	Gets back to the item list for the meeting.	The create item-form disappears.	Click "+" to add the item.
Closes pop-up window when "create item" is open but not completely filled out.	Does it by accident.	Pop-up window with question if they want to discard their item.	They see the pop-up window.	Click "no" and continue creating the item.
Does not fill in all required information in the item.	Does not know it is needed.	It is not possible to save.	It is not possible to click "save to agenda".	Continue creating the item.
Does not click "save to agenda".	Forgets to do it.	The item is not saved.	The pop-up window does not close.	Click "save to agenda".

Appendix B: Test scenario

You work at a company called FlexLink and get an email from your boss Linda Blixt. The email contains an invitation to attend a meeting on the 25th of March. The project name is Juice Factory and the meeting name is Choose Speed for Production Line. In the email is also a link to the tool that your company uses to create collaborative meeting agendas prior to meetings.

Appendix C: Full Affinity Diagram from Usability Evaluation 1

Desired functions (when creating item in "Item list"):

- Participants wanted to be able to attach images and other files when creating an item to clarify the message.
- Participants wanted to have fields to fill out about for example status of the item and if this is the first time this item is brought up during a meeting or not.
- Participants wanted to be able to add sub-items to items.
- Participants wanted to be able to assign an item to several persons.

Visual problems with the "Item list":

- Participants thought that the "+-button" is unclear.
- Participants thought that the two items in the "Item list" are related since they are close to each other.
- Participants thought that the item in the "Item list" looks like a drop-down menu making them think that they are supposed to choose something from there. However, some other participants thought that it must be clearer that it is possible to "drop down" the item in the "Item list" to see more information.
- Participants thought that the box surrounding the headlines makes it look like a tab, making them believe that you can have more than one tab open.

Where did I end up? (when logging via the link and getting to the "Item list" for the meeting):

- Participants were not sure where they were after logging in. It was not clear that they entered the "Item list". It does not say that anywhere and there is no name, date or time for the meeting that helps the participant to understand that they are in the "Item list" for a meeting.
- Participants did not understand the page.
- Participants did not know where their item ended up after they created it.

What I expected to happen when I logged in, did not happen

- Participants thought that it would have made more sense to enter the "Create item"-page when logging in.
- Participant were insecure where they were in the tool once they had entered
- Participants did not think that the "Item list" looked like the typical page to enter when logging in to a tool.

What is in the "Item list"?

- Participants thought that it was not clear that the things in the "Item list" are items, one participant thought that the different items were meetings.

What is an item/" Item list"?

- Participants did not understand what they were doing in the "Item list". Did not know if it was collaborative or not. Some participants realised what the "Item list" was first after they had added an item to it.
- Participants did not know what an item was.

What is included in this item?

- Participants thought it should be clearer from whom the item was.
- Participants thought that it would be clearer if the items were marked with different symbols depending on what kind of item it was.

What do you do on the page for "Create item"?

- Participants thought that the field for creating items was for creating new meetings as "Upcoming meetings" were just below.
- Participants had difficulties with understanding "from" in the information box in the "Item list" and "to" in "Create item"-function as well as in the information box in the "Item list".

I need control/ how much control do I need?

- Participants lacked an overview in the "Item list" since there was too much text in the header.
- Participants desired to see more information about the meeting in the "Item list", especially the start time for the meeting.
- Participants felt insecure as they were not sure how to know that the item they wanted to submit had not been discussed before.

Visual remarks in general

- Participants did not find the user interface pretty.
- Participants thought that the logo on the login-screen was too small.
- Participants found the user interface boring as it lacked colour.
- Participants found the order of "Upcoming meetings" and "Create item" confusing.

Notices

Participants expressed concern that they would forget or lose the email with the link to the tool.

Appendix D: Cognitive Walkthrough and Predictive Human Error

CW och PHEA: Login to the meeting "Bottle Distance" in the tool.

