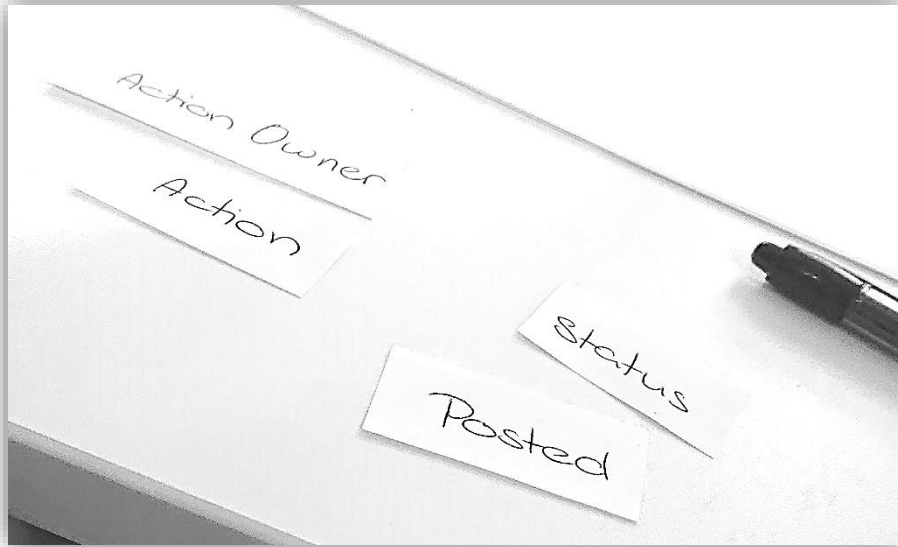




CHALMERS
UNIVERSITY OF TECHNOLOGY



Communication in collaborative projects

A design proposal

Master's thesis in Industrial Technical Design

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DEPARTMENT OF Industrial and Materials Science
Industrial Design Engineering

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Communication in collaborative projects
A design proposal

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Cover:

Image of a part of the physical prototype developed in the project.

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Abstract

Projects within the product development industry are often collaborative, meaning that the projects involve multiple companies, a fact that complicates communication. In this thesis, two projects at FlexLink's site in Gothenburg were studied to identify what communicative challenges they faced. Based on the identified challenges in the projects and the needs of the project team members a concept for a collaborative meeting agenda was developed. The concept is a shared digital platform focusing on improving meeting quality. The initial concept was validated with end users in individual feedback sessions and then further developed and tested through interactive prototypes in three iterations. The tests were conducted in three real meetings in which the prototypes were used. The user experience was then evaluated with a Semantic Differential Scale and the SAM tool. The iterations unveiled further needs and requirements that were compiled into a list of requirements that served as a base for the further development and evaluation of a final concept, which is a visual representation of the functionality as well as a basic design proposal for the UI.

Additional to the main study at FlexLink, an explorative study was conducted at six companies in the southwest part of Sweden. The aim of this study was to provide a frame of references for how meetings should be conducted and what issues as regards communication can occur within an organisation.

Keywords: Collaborative projects, meeting agenda, digital meeting tool, meeting efficiency

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Finally, there is a person not obligated in any manner to contribute to this study or report, but still did. To be able to generate the type of prototype desired, extensive coding to create macros in Excel was needed. Thank you, Johan Nyström, for being our real life and online support when Excel took the better of us.

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1. Introduction

Many organisations across different types of industries face problems communicating efficiently in collaborative projects. However, the construction industry has undergone a transition of how to successfully communicate between different actors and this transition was the inspiration for the research project, Kidsam, financed by Vinnova (2018), of which this thesis project is a part. The thesis project focuses two projects of a collaborative nature at one department at FlexLink, a company partner in the KIDSAM project. FlexLink is a company that develops and produces production lines worldwide. The company was founded in 1980, as a spin-off from SKF, and has grown in both the type of lines they produce and geographically. (FlexLink, 2019)

1.1 Background

In 2005, a matrix named “question-answer” (Q&A) was developed at PEAB, targeting the construction industry. The matrix had an impact in terms of shortening lead times in projects and enabling informed decision making related to important problems (Dalman, 2006).

Within the construction industry, projects tend to be of a collaborative nature due to the different expertise needed (Dalman, 2005). This, however, also means that the projects hold high complexity since there are several actors that need to both receive and deliver relevant and correct information to internal and external parties. The difficulty lies partly in who delivers what information to whom.

The study, from which the Q&A matrix emerged, saw that prior to the implementation of the matrix, projects did not finish in time. The site managers found it difficult to get a holistic view of the project tasks and what to prioritise, often finding themselves feeling spread thin and very stressed. When the Q&A matrix was introduced it successfully improved the communication of tasks and supported the project management as it brought clarity to the decision-making process and facilitated backtracking the same in collaborative projects.

Companies outside the construction industry are more often than before collaborating with external parties in collaborative projects to become more competitive on the market (Bertilsson & Wentzel, 2015). One of the reasons for this is that companies today have a need to develop products with a level of complexity that they do not have expertise of within the company. This creates a need for outsourcing or collaboration with an external party. However, this is also resulting in higher complexity and uncertainty of projects (Eslami, 2017). Since the construction companies found a solution to the challenges they faced in regard collaborative projects, it was deemed feasible that there is a possibility to also improve collaborative projects in other sectors.

One company that has developed a tool to improve collaborative projects is Yolean. They originated from a research project at Chalmers University of Technology (Chalmers), Gothenburg, Sweden, that investigated the benefits of digitalising tools for the construction industry, there among the Q&A matrix. As FlexLink is growing, they are entering new markets and have come to realise that the core benefit of their product is desired in other branches as well, but also that new needs and requirements arise as a consequence.

FlexLink was involved in a project with Chalmers called Kidsam (Vinnova, 2018), a research project regarding knowledge and information sharing in collaborative projects. The expected results and effects of the project were the following.

1. Digitalisation of effective working methods focusing on work tasks, not on administration.

2. Safe data management, Storage (in the background without disturbing the work) over time in a legally valid manner.
3. The ability to collaboratively and proactively safely integrate advanced and situational knowledge from multiple sources between parties without compromising on either 1 or 2.

The thesis project presented here was a part of the Kidsam project, focusing on issue #1.

1.2 Aim and objectives

The aim of the thesis project was to investigate the needs and requirements related to communication in collaborative projects and based on these develop a digital tool to face those challenges. The research questions posed were the following:

1. What communicative challenges are faced in collaborative projects at FlexLink?
2. How can these challenges be faced with the introduction of a new tool?
3. If so, what functionality should the tool possess?

1.3 Demarcations

The thesis project has not considered the second expected result listed in the Kidsam project description; Safe data management, Storage (in the background without disturbing the work) over time in a legally valid manner. Furthermore, the thesis project has not explored any programming challenges associated with the proposed solution.

1.4 Approach

The overall approach of the thesis project has been the Double Diamond, developed by the Design Council (2019). It is a user-centred design approach consisting of four phases described as discover, define, develop and deliver, (see figure 1).

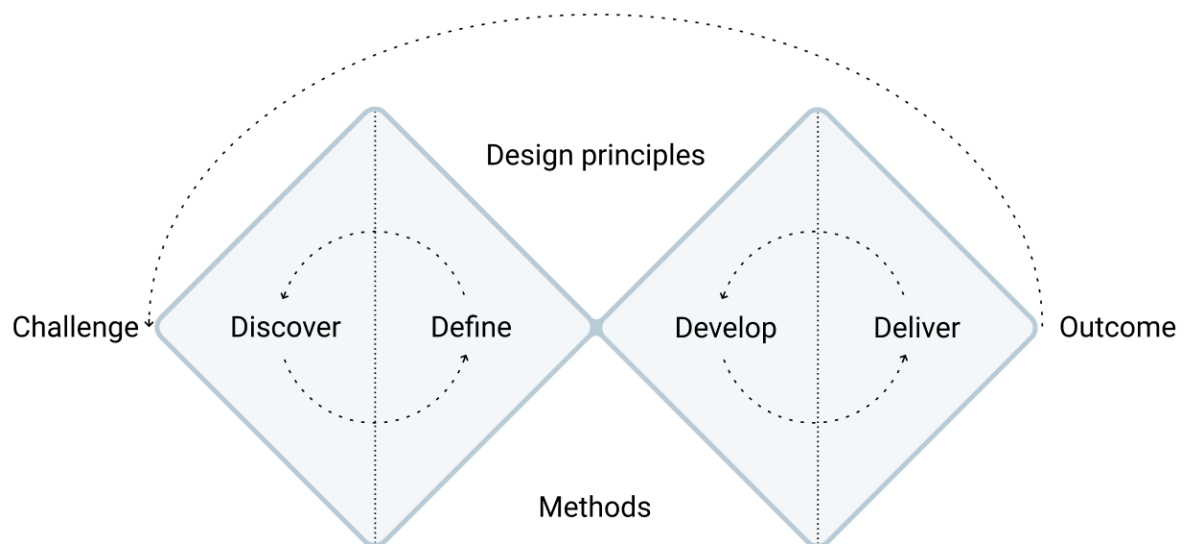


Figure 1: Visual representation of the Double Diamond method (*Design Council UK, 2019*).

The first phase is to discover what the problems are. Before initiating the work at FlexLink, an explorative study was conducted at six different companies to gain a point of reference of how communication can be conducted and to explore different types of meeting cultures. This was done by interviewing project and line managers as well as project members, and also by conducting observations of meetings at the same six companies. As the discovering phase explored businesses of different types, the main aim of the second phase, to define, was to

identify common challenges and eventually the root causes. By studying many projects at different companies, an understanding of diverse communication methods was obtained.

After exploring several different businesses, the main user study was initiated that focused on two projects at FlexLink, i.e. an iteration back to discover. The study included observations of meetings and interviews with the purpose to gain a true understanding of intended the users of the tool, their procedures, the problems they face in their work as well as what works smoothly. With the knowledge and understanding of the users and their procedures, the second phase was initiated. In this phase problem areas were defined. The defining phase aimed to highlight other problem areas as well, in order to lay a solid ground for the third and fourth phase.

Initiating the second diamond and the third phase, to develop, several idea generation methods was used to find solutions to the problem areas found in phase two. The initial ideation emphasised the importance of quantity of ideas for solutions rather than the quality and completeness. In a first iteration, an early concept was developed and evaluated through user feedback. The three following iterations, during the third and fourth phases develop and deliver used rapid prototyping (interactive Excel prototypes) to develop prototypes that were used in user tests. The development and test of each prototype defined each iteration. The first design proposal and the following three prototypes were considered deliveries, referring to the second diamond. The final concept was the final delivery.

Figure 2 presents the elements used to answer the research questions formulated in section 1.2. As described above, the first iteration of the first diamond consisted of a study of six different companies, the reference companies. The theory used are methods and design principles, as well as organisation theory and other background theory.

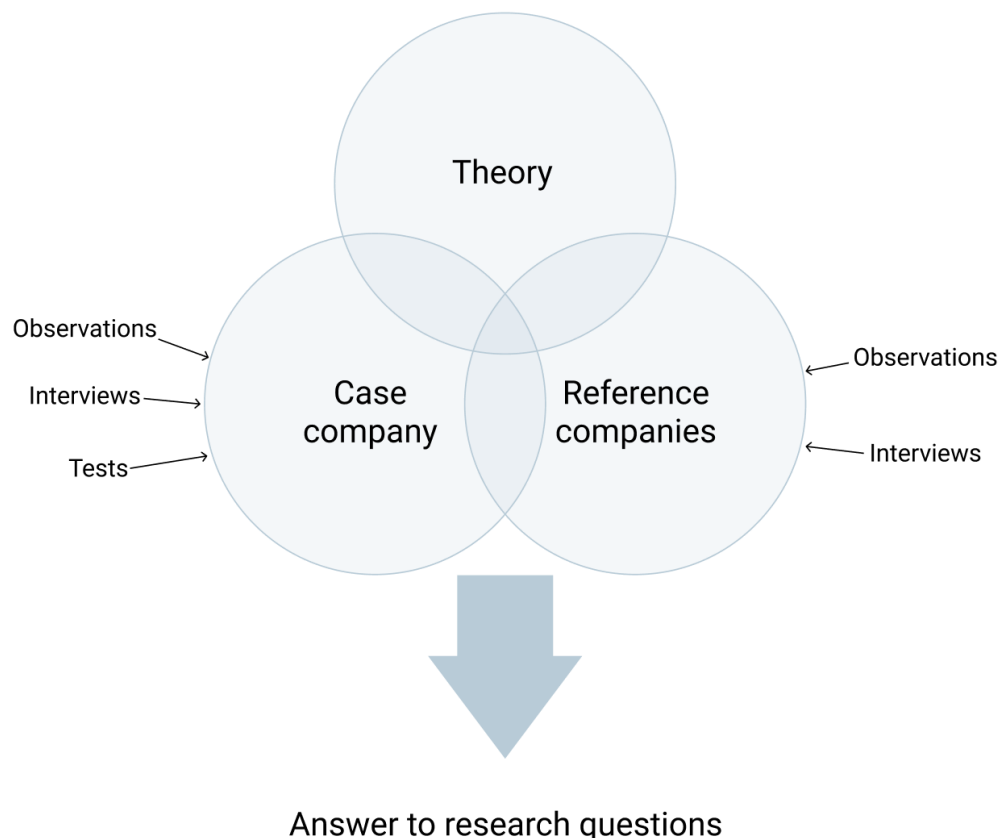


Figure 2: Visualisation of the elements of the thesis.

1.5 Report structure

The report is organised as follows:

- *Chapter 2* presents a theoretical framework which is used continuously throughout the report.
- *Chapter 3* presents the explorative study of the six reference companies. This includes the phases discover and define.
- *In chapter 4* the main user study at FlexLink is initiated, which includes another iteration within the first diamond with the phases discover and define.
- *Chapter 5, 6, 7 and 8* describe the concept development, each including a full cycle of the double diamond.
- The final concept is presented in *chapter 9*, which is the final delivery and outcome of the thesis project.
- *Chapter 10* presents a discussion of the whole thesis, including the process, methods used, possible implementation and future work.
- A final conclusion of the thesis project can be found in *chapter 11*.

Part 1: Exploration

2 Framework

A literature study was carried out in order to create a framework that could provide a basis for the thesis project. This chapter summarises descriptions of theories that are used in the project and that need more elaborate explanations. Since the aim of this thesis project was to find a solution to aid collaborative projects between organisations, theory behind success factors within organisations need to be understood along with organisational theories of how an organisation and the people in it operate and can operate. Although the overall aim of the project was to find out how a tool could help FlexLink to address challenges associated with communication in collaborative projects, the questions guiding the literature study were more generic.

- 2.1 Group dynamics effect on organisational management
 - How does company culture impact the communication in organisations?
 - What mechanisms in group dynamics effect communication and what is important to considered?
- 2.2 **Fell! Hittar inte referenskälla.**
 - What mechanisms are there that effects communication of knowledge?
- 2.3 Project management
 - What main steps in are there in an project, what information is being processed and what impact can visualisation have?
- 2.4 Meetings
 - What type of meetings are there and what is considered good practise for planning and conducting meetings?
- 2.5 Quality of an answer
 - When giving an answer, what parameters effect the perceived quality of that answer?

Figure 3 visualises how the different parts of the theory presented in this chapter are considered to be interlinked. Software is seen as something that is outside the system of staff within an organisation but that both affect each other, the software important for this thesis are presented in Appendix B. It is believed that an organisation is made up of people that are desired to operate efficiently and to this the thesis presents a selection of theory believed to be most relevant to the research question.

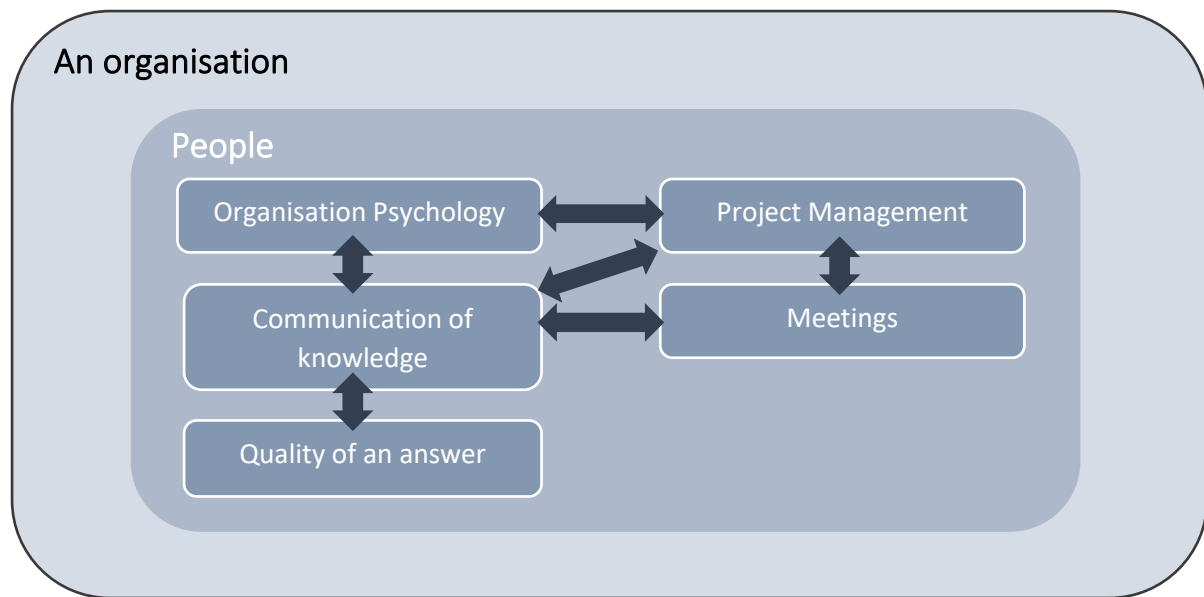


Figure 3 - Illustration of the correlation between the theories explained in the chapter

The mechanisms affecting groups of people within an organisation needed to be understood to better understand how a possible solution was to be affected or affect. Theory of organisation psychology was therefore studied.