	J/N	Varför?	Problem	Anteckningar
1. Kommer användaren försöka uppnå rätt effekt?	Yes	They expect that they need to write their username and password to get into the tool.	-	
2. Kommer användaren att notera att rätt handling finns tillgänglig?	Yes	There is a field for username and password and a button saying "login".	-	
3. Kommer användaren att associera korrekt handling med rätt effekt?	Yes	The layout of the login page matches with their mental model.	-	
4. Om rätt handling är utförd, kommer användaren att se att handlingen har för uppgiften närmare målet?	Yes	They will get to the first page of the tool and see their meeting.	-	
• Vilken handling kan användaren göra fel vid rätt tillfälle? • Vilken handling kan användaren göra rätt vid fel tillfälle? • Vad händer om användaren utför en ej fullständig handling eller utesluter en handling? • Vad händer om användaren utför handlingarna i fel ordning?				

Fel	Orsak	Konsekvens	Upptäckt	Återhämtning
Closes the email with the link.	Does it by accident.	The email window will close.	Cannot see the email and the link anymore.	Open the email again.
Opens the link to another meeting.	Does not know the name and/or date of the meeting.	The login page for another meeting will open.	The item will not be discussed in the expected meeting.	Add the item to the correct/next meeting.
Does not fill in username and/or password or does not click "login".	Forgets to do it.	Does not login.	Stays on the login page.	Fill in username and/or password and click "login".
Clicks "login" before filling in username and/or password.	Forgets to fill it in.	Does not login.	Stays on the login page.	Fill in username and/or password and click "login".

CW och PHEA: Edit an item that has already been created.

	J/N	Varför?	Problem	Anteckningar
1. Kommer användaren försöka uppnå rätt effekt?	Yes	They understand that they need to do something to edit the item.	-	
2. Kommer användaren att notera att rätt handling finns tillgänglig?	Yes	They will understand from the edit symbol that it is possible to edit the item.	If they do not manage to open the item they will not see the symbol for that specific item.	
3. Kommer användaren att associera korrekt handling med rätt effekt?	Yes	The symbol matches with their mental model of how an edit symbol should look.	-	
4. Om rätt handling är utförd, kommer användaren att se att handlingen har för uppgiften närmare målet?	Yes	"Edit item" will be visible and the information fields will look editable.	-	
• Vilken handling kan användaren göra fel vid rätt tillfälle? • Vilken handling kan användaren göra rätt vid fel tillfälle? • Vad händer om användaren utför en ej fullständig handling eller utesluter en handling? • Vad händer om användaren utför handlingarna i fel ordning?				

Fel	Orsak	Konsekvens	Upptäckt	Återhämtning
They do not find the edit button.	They do not open the correct item.	The item will not be edited.	They do not find it.	Ask someone for help.
They create a new item.	They might think that the "+" means that they will add information to an item.	A new item will be created.	There will be an undesired item	Delete the undesired item and eventually edit the desired one.
They delete the item.	They do it by mistake.	The item disappears.	An item is missing.	Re-create the item.
They save an item where the editing is not finished.	They are distracted	The item is incomplete	They see that information is missing from the item	Continue editing item
They try to leave edit mode before saving.	They click away by accident	They get a warning message about whether they want to continue editing the item	They read the message	They click "Yes" and continue editing :)

CW och PHEA: Create item

	J/N	Varför?	Problem	Anteckningar
1. Kommer användaren försöka uppnå rätt effekt?	Yes	They realise that they need to do something to create an item		
2. Kommer användaren att notera att rätt handling finns tillgänglig?	Yes	There is a button that says "Create item" and is supported by the symbol "+"		
3. Kommer användaren att associera korrekt handling med rätt effekt?	Yes	They can read and interpret the symbol correctly		
4. Om rätt handling är utförd, kommer användaren att se att handlingen har för uppgiften närmare målet?	Yes	An form will appear where they can add relevant input		
• Vilken handling kan användaren göra fel vid rätt tillfälle? • Vilken handling kan användaren göra rätt vid fel tillfälle? • Vad händer om användaren utför en ej fullständig handling eller utesluter en handling? • Vad händer om användaren utför handlingarna i fel ordning?				