To then be able to give an answer to the research question communication of knowledge was needed to be understood within the context of groups of people in an organisation.

Organisational psychology is also interlinked with project management which was also studied to give a deeper understanding of the requirements on a solution that were to be used within projects. Meetings are both a way that knowledge and information is transferred and in addition a tool for project management, this resulted in theory being studied regarding aspects of meetings with different purposes. Since the thesis aims at finding a solution to improve the communication in collaborative project, the quality of an answer was also found to be of interest for the thesis.

2.1 Group dynamics effect on organisational management

Where there are people there is psychology that tries to make sense of the actions of humans. Organisation psychology addresses motivational and emotional aspects of working to better understand how a group or an organisation operates and can operate (Cascio, 2015). Control theory within organisational theory helps to understand different types of organisations in relation to the group dynamics and what “control” to apply for organisational and individual success. This is important to understand due to that if a tool is to be implemented at FlexLink, contextual aspects that might affect an individual’s ability to communicate effectively within an organisation need to be identified and understood. This so that a tool can be created that supports communication at an organisational, team and individual level in the right way.

2.1.1 Organisational control theory

Control theory is a term used in several different field such as mathematics (Zuazua & Fernández-Cara, 2003) where control is how well something can be predicted and measured against the actual result. It is also used within psychology and sociology (Bernard, 2012). Within sociology containment theory was founded by Walter Reckless, that later gave rise to control theory. Containment theory says that humans are steered by inner and external mechanisms. Inner mechanisms are explained to be “moral and religious beliefs as well as from a personal sense of right and wrong” and externally a person is influenced to some degree of the persons around him or her such as family and other authorities.

Later added to control theory was the dimension of why humans conform to social norms. In turn, this theory is divided into social control theory and self-control theory (Taylor, 2001). Social control theory is based on the belief that how much a person cares about another individual's wishes and expectations depends on how likely they are to deviate from the norms. If he or she does not care, they will not be bound by those norms and are therefore more likely to deviate from them. Self-control on the other hand is more based on the individual's character that is based on if a person is impulsive, a risk-taker, sensitiveness towards other's feelings and being short sighted.

Both theories of containment and control within sociology stem from criminology research, studying humans in a criminal environment and why they commit offences. However, they give background and an initial understanding of behaviour control that is a part of organisational control theory (Gao, Borman, & Liua, 2014). Organisational control theory aims to control an organisation through a set of mechanisms so that it moves towards its goals and objectives (Ouchi, 1979). There is slight debate on exactly how it should be done but there are some general control mechanisms.

One of those is, as mentioned, behavioural control, which is executed, among others, through design guidelines, role specification and close supervision. These all contribute to control of how individuals within the organisation act. Behaviour control is something that can only be applied effectively when tasks and goals are well understood within an organisation or group (Gao, Borman, & Liua, 2014). First when the goal is clearly communicated can behaviour control be performed effectively, such as through design guidelines, role specifications and close supervision. Stable manufacturing industries have been said to have the requirements for behavioural control (Ouchi, 1979). Fast growing industries and organisations are on the other hand said to not have the requirements for behavioural control, but that clan control should be applied (explained in the next paragraph). However, there is research that suggests that behavioural control should be avoided in most cases and focus should be on other control mechanisms (Gao, Borman, & Liua, 2014).

Beside behavioural control there are three other types of control: clan control, input control and output control. Clan control is categorised by goal setting, evaluation and administering of consequences by a group sharing similar goals, values and norms (Gao, Borman, & Liua, 2014). The clan mechanism is very powerful and something that might not be recognised by an inexperienced eye since it is not bound by official standards and guidelines (Ouchi, 1979). With this type of control, it is important with joint problem solving, participatory decision making, transparent and honest information and that promises are kept (Gao, Borman, & Liua, 2014). Input control is linked to the selection of staff, resource allocation, along with the training of the same staff, what is put into the organisation is controlled. Clan control and input control are closely linked since the selection of staff effects clan control by to which extent the staff shares goals, values and norms. If an organisation grows, the turnover changes and specialisation of staff can all undermine the creation of goal concurrence throughout the company since departments tend to become less dynamic. Therefore, it becomes increasingly important to focus on the clan mechanism (Ouchi, 1979). Finally, output control can be system specifying, tracking, validating and incentivizing project targets which is possible if outputs are measured (Gao, Borman, & Liua, 2014).

Figure 4 shows what control type is possible depending on the ability to measure outputs and the knowledge of the transformation process that is defined by the "ability to specify the steps that need to be followed" (Gao, Borman, & Liua, 2014).

		Knowledge of the transformation process	
		Low	High
The ability to measure outputs	High	Output control	Behaviour and/or Output control
	Low	Input control Clan control	Behaviour control

(Ouchi, 1979) (Gao, Borman, & Liua, 2014)

Figure 4 - What type of control that should be applied when.

How much and what control that need to be performed for organisation to succeed depends. It depends foremost on the organisations choice to either select individuals that match the organisation perfectly regarding their values and the task that is to be performed or if these must be taught (Ouchi, 1979). However, for the organisation to succeed the individual must succeed. The information needed for the individual to succeed exists within the rules set up by the organisation in some way. A rule indicates a standard that also implies that a comparison has been done, i.e something is considered better than something else. Management must therefore assign a value to a rule so that evaluating the outcome, i.e performance, becomes possible. The perception is often that the value assigned to a rule have to correspond to the current situation that the organisation operates in and the more qualitative the rules are, the higher the administrative cost. The more unique tasks there are to assign rules to, and values, to evaluate performance the closer the supervision needs to be to evaluate performance of staff.

2.2 Communication of knowledge

Communication relates to some information that is being exchanged between individuals (Lindlöf, 2014) which does not always happen smoothly. There are several barriers for knowledge sharing (Ridge, 2005). Information exchange that also build knowledge is important for organisational success but something that is hard to finetune, "...knowledge is more than an abstraction of data and information, as knowledge is personalized and therefore relative" (p.24) (Lindlöf, 2014). The fact that all humans have a unique set of knowledge are one of the factors effecting communication but there are also other barriers for knowledge sharing.

These barriers can exist on an individual level, such as lack of time to share information, lack of contact time and interaction between knowledge sources and recipients, low awareness of the value knowledge of other have, strong formal organisational hierarchy, insufficient handling and documentation of past mistakes and trust in others to misuse information or to be perceived as not have enough credibility to be believed in. Barriers for knowledge sharing can also exist on an organisational level. The barriers can include that the organisation has insufficiently implemented knowledge management strategies, lack of leadership that clearly communicates the benefits of knowledge sharing practices, knowledge retention from skilled staff is not prioritised, communication and knowledge sharing is forced into one direction such as top-down, or that internal competitiveness and size of business units are not small enough to effectively facilitate sharing of information.

When referring to communication as information produced or possessed by humans, it can be divided into three main knowledge categories defined as individual, global and organisational knowledge (Tryon Jr., 2012). Individual knowledge is defined by the knowledge a person has absorbed through formal education and personal experience, meaning that two persons will never have the exact same individual knowledge. The definition of global knowledge is the information accessible to anyone through books, internet, industry standards, government publications etc. Global knowledge is therefore also used to shape individual knowledge. Finally, organisational knowledge has elements of both individual and global knowledge. It is, however, considered to be a separate category as it includes the formal integrated applications of knowledge beliefs and processes within a specific collection of enterprises and their organisations data, information and decision making. It can be said that “Organizational knowledge is the knowing required by an enterprise to produce the products and services necessary to perform the work of the enterprise.” (s.56) (Tryon Jr., 2012).

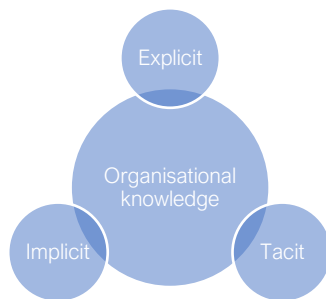


Figure 5 - The main types of knowledge within organisations

2.2.1 Explicit vs Implicit vs Tacit knowledge in organisations

Knowledge management within organisations can be further broken down into explicit, tacit and implicit knowledge (as shown in Figure 5). The *explicit knowledge* is the knowledge that is easily captured in a physical medium such as in a text, or an audio- or video recording without the receiver misunderstanding or having to ask questions about the content. Knowledge that an individual possesses and that cannot be captured in physical medium such as in text or with words, is tacit knowledge. *Tacit* knowledge is important for an organisation but also the most challenging to communicate to others. However, some tacit knowledge can be communicated and become explicit knowledge. Such knowledge, that can become explicit knowledge, but at the given time has not

been communicated, is called *implicit knowledge*. Implicit knowledge can be further explained as information an individual or group does not acknowledge that they have, with or without intention, the information or knowledge will therefore stay tacit and will not become explicit to others in the organisation (Lindlöf, 2014). The more accessible the information, the less effort is required to acquire the information. To transform implicit knowledge to explicit knowledge is often a matter of asking the right person the right question and then in some way record the answer (Tryon Jr., 2012).

2.2.2 Organisational growth's effect on communication

As a company grows larger with more staff the complexity of the organisation increases and it becomes increasingly difficult for information to be communicated to where it is needed (Lindlöf, 2014) (Mintzberg, 1979). The problem may not be that the information does not exist, one example being implicit knowledge, but that it is not communicated in an effective way or at all. How well information is communicated has little to do with physical distance and how much information must be distributed.

A company smaller than 40 staff can operate successfully by informal ways of communication, but as the organisation continues to grow more formal and structured ways of communication need to be put into place. Since the growth of the company will increase the difficulty to communicate information to where it is needed, an organisation will be required to move away from more informal communication and mutual adjustment (Lindlöf, 2014). Instead they will have to move towards more official ways of communication and standardization of tasks, outputs and even skills when the organisation grows larger.

2.3 Project management

A project from that of initiation to completion goes through four main steps (Project Management Institute Pennsylvania, 2013): initiating, planning, executing and closing. The



Figure 6 - Main steps for project management through a project.

initiating phase defines what the project should achieve, the planning phase deals with how and when that should be achieved, the main goal of the project is achieved in the executing phase and finally the process of closing down a project is done when acceptable deliverables have been achieved. One step does not end as soon as another begins but they overlap and, in some cases, it is an iterative process between the two phases. As a project starts to execute the objectives of the project, new things are discovered and will therefore need continuous planning throughout the project. In all phases, different control mechanisms are utilised, such as meetings, which theory is elaborated in 2.4. This master thesis focusses on the control of planning

and executing but the closing phase will be briefly discussed, since it effects planning and execution for future projects.

2.3.1 Planning and executing a project through visualisation

Product development projects have always a level of uncertainty, even if a plan is conducted, since things can change throughout a project (Lindlöf, 2014). The uncertainty exists as an organisation need to know more than it already does. To manage this knowledge gap and minimise the uncertainty throughout a project, planning is conducted using different methods and tools.

After the initiation of a new project a plan for the project is therefore typically done (Project Management Institute Pennsylvania, 2013). The plan should define the actual problem to be solved, the main activities taking place to do so, who the different stakeholders are and what they expect, timelines for the different activities, budgeting, resources and material needed for the project (Harvard Business Review, 2016). A plan should not be seen as something that is fully completed before the execution phase but something that is consistently updated and reviewed throughout the entire execution phase (Project Management Institute Pennsylvania, 2013). This can be done with varied success. A reoccurring issue is that teams fail to remain focused on the goal of the project, the actual problem to be solved (Ulrich & Eppinger, 2012)

Different methods for planning have been used over time and something that have emerged the last few years is Visual planning (Lindlöf, 2014). The use of a visual aid to communicate can be traced back thousands of years and now with the emergence of technology it is being used more extensively then before in society, there among different industries. Visualisation have been proven to improve reasoning and problem-solving abilities, as well as finding patterns and memory capacity. All these aspects of visualisation are attractive traits for a planning tool and that can support focusing on the goal of the project through outlining activities and deliverables in a visualisation.

Due to visual management not being researched until recently, the definition of what visual planning is varies slightly (Lindlöf, 2014). It can be said though that it is a tool where a visualisation, showing activities and deliverables, is used in combination with frequent meetings to help manage the activities and deliverables throughout a project. Today there are companies

were some are using physical visualisation and others that use digital visualisation. Although visualisation for management and planning comes with many benefits, the use of visualisation is only as good as the visualisation itself (Lindlöf, 2014). Controlling the communication, as visual management does to certain extent, is something beneficial in the sense that it can focus the communication on high priority issues. However, the communication will rely on what the visualisation contains and therefore all content presented in the visualisation need to be put there consciously.

Visual planning should not be confused with the visual representation of the ideal process presented in more traditional management literature, visual planning is a tool focusing on the actual activities and process taking place within an organisation and are not trying to represent a formal process (Lindlöf, 2014). In visual management It should be mentioned that there is a difference between visualisation of knowledge and visualisation of information. Explicit knowledge, explained in 2.2.1, is the focus of information visualisation, whereas knowledge visualisation focus on implicit and tacit knowledge, also explained in 2.2.1. Since implicit and tacit knowledge is important knowledge for an organisation but is hard to transmit to others, research is being done on how visualisation can help ease to spread this knowledge and turn it in to explicit knowledge.

There is said to be four important perspectives when developing visualisation for knowledge shown in Figure 7. Firstly, what is the function of the visualisation and what is it to be used for? Second what knowledge should be transferred through the visualisation? Thirdly, who is the receiver of the knowledge, and lastly, what type of visualisation should be used?



Figure 7 – Remo Aslak Burkhard's four perspectives of what is important when developing knowledge visualisation (Lindlöf, 2014)

The application of visual planning is to use some type of board, digital or physical, that is being used at frequent meetings with the member of a project. When used at a project portfolio level, these meetings are sometimes referred to as Pulse meetings, explained in 2.4.3, along with how visual planning is applied in coordinating meetings to become a synchronised project team.

2.3.2 Closing

When a project has come to an end a process of closing the project begins. As seen in Figure 8 There are Several inputs from the previous steps of a project that need to be collected and processed in the closing phase (Project Management Institute Pennsylvania, 2013).

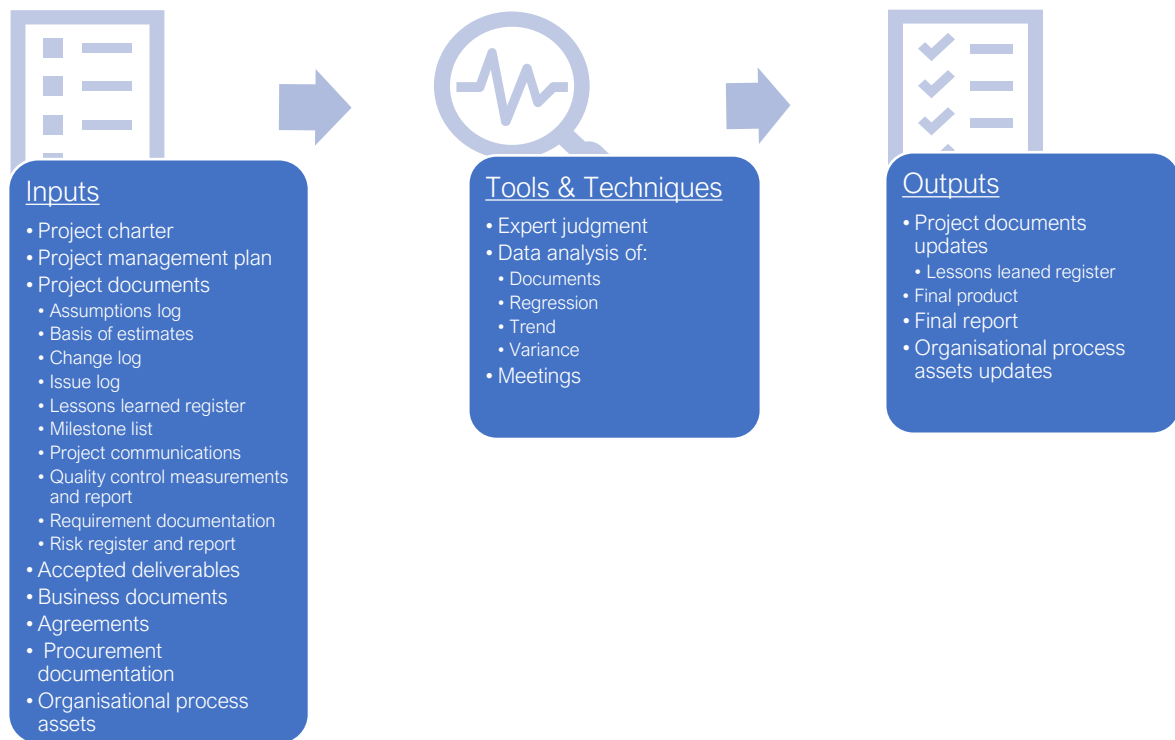


Figure 8 - Overview of the process, information and steps needed to close a project (*Project Management Institute Pennsylvania, 2013*)

One of the outputs from the closing of a project are lessons learned. They can be documented in a lesson learned register that is updated during the entire project by the management and project members. Since it is documentation that should be done throughout the project it therefore also becomes an input to the closing phase. The register is then analysed in the closing phase to retrieve knowledge from what can be improved to the next project or successes that should be applied in the future as well.