Fel	Orsak	Konsekvens	Upptäckt	Återhämtning
Close down the Create item-form	They click away by accident	They get a warning message about whether they want to continue creating the item	They read the message	Click "Yes"
They can click "Save to agenda" before they have finished creating the item	They do it by accident	The item is incomplete	They notice that input is missing	They edit the item and add the relevant input

Appendix E: Full Affinity Diagram from Usability Evaluation 2

Information about the meeting (missing information and hierarchy)

- Participants wanted an overview of the meeting first. Participants did not think that it was clear where the meeting was going to be held or if it was going to be digital. They also wanted to know who should attend the meeting.
- Participants wanted to see more information about the meeting directly in "Upcoming meetings" and thought that the time for the meeting should be bigger.

How much time do I have left to submit my item?

- Participants thought that a large number of hours does not make sense to them and that they would like to have the remaining time presented in a number of days.

Increase clarity of which month the meeting is to the left in "Upcoming meetings"

- Participants thought that the month needs to be more clear and easier to spot.

Who has created this item?

- Participants did not see "From" when viewing an item, hence it became unclear who had created it.

What does the green frame around an item mean? What does a green box mean?

- Participants did not understand the difference between (or the meaning of) the item that had a green frame and the one in a green box.

The numbering of items

- Participants found "No." before an item unnecessary and thought that numbers (1,2, 3..) would be sufficient.

State the day in "Upcoming meetings"

- Participants desired to know which day of the week a meeting should be held to complement the date and time.

The calendar view

- Participants wanted a monthly and yearly view over their meeting calendar.
- Participants wanted to be able to switch between different calendar views.
- Participants wanted a clear overview over how many meetings they had in a day.

Comments on the visuals from test participants

- Participants thought that the interface looked unfinished and since elements and buttons in the interface were big, this made it look young and immature.
- Participants felt that they were locked in in the interface as there were too few action options.

Interface hierarchy

- Participants wanted the meeting headline to take up more space than the items.

Desired functions and notices:

- Participants thought that it would be good to have a tag indicating who edited a specific item last.
- Participants thought that it would have been nice with transitions between the screens.
- Participants were wondering how it will look when they enter the meeting view.
- Participants thought that it would have been good if attached images/PowerPoints were visible directly in the item without having to open or download them.
- Participants thought that it should be easy to open PowerPoints directly in the software. There should not be any need to pause the meeting so that someone can open the presentation on their computer. It should be integrated in *G-suite/Outlook* etc.

Appendix F: Cognitive Walkthrough and Predictive Human Error Analysis 3

CW och PHEA: Save an item for later

	J/N	Varför?	Problem	Anteckningar
1. Kommer användaren försöka uppnå rätt effekt?	Yes	There is a button saying "Save for later".	-	
2. Kommer användaren att notera att rätt handling finns tillgänglig?	Yes	It is visible and is placed next to another button.	-	
3. Kommer användaren att associera korrekt handling med rätt effekt?	Yes	There is a text on the button saying "Save for later".	-	
4. Om rätt handling är utförd, kommer användaren att se att handlingen har för uppgiften närmare målet?	Yes	They will get feedback (text + their item disappears + the personal menu symbol gets highlighted).	The user might have problems understanding where their item ends up.	
• Vilken handling kan användaren göra fel vid rätt tillfälle? • Vilken handling kan användaren göra rätt vid fel tillfälle? • Vad händer om användaren utför en ej fullständig handling eller utesluter en handling? • Vad händer om användaren utför handlingarna i fel ordning?				

Fel	Orsak	Konsekvens	Upptäckt	Återhämtning
They can save the item directly to the agenda.	Does it by mistake.	The item ends up in the agenda preview.	The item will immediately pop up in the agenda preview and will not be in the list of saved items.	Create a new item and save it for later. Delete the old one form the agenda preview.