Although good practise is to both add successes as failures to the lessons learned, people tend to focus on what went wrong rather than right (Amyotte, 2019). Since one of the aims in a project is to minimise uncertainty and risks, it is easy to come into the mindset of focusing on only the things that went wrong. However, the successes in a project are equally important lessons to learn from and should be documented as well. What exactly a “lessons learned” register contains can vary but it may conclude:

- Category and description of the situation
- Impact it had
- Recommendations for what to do next time
- What is proposed to do next time in a similar situation
- What risks and/or opportunities that were realised associated to the situation
- Challenges associated with the situation

How this is captured may also vary and some examples are videos, pictures, audio and documentation through text, one or a combination of several can be used to best describe the lesson that needs to be learned. Another output of the project should be the issue log that is created in the very beginning of a project and then also continuously updated throughout the project, when an issue occurs, making it also an input to the closing phase. In the issue log the following should be stated to help management track and manage issues to make sure that they are resolved:

- Issue type

- Who raised the issue and when?
- Description
- Priority
- Who is assigned to the issue?
- Target resolution date
- Status
- Final solution

The analysis of the issue log then also becomes part of the “lessons learned” from the project.

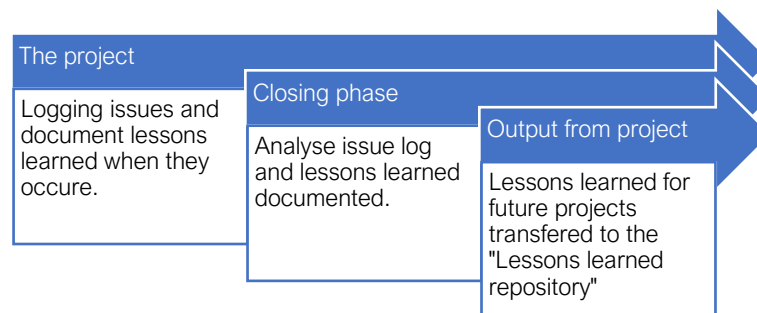


Figure 9 - The main steps to add information to the "Lessons learned repository"

2.4 Meetings in development projects

When looking at the core for what a meeting is and how it is used within organisations, it is used to bring people of two, or more, together to discuss issues and their solutions (LeBlanc & Nosik, 2019). Today there are several ways we can communicate, one being through email but people tend to overestimate the effectiveness of emails. If an issue cannot be explained in 50-125 words or less a meeting is most often preferred. Meetings allow for more complex and dynamic discussions to take place (LeBlanc & Nosik, 2019) (Lindlöf, 2014).

If collaborating with an external party there will be a higher level of uncertainty which requires a close collaboration, which mean that both parties need to set aside time as well as resources for, among others, meetings (Mohammad & Melander, 2016). There are many different types of meetings but there are two main categories: formal and informal meetings. Informal meetings can occur nearly anywhere and will not typically have a predefined and communicated agenda were as the formal meetings do. Formal meetings have an agenda with purpose, a set duration, held at a predefined place at a given time.

2.4.1 Formal meetings

The purpose of a formal meeting may vary but what all meetings share, formal or informal, is that they take up time and are thereby a cost for the organisation, formal ones more so than informal ones (LeBlanc & Nosik, 2019). Not only are meetings a cost, they are also often perceived as unnecessary and time consuming. It is important that formal meetings do not become another weekly habit that should be ticked off a list but that it generates something useful (Scott, Rogelberg, & Kello, 2007).

To have a clear purpose for the meeting and carefully choosing who to invite to a meeting should be to contradict meeting being and feeling a waste of time (Hartman, 2014) (Scott, Rogelberg, & Kello, 2007). “Svenska möten” (2018) did a survey showing that only 27% believed that all meeting attendees were concerned with what was being discussed at the meeting. There are also studies showing that meetings are often badly run, poorly timed and too frequent. Poorly run meetings can be directly damaging for the organisation and contribute to

the feeling of meetings as something that is time badly spent. (LeBlanc & Nosik, 2019) (Perlow, Hadley, & Eun, 2017).

Formal meetings can be an effective tool if used correctly (Perlow, Hadley, & Eun, 2017), if appropriately timed and scheduled with the right persons present (LeBlanc & Nosik, 2019). Duration of what is considered necessary for a meeting can vary but one hour is often recommended to be the maximum time to schedule for a meeting. However, if in-depth conversations, brainstorming or extensive feedback and editing of a product is needed, longer meetings can be beneficial.

Who and what decides what a good meeting is? The person leading the meeting often perceives the meeting as time well spent, although that not always is the case (Delaryd, 2019) (Möten, 2018). Since organisations shifts in structure, people, culture to just mention a few, there is not just one right way to conduct meetings, since situations change that affect how a meeting needs to be run (Hallberg & Strand, 2014). Although there is no universal truth for what the process of a meeting should look like, there are some fundamental aspects that need to be present having a successful meeting. At its core it starts with having individuals at a meeting that can cooperate, working along the purpose and towards the goal of the meeting. People that contribute to the meeting agenda are thus more likely to be engaged during the meeting, contributing and will be responsive to performance feedback (LeBlanc & Nosik, 2019). Besides having the right persons present at the meeting, there are some common fundamental aspects that need to be present for a meeting to be perceived, subjectively and objectively, to be time well spent for all attending the meeting. When a meeting is well run, the cost of the meeting is outweighed by the value of the result produced by the meeting. It is more likely to be a successful meeting if it has the following:

- ✓ Have the right people present for the meeting (Hartman, 2014) (LeBlanc & Nosik, 2019)
- ✓ Use an agenda that is communicated beforehand (LeBlanc & Nosik, 2019) (Scott, Rogelberg, & Kello, 2007)
- ✓ The meeting should have a predefined purpose that is based on what goal, desired outcome, for the meeting. (LeBlanc & Nosik, 2019) (Scott, Rogelberg, & Kello, 2007) (Hallberg & Strand, 2014)
- ✓ Make meeting notes such as meeting minutes (LeBlanc & Nosik, 2019)
- ✓ That the participants and the meeting is punctual (LeBlanc & Nosik, 2019) (Hartman, 2014)
- ✓ Have an appropriate meeting environment and equipment (LeBlanc & Nosik, 2019)
- ✓ Have a meeting leader (LeBlanc & Nosik, 2019)

Goal setting, task clarification and performance feedback have shown to improve employee performance and are all directly connected to the meeting elements listed above that will increase meeting productivity (LeBlanc & Nosik, 2019). A well-planned meeting starts with defining the purpose of the meeting and then developing an agenda, preferably together with those thought to attend the meeting. The agenda should be shared beforehand, preferably 24 hours before the meeting, and will during the meeting help guide the participants through the meeting. During the meeting, the agenda will provide structure and the sequence of the meeting topics should therefore be carefully thought through (Scott, Rogelberg, & Kello, 2007). One example is meetings for problem solving were it is important to first go through points that define the problem before moving to discussing solutions.

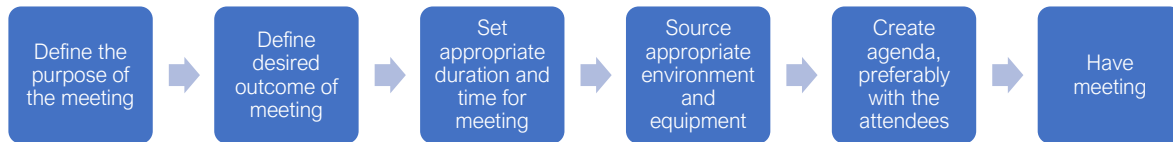


Figure 10 - Main steps for executing a meeting

The goal of a meeting that should be set beforehand can vary but some common goals, or purpose, are problem solving that has a more creative nature, synchronisation of a team to streamline a team towards a common goal, take decisions and it can also be to simply share information in either a reporting manner or with an educational purpose (Catic, Stenholm, & Bergsjö, 2016) (Scott, Rogelberg, & Kello, 2007). Meetings with the purpose of problem solving and synchronisation will be the focus in this report.

2.4.2 Meetings for problem solving

Meetings which goals are problem solving, no matter the size of the problem, can often be emergency meetings with short notice (LeBlanc & Nosik, 2019). These types of meetings are negative for an organisation since it causes stress for the individuals involved. However, things happen that must be solved quickly but it is then preferable to contact only key persons and not the whole group working in a project. This might cause unnecessary stress among staff, whereas when only individuals key functions are involved, the negative impacts can be contained.

Meetings are a good way to generate ideas and solve issues, but meetings need, if formal, to be planned. A meeting cannot cover the whole process of solving a problem process and some steps are better suited to be handled at a meeting than others. The early process of problem solving is often to gather information and to reflect, which should occur before a meeting to be ready to work on a solution with others. During the actual meeting, the problem should be analysed and discussed what possible solution there are to agreement on what to do next. If a person should attempt to find the solution themselves on something that effects multiple parts within the organization aspects of the issue might not come to light resulting in an incomplete, or even wrong, solution. When then a meeting has come to an end all attendees should know what to do and after the meeting the work should be executed by the appropriate staff, with the right knowledge, to solve the problem. An illustration of the process is shown in Figure 11.



Figure 11 - Main steps through the use of a meeting choose appropriate solution

The impact of the solution will be delayed with some time that is dependent on the solution itself and the problem it solves. Since the impact of a solution is delayed, a follow up, done an appropriate time after the implantation, on the impact is desired. This is a as important step as

the implementation itself and will there for be important to schedule time for this step as for giving time for staff to implement a solution. Figure 12 show the main steps when implementing a solution.



Figure 12 - Main steps when implementing a solution

2.4.3 Meeting for synchronisation

Visualisation as explained in 2.3.1 has been proven to be an effective tool to synchronise teams, making project members better understand and work towards a common goal throughout a project (Lindlöf, 2014). When adopting the methodology of “visual planning” to a project it involves having a board, physical or digital such as a Yolean board, explained in Appendix B, typically displayed on a wall that can be accessed by all project members and placed so that meetings can be held where all project members can stand around the board. The meetings should be held frequently with an appropriate frequency and duration for the project and group.

The board, physical or digital, will have a timeline going horizontally that can be divided into days, weeks or other time period that is suitable for the project. Vertically to the left should be the different groups, persons or other that a task and deliverable typically is assigned to. This then creates cells where a task or deliverable can be added with a deadline, assigned to those that are responsible to execute it. An example is shown in Figure 13, visual cues are given such as colour that corresponds to a specific meaning of the note.

Assigned to	Monday	Tuesday	Wednesday	Thursday	Friday
Group 1	 				
Group 2					
Group 3				 	
Group 4					
Group 5					

Figure 13 - Example of the fundamental elements of a board used for Visual planning (Catic, Stenholm, & Bergsjö, 2016)

At the meeting there should be someone leading the meeting that together with the meeting attendees goes through what have been done with the tasks and deliverables assigned from last time they had a meeting. After that has been done and appropriate changes to the board have been made, such as marking tasks done or removing them from the board. When that is done the meeting focusses on how to plan for the period until the next meeting, new notes with deliverables and tasks are added and assigned.

If looking at how to synchronise several teams and projects, project portfolio level, there is a method called Pulse (Lindlöf, 2014). The foundation of Pulse is frequent meetings scheduled daily, weekly or biweekly that only lasts no longer than 25 minutes to synchronise a group or organisation by discussing deviations from the plan. Typically, a white board, referred to as a Pulse board, is used to give a brief status report of deviations in different projects. An example of a “pulse board” is shown in Figure 14. The board is updated before the meeting and during the meeting it is briefly discussed how to solve the current deviations while all meeting attendees gather around the board (Catic, Stenholm, & Bergsjö, 2016). No lengthy discussions should take place at the meeting, since the idea is that the meeting should be short and the deviations should not be solved at the meeting to avoid a long meeting. If more lengthy discussions are needed a separate meeting should be arranged.

Assigned to	Recipient 1	Recipient 2	Recipient 3	Recipient 4	Recipient 5
Project 1					
Project 2					
Project 3					
Project 4					
Project 5					

Figure 14 - Pulse board to synchronise project to recipient, red meaning a deviation, yellow meaning that there is a deviation but that there is a plan to solve it and green for solved deviation. (Catic, Stenholm, & Bergsjö, 2016)

Another method developed from visual planning and originating from the construction industry is the “Question and Answer matrix” (QA matrix) that is used during meetings were all on site of a built is present (Johansson, 2005). The QA matrixes is one of several matrixes used in visual planning for a construction, but the QA matrix is the prominent one used during meetings. At this methods core is as well that meetings should be short but with the addition of that questions can be posted on the board before a meeting. The person that has been given a question should then have a correct answer at the meeting and should be ready to respond. This method shares with Pulse meetings that they should be frequent and that lengthy discussions should be scheduled outside these meetings.

From/to	Person 1	Person 2	Person 3
Person 1			
Person 2		 	
Person 3	 		

Figure 15 - QA matrix board visualisation, question posted from one person to another (Johansson, 2005)

2.4.4 Meetings for information sharing

Although synchronisation can be a form of information sharing, meetings solo for information sharing fall under a separate category (LeBlanc & Nosik, 2019). Some information can be shared through other mediums whereas other information is best shared in a meeting. As explained in 2.4, if it takes more than 125 words to explain something a meeting is preferred with that person or group the information is intended for. Depending on the urgency it can be better to collect several items of information to be brought up at a meeting to not cause the issue of having too many meetings but, at the same time not falling into the trap of having too long meetings. An informational meeting should not exceed an hour. The information shared at these meetings can regard organisational changes, management information to the group or project updates to stakeholders.

To have a meeting rather than sending out information through text in an email, or other similar medium, it allows to observe attendees' body language and responses. For the person giving the information this becomes valuable since it can help to understand if the information was understood and how well, or badly, it was received. The purpose of having a meeting to share information is a combination of giving the information but likewise as important is for the person giving the information to observe if and how it was received, and respond accordingly, for it to be information communicated effectively.

2.4.5 Meetings for taking decisions

Decision making is a large part of what an organisation does. The more centralised it is, the fewer people are involved in making them (Ungvarsky, 2019). In a democratic society, there tend to be more than one involved in the decision-making process for an organisation. Decentralising decision making has several advantages such as faster decision making, more

flexible responses and encourages more innovation since the decisions are spread out throughout the organisation. Decentralised decision structure also mean that decisions should be made by the people effected and, or, the persons with expert knowledge within the organisation.

When entering a decision meeting the discussion leading up to a decision should already been had, and the attendees should possess the information necessary to make an informed decision (Jost, Weiss , & De Smet, 2019). A follow up of some sort is often needed, people tend to sometimes not follow through on commitments for varies reasons. Reasons such as they forget, they felt one way at the meeting and something else after or something causing them to not commit to the decision made at the meeting.

2.4.6 Choosing environment, equipment and location for meetings

Where what meeting should be held is important for logistic, that the room or venue have the right amount of space for the amount of attendees and appropriate technology that will facilitate the meeting and its attendees (LeBlanc & Nosik, 2019). Good ventilation and temperature also play an important part in having a qualitative meeting. In today's working environment it is common to have meetings were not all are located at the same site or office. Due to logistics in an increasingly international business environment all those that need to attend a meeting might not be able to meet face to face, technical solutions make it possible to have meetings were remote attending is possible. Depending on the purpose of the meeting it can be, more or less, appropriate to not meet in person.

Dynamic engagement is more likely to happen if all attendees are present in person at a meeting, if in-person meetings are possible this is preferred, especially if the purpose of the meetings is more likely to be fulfilled. An example is that if the purpose of the meeting is to perform more complex problem solving it requires more dynamic engagement. Were as when performing more simpler tasks, as editing a document that already exists, this can be done effectively using a digital tool were the participants to not have to meet face-to-face.

Today there are many different technologies to choose from when having a meeting were all attendees cannot be at the same place at the same time. Audioconferencing, videoconferencing, screen sharing, web conferencing and electronic meeting system (ESM) (Schwarz, 2016). Depending on what technology is chosen, or combination of, it offers different opportunities but also raises different challenges. At a virtual meeting, regardless of what technology that is chosen, the first big drawback is that technology is not always reliable. When the technology does work there are still some challenges to overcome; it will be harder to follow along, give feedback and comment, remember who is in the meeting, people might multitask and disengage from the meeting. On top of these challenges it will also be much harder to establish a team spirit to effectively build a team or repair a dysfunctional one.

When choosing what technology that is best suited there are three main questions to be answered; what technologies are accessible for all participants meaning both by knowledge and access, how large is the group due to that different systems allows for different amount of online attendees and finally, what tools does the meeting require to effectively fulfil the purpose of the meeting, for instance, does everyone need to see an image of something?

To effectively run a virtual meeting, the facilitator, the person leading or that have initiated the meeting, will have to select the appropriate technology and to prepare it to try to make the technology as reliable as possible. The facilitator has to have an understanding of the technology being used themselves and its possibilities also making sure to create

understanding, or know that it already exists, of the technology being used among the meeting attendees.

2.4.7 Cognitive pool of resources

People have a limited pool of resources, meaning that one can only perform a certain number of tasks of a certain complexity. If a person is to perform one task only, all the cognitive resources may be focused on that task. If there is more than one task to be performed the pool of resources must be divided between the tasks, hence the performance declines along with the competition. However, tasks may demand different kind of cognitive resources which effects how the cognitive resources will be affected.