CW och PHEA: Find a saved item

	J/N	Varför?	Problem	Anteckningar
1. Kommer användaren försöka uppnå rätt effekt?	Yes	They realise that they need to do something to find the item since it is not on the first page and they know that they do not want to create a new one.	-	
2. Kommer användaren att notera att rätt handling finns tillgänglig?	Yes	They realise that since they have saved it, it has to be somewhere and since they are the creator it should be personal to them (personal menu).	Might be difficult to find.	
3. Kommer användaren att associera korrekt handling med rätt effekt?	Yes	The button says "My saved items" and there is a symbol resembling the saved items list.	-	
4. Om rätt handling är utförd, kommer användaren att se att handlingen har för uppgiften närmare målet?	Yes	They will see the items they have created and saved for later.	-	
• Vilken handling kan användaren göra fel vid rätt tillfälle? • Vilken handling kan användaren göra rätt vid fel tillfälle? • Vad händer om användaren utför en ej fullständig handling eller utesluter en handling? • Vad händer om användaren utför handlingarna i fel ordning?				

Fel	Orsak	Konsekvens	Upptäckt	Återhämtning
They might search for it in the agenda preview.	It is possible that they think that the saved items will be in the agenda preview but only visible to them.	They will not find their saved item.	They realise that they do not find it.	Try again and find the "My saved items"-button.

CW och PHEA: Enter a meeting

	J/N	Varför?	Problem	Anteckningar
1. Kommer användaren försöka uppnå rätt effekt?	Yes	They know that the agenda for the meeting will be visible in the software tool.	-	
2. Kommer användaren att notera att rätt handling finns tillgänglig?	Yes	There is a button visible saying "Enter meeting".	-	
3. Kommer användaren att associera korrekt handling med rätt effekt?	Yes	They understand the message on the button.	-	
4. Om rätt handling är utförd, kommer användaren att se att handlingen har för uppgiften närmare målet?	Yes	They will see the meeting agenda and a button saying "Exit meeting".	-	

- Vilken handling kan användaren göra fel vid rätt tillfälle?
- Vilken handling kan användaren göra rätt vid fel tillfälle?
- Vad händer om användaren utför en ej fullständig handling eller utesluter en handling?
- Vad händer om användaren utför handlingarna i fel ordning?

Fel	Orsak	Konsekvens	Upptäckt	Återhämtning
They might stay in the agenda preview.	They can already see the agenda and does not fully understand the method for the tool.	They will not be able to see changes that are made in the agenda during the meeting.	The other meeting participants will talk about things that they cannot see on their own screen.	Click "Enter meeting".
They might enter the wrong meeting if several are held at the same time.	They do not read the name of the meeting.	They will be in the wrong meeting.	What they see on their screen will not match with the items that are discussed during the meeting.	Click "Exit meeting", find the correct meeting and enter that meeting.

Appendix G: Full Affinity Diagram from Usability Evaluation 3

Visually:

- Participants thought that the different font sizes are confusing.
- Participants wanted to have the identity of the interface visible (for example logo) to understand where they are.
- Participants thought that the meeting headline was outside of their range of view. They thought that it was the logo of the tool.
- Participants did not see "Enter meeting" in "Upcoming meetings".
- Participants did not at first understand that the green background of the item had a meaning.
- Participants said that it took them a while before they saw the menu bar.

Functions of meeting view:

- Participants were worried that since the meeting view opens in the same window it might be difficult to edit things during the meeting.
- Participants wondered if it was possible to navigate to other screens.
- Participants said that it is important that they are able to take notes during the meeting.
- Participants wanted to see who else was in the meeting when they were in a meeting view.

Preferred way of saving an item:

- Participants thought that the tool might give them too many options and that it could demand them to complete their item immediately and save it to the agenda.
- Participants said that when they feel comfortable with their group they can save the item directly to the agenda even if it is not completed. Otherwise they want to save it for later.