Wickens's multiple resource theory illustrates the different stimuli demands for different cognitive resources and how the stimuli is processed in different stages, see Figure 16. The same type of input information, code, and modality is very hard to encode simultaneously such as reading a text and listening to someone talking. However, if they are of different kinds, they are more easily encoded meaning that a person can take in both where an example is that a person can listening to someone talking while reading a map. Not seldom a person needs to encode stimuli that demands the same cognitive resources and then the task performance will decrease, an example being that the response accuracy decreases, or the response time will be longer. When developing a machine, or tool, for human-machine interaction it is important to consider the multiple resource theory to not unnecessarily burden the individual cognitive pool of resources and therethrough harm the performance. (Bligård, 2018)

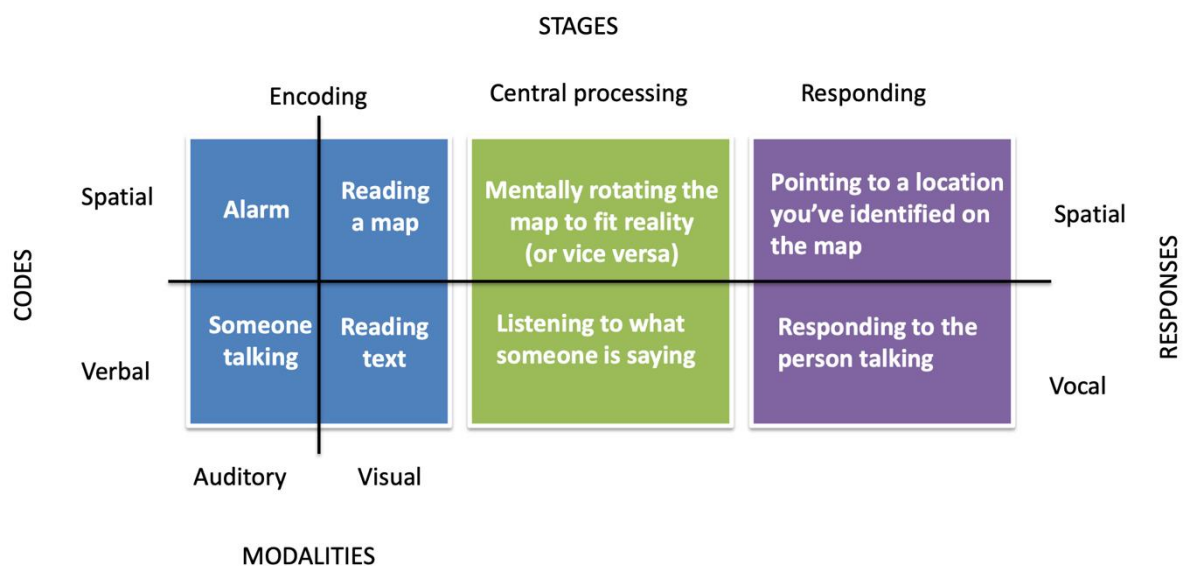


Figure 16: Illustration of Wickens's multiple resource theory.

2.5 Quality of an answer

Today it is common to have collaborative projects. The interaction of supplier and buyer have shifted to be more depended of each other, especially the buyers need to effect the supplier output (Joshi, 2009). Since there is an increase in dependency, the communication between the two parties becomes increasingly important as well. A collaborative communication is said to be with a:

- High frequency
- High formality, such as regular meetings that are booked with a defined purpose as explained in 2.4.1
- High reciprocal feedback, both parties engage to achieve a desired outcome

- Use of rationality as a means of attaining influence

What is, from a buyer perspective, desired in a collaborative project with a supplier to receive the best finished product is to control the output and capability of the supplier, not the production process. When a buyer has a high control of the manufacturing process, the quality is more likely to be even however very rarely be better than expected. This means both the price and quality of the actual product. When a supplier is able to act freer in terms of how to achieve the, by the buyer, desired product the risk might be uneven quality but gain is the possibility of a higher quality product or a better price. The reason for this is that the supplier gets to apply their expertise and produce in a way that they see will get the best result within the capability and resources of their organisation. Process control have also been shown to have a negative impact on supplier knowledge.

When the supplier engages in collaborative communication and a lower process control, both parties gain knowledge. This allows the supplier to improve their delivery to the customer and in the long term be able to perform continues production improvements since the supplier will have gain a deeper understanding of the needs that the customer has.

To satisfy the need of the costumer the communication needs to be of high quality. One of the aspects of communication in the supplier-costumer relationship is the *response expertise* and *response speed* (Jayachandran, Hewett, & Kaufman, 2004). Response expertise is how well the responses of an organisation meets the customer needs and response speed is how quickly those are met. With increasing customer related knowledge, such as their needs, the supplier has a better capability to respond. The better the knowledge, the easier it is to respond to questions, making it possible to decrease the response time. Response time is of great importance due to that it affects how the receivers experience the quality of the response, the quicker a response is given the higher the quality is perceived.

An aspect of knowledge is that uncertainty is reduced with the greater the knowledge. Uncertainty is often perceived as something undesirable, which is also discussed in 2.3.1, and that should be managed. A reason for responses to be delayed to a customer is when managers feel uncertain about the outcome of their response. However, customer responses are important for a company's success but can be constraint if considered risky due to uncertainty, which may lead to not satisfying its customer's needs. Therefore, management's ability to tolerate risk becomes a measurement for determining a company's response capability. It should also be said that the ability to retrieve information and gain knowledge also reduces the perceived uncertainty and therefore also becomes a way to increase response capability.

In 2.4.5 it is explained that when organisations decentralise their decision making, it becomes more rapid. This is also true for rapid response time to customers. Centralised decision making can also vastly reduce customer knowledge since it is not letting staff that are in contact with the customer take decision based on their explicit and tacit knowledge of the customer.

2.6 Summary

The framework has brought together literature on what were considered theories of relevance for the thesis project. In summary,

- What "control" that needs to be applied on a group depends on how well the output of a task can be measured and how well the task is communicated and understood.

- Barriers of communication of knowledge are on an individual level lack of time, lack of interaction between knowledge sources and recipients, low awareness of the value knowledge, strong formal organisational hierarchy, insufficient documentation of past mistakes and lack of trust in others.
- Barriers on an organisational level are insufficient implementation of knowledge management strategies, lack of leadership that clearly communicates the benefits of knowledge sharing practices, knowledge retention, communication and knowledge sharing is forced into one direction such as top-down, or that internal competitiveness and size of business units are not small enough to effectively facilitate sharing of information.
- Implicit knowledge is often not turned into explicit information which affect the organisational knowledge.
- Organisational size and growth influence what type level of formality communication needs to have.
- The main steps in a project are: initiating, planning, executing and closing.
- The impact of visualisation when used in planning is shown to improve reasoning, problem-solving abilities, as well as finding patterns and memory capacity.
- There are different types of formal meetings with unique characteristics and their own requirements on what is considered a successful meeting.
- Good practise for planning and conducting all formal meetings include having the correct environment, equipment and location for the meeting
- When providing an answer, the perceived quality of the answer is based on how quickly the answer is given. The same quality answer is considered higher if given faster.

3 Exploration phase

As a start to this thesis project six companies were visited in order to observe meetings and interview staff, mainly project managers, to find out more about communication within the company. Aim, method and procedure introduce this chapter and are followed by the result from the data collection. The chapter finishes with an analysis of the data and a conclusion regarding what have been learned that will be useful in the continuation of the thesis project.

3.1 Aim

The aim of the explorative study was to create a frame of reference for how communication is conducted within companies and what type of meetings that are common and understand how those are held.

3.2 Method

3.2.1 Sample

Before any companies were visited a selection of what companies to visit was made. The selection was a mix of, what was believed, to be companies using more traditional planning methods and others using the tool Yolean. Companies were also selected based on their size as choosing companies that varied in size allowed a study of whether or not communication issues could be independent from company size.

3.2.2 Data collection

All interviews conducted were unstructured and transcribed live as sound recording was not possible. The observations were done by joining a meeting decided beforehand. The goal was to impact the meeting as little as possible and to make notes of what was being said and done. For this a laptop was used for and, again, no sound recordings were made. These notes, in conjunction with the ones from the interviews, were then analysed based on theory

3.2.3 Procedure

Initially, observations along with unstructured interviews of project members at three different companies, already using the Yolean tool, was conducted with the purpose of gaining an understanding of how an unconventional tool, such as Yolean, is used in practise.

As a next step, three additional companies were studied that did not use the Yolean tool, to provide a reference to how the meeting process might differ. Focus was to identify challenges that reoccurred across all companies studied as well as methods or tools used in meetings or for general communication.

The project meetings observed, and project members interviewed, at the different companies were at the time only involved in internal projects. Overall, the persons accessed at the different companies worked mainly or exclusively with internal projects and had minimal communication with external parties. Since the involvement of an external part in the projects studied in this phase was extremely limited there was no possibility of making any analysis of communication challenges associated with collaborative projects as defined in this thesis project. However, the study provided the main study with reference points and understanding of internal communication. This was expected to be vital to better understand the complexity of communication in collaborative development projects.

The characteristics of the companies visited are presented in Table 1 and the companies will hereafter be referred to as company 1, 2, 3, 4, 5 and 6 in the following text of this report.