Save item for later:

- Feelings before saving an item for later:
    - Participants were worried that they would not be able to find the saved item after saving it for later.
    - Participants were afraid that they were going to forget that they had a saved item if they saved for later.
- Feelings after saving for later but remaining in the agenda preview:
    - Participants thought that they would somehow be noted that they had an item that was saved for later that belonged to the meeting.

- When participants were searching for their saved item:
    - Participants had trouble locating the “My saved items”-page.
- When having found the “My saved items”-page and saving the item to the agenda:
    - Participants thought that they would come back to the agenda preview after having saved an item to the agenda that was located in the “My saved items”-page.

Meeting view:

- Participants were not used to a meeting view hence, they did not look after it when asked to enter the meeting.
- When entering the meeting view the message under the button made participants feel like they were late for the meeting.
- Participants did not understand why there was a specific meeting view.

Appendix H: Final list of design criteria

Create a meeting

- The tool should enable an admin or a project manager to create meetings
- Meeting details should contain
    - Time and date for meeting
    - Name of meeting (headline)
    - What project it belongs to

Agenda preview

- The tool should contain a preview of the agenda
- When entering agenda preview the Meeting details should be immediately visible
- Meeting details should include
    - Creator of meeting
    - Day and date for meeting
    - Start and end time
    - Location or whether it is digital or not
    - Information about the meeting
    - Meeting participants
- The tool should enable a project member to add items to the agenda preview
- The possibility to add items should close automatically 24h before set time with the exception from weekend if meeting on a Monday (then 72h before)
- The tool should enable users to see what items are posted already
- An open item in the agenda preview should show
    - Item headline
    - Item number
    - The person who edited the item last and when it was edited last (day and date)
    - The creator of the item
    - Information
        - If it exists
    - Attached files
        - If they exist
    - Options to edit or delete the item
- The number of characters visible of an item headline should be 30
    - If an item is longer it is interrupted by "..."
- It should be clearly stated if an item contains an attached file

    - This is marked by a symbol
- All items in the preview of the agenda should be numbered
- The tool should enable users to create items from the agenda preview- page
- The tool should enable users to see that their items end-up in the preview of the agenda
- The tool should enable users to see clearly what items that are created by them
    - This is marked by text and a colour
- The tool should automatically add the name of the creator of an item to the item
    - This is visible for everyone viewing the item
- The last created item should end up in the bottom of the list
- The active item should be marked by colour

"Create item"

- It should be possible to create items from the page agenda preview, this opens the "Create item"-form
- The "Create item"- form should contain: Headline, "To" that is chosen, what project the item belongs to, a "free-text" field where additional information can be (if wanted) added by the user for further explanation of the item
    - The number of headline-characters is restricted to 50
- An item is created into a meeting which belongs to a project
- When an item has been created, the creator should be stated after "From"
- It should be possible to save an item for later
- To be able to save an item for later it must contain a headline

"Edit Item"

- It must be possible to edit items
- Anyone should be able to edit an item that is saved to the agenda preview

"Upcoming meetings"

- The upcoming meetings should be visible in a list
    - The upcoming meetings should be sorted by the date for the meeting
- The visible information of a meeting in the Upcoming meeting list should be
    - Meeting name
    - The name of the project that the meeting belongs to
    - Day and date of the meeting
    - Start and end time
    - Location or whether it is digital
    - How much time is left for submitting items

        - If the time for submitting items is longer than two weeks, the time left for submission should say “More than two weeks to submission closing”
- The user may click on any meeting and access the preview of its agenda
- Once the meeting has started it should be possible to access the meeting view directly from the meeting in “Upcoming meetings”

“My saved items”

- Contains a list of the users saved items which can only be accessed by that user
- An item that is saved for later should contain
    - The date it was last edited
    - Which project it belongs to
    - Which meeting it belongs to
    - Day and date for the meeting
    - Start and end time for the meeting
    - Item headline
    - Item information
        - if it exits
    - Attached files
        - if they exists
- There should be options to edit or delete an item or to save an item to the agenda or save it for later.
    - it should only be possible to edit
        - The item headline
        - Item information
        - Attached files
- An item in the saved items-list should contain
    - Item headline
    - Project it belongs to
    - Meeting it belongs to
    - Day and date for the meeting

Upper border

- Contains:
    - Step back and forth,
    - “Upcoming meetings”-button and a personal menu
    - A personal menu which contains
        - Settings,

        - "My saved items "
        - Log out

Meeting view

- The meeting view should be accessible when meeting starts
    - The button for accessing the meeting should replace the "Create item"-button in the agenda preview
- It should consist of a list of all items that have been created into the meeting beforehand
- When opening an item, the item information should be shown
- It should be possible to assign an owner to an item
- It should be possible at any time to exit the meeting and come back agenda preview

Appendix I: Design guide

Here the design guide for the tool is presented including font sizes and colour codes (Figure 65). The font type used is Open Sans.

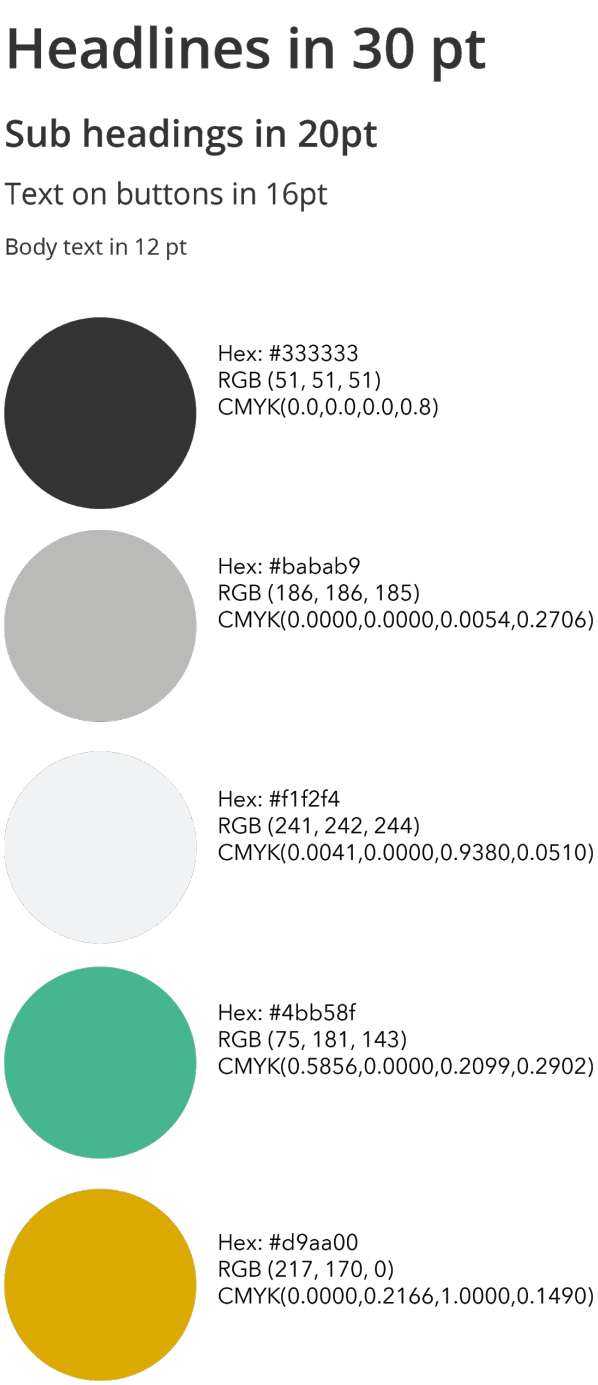

Figure 65: The design guide for the tool.

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