Table 1 - Company characteristics of the companies investigated during the exploration phase.

	Area of industry	B2 B	B2 C	R&D	Production	Nr. of employees	Yolean tool used
Company 1	Interior for service vehicles	X		X	X	92	X
Company 2	Domestic windows		X	X	X	28	X
Company 3	Automation Solutions and commercial & Residential Solutions	X	X	X	X	76 500	X
Company 4	IT security intelligence	X		X	NA	490	
Company 5	Renewable energy solutions	X		X	X	68	
Company 6	Automotive products	X	X	X	X	100 000	

3.3 Findings

3.3.1 Observations

The observation focused on understanding the function of the meeting, what information that was communicated and in what way. Observations during meetings was not possible at companies 4 and 5, why interviews were the only data collection method at these companies and are presented in section 3.3.2. An overview of the meetings observed can be found in Table 2.

Table 2 - Meeting data for those meeting observed at each company

Company	Meeting type	Attendee nr	Meeting duration	Interaction with Yolean tool	Tools used for meetings
1	Daily pulse with project members	5	8min	Only used to visualise tasks, no interaction during meeting	Paper and pen, computer notes, outlook, Yolean
2	Weekly board meeting	6	50min	Used to add "Jobs" twice during meeting	Paper and pen, computer notes, Yolean, outlook
3	Weekly project meeting with project members	9 + 2 called in	45min	Screen shoot of Yolean tool used in ppt document, that is used for meeting documentation	Paper and pen, computer notes, PPT document, outlook
6	Global project meeting with project managers	20	60min	Does not have Yolean	Paper and pen, computer notes, Excel, SharePoint
6	Decision meeting with project managers and project office	3 in room + 12 via skype	60min	Does not have Yolean	Paper and pen, computer notes, excel, SharePoint, skype

3.3.1.1 Companies using Yolean

Adding information to the Yolean tool was only done in one of the meetings observed, at company 2, but only at two times during a 50 minute long meeting. However, during this meeting other software tools were used to visualise sales that were the focus of this meeting. After the meeting was completed it was explained by the CEO that the Yolean tool was mainly used during their morning "Pulse" meeting. This will be further explained in 3.3.2.1.

At company 1, an eight minute long "Pulse" meeting was observed. The purpose was a morning update of the activities completed, ongoing and ahead. The meeting was held standing up and a big screen showed a Yolean board. The Yolean tool was shown on the screen during the entirety of the meeting. It consisted of different deliveries at project level and no details were added to any Yolean note. The notes consisted of tasks and not issues, and delays were not marked in any way. This type of information was instead kept track of by the project member that oversaw that delivery. Nothing was added to the Yolean tool, but the board was kept on the

monitor, discussions were held where the screen was used for pointing at or the mouse pointer used to communicate what note at the board was talked about.

Company 3 did not use the Yolean board itself, but a screen shot of the Yolean tool that showed a short-term plan of three weeks. This screenshot was added to a power point document that was used as a combination of meeting minutes, short-term planning and meeting agenda where project members added items they liked to discuss before the meeting. All members of the team had access to the document, but documentation was done in several different ways where each member made notes for themselves, either on their laptop or with paper and pen. It was observed that the current system for how they did all their documentation seemed to lack the ability to provide a good overview, especially regarding individual workload and tasks. During the meeting, the project manager had to ask whether he remembered their previous and current tasks correctly, exposing the lack of support for this information in the current tools used.

3.3.1.2 Companies not using Yolean

The only company where meetings were observed that did not use Yolean was company 6. The two meetings observed were of different character but had some common denominators. At both meetings one person led the meeting. One meeting was more educational with a seminar inspired structure and the other meeting was a “decision meeting”. At this former meeting the aim was to gather all managers within a large international project to synchronize the project and take decisions that either affected other managers within the project or that needed input from them. During both meetings a projector was used to display information to all at the meeting. During the “decision meeting” however all managers’ plans and questions needed to be put up on the screen. There was no shared platformer to accomplish this and it was solved by screensharing that sometimes didn’t work directly and the meeting attendees had to wait for up to approximately 30 seconds. There were eight managers presenting information, and they had at least one, up to three, Excel or another list to show. Frustration from the meeting leader was observed but since nearly all managers called into the meeting and having their microphones ‘off’ if not speaking to the others in the meeting made it hard to study their reactions.

Of those that were physically in the meeting room, at both meetings, about two thirds had computers with them but mainly used paper and pen to take notes. When a computer was used by someone during the meeting it was observed often to most often involve answering emails, messages or to check their schedule.

3.3.1.3 Common denominators

At all companies studied, it was observed that nearly all meeting attendees brought their computers, but all made analogue notes with paper and pen, exclusively or partly. At all the meetings, the project manager acted as a moderator in most discussions and was the driving force in the meeting. At no meeting, there seemed to have been an agenda set beforehand. Instead, the project manager had ‘mental notes’ of what to bring up during the meeting and each project member had a responsibility to raise issues or questions they had.

3.3.2 Interviews

At the companies where an observation was conducted, i.e. companies 1–3 and 6, the interviews were made directly after the meeting was done. At two of the companies, interviews were conducted without a meeting observation and were therefore also of a different nature to a certain extent. All interviews were unstructured and had more the character of a discussion, including questions about communication that were adjusted depending on what the

interviewee brought up. The initial question was however always “How is communication conducted within the company?” and then the conversation was taken from there.

In Table 3 the persons at each company that were interviewed are listed with their title and duration of the interview. Interviews were possible at all companies but how many that were able to be interviewed varied.

Table 3 - Interviews conducted at what company and with whom based on their title and the duration of the interview

Company	Interviewee title	Interview duration
1	Head of product development	5min
1	Head of communication	60min
2	CEO	60min
3	Product manager	45min
4	Head of user research	60min
5	Line manager	60min
6	Project manager	50min
6	Project manager	50min
6	Project officer	30min

3.3.2.1 Companies using Yolean

At company 1 two people were interviewed, the head of product development (HPD) and head of communication (HC). The HDP only had time for a very brief interview, and due to the time restriction, the interview was of a slightly different character. The question asked to HDP was “When and by whom is information added to the Yolean tool?” and “Do you use any other tool to plan and/or organise your ongoing operations?”. The information received was that HDP was mainly the one to add information to the board, before and/or after the meeting. The board was only used during the morning Pulse meeting each day to make it easier to know what needed to be brought up and which note that was currently addressed in the meeting. It was the responsibility of each project member to have their own system, digital or with paper and pen, to keep track of their tasks to be performed to reach a certain delivery stated on the board. The “to-do” lists of each project member were not shared between project members or with management.

To manage all projects at the company the management met every Friday to go through the status and updates of all active project. The Friday meetings were managed by means of an Excel document where all project updates were documented. The duration of the meetings varied from four to eight hours.

After the brief interview with the HPD a longer interview with the HC was conducted. This position was less than six months old and a head of communication had been appointed due to an identified need to improve and align communication throughout the company. One main issue that had been identified was that there was little to no possibility to trace the root cause of an issue associate with a produced product. The current system was difficult to use and as a result, employees would not use it in the correct way to document the deviations that could affect product performance. This meant that the head office did not receive sufficient data to understand if and what improvements of parts were needed in the production phase.

During the interview it was explained how the meeting structure differed within the company. Company 1 had a workshop where manual labour was executed by a team of 10 employees. To manage planning, delivering on time and for all to know what tasks they were expected to do; this team used visual planning. The workshop differed from the rest of the company where planning was done digitally, through Excel and Yolean. Since the staff, not working in the workshop, typically were more scattered across company buildings and locations, it was easier

to document digitally. When face to face communication was not possible, email and phone calls were the most used courses of action, however, meeting in person was preferred.

At company 2, the employees were few and due to the shared small office, nearly all internal meetings were held in person. The CEO that led the meeting observed at company 2 was asked if the Yolean tool is used during any other meeting since it was observed that it was only interacted with twice during the observed meeting. The CEO explained that the Yolean tool was mainly used during their morning meeting that lasted approximately 10 minutes know what tasks needed to be done for that day. According to the CEO, information was not added to the Yolean board during these morning meetings but instead by the CEO before the meeting.

Another company that also made use of visual planning was company 3. However, they did not use it for daily, or even weekly planning, but for overall project planning before initiating a project. The experienced benefits of the method, expressed by the project manager at company 3, were similar to what was mentioned by the HC at company 1. They expressed that the large amount of data was displayed in a way that gave an overview of the project and that project members could receive information while walking past the board. Also, meetings regarding project planning was facilitated by the board as it made it visually clearer what was discussed. When asking the project manager what the benefits were of the power point meeting document used the perceived values were that; it carries all the information needed for the meeting and that all project members could access the document to add their own updates.

3.3.2.2 Companies not using Yolean

All companies used mainly more traditional ways of communication such as email, phone calls, Skype for business (Skype, 2019) and regular face-to-face meeting. The exception was company 4 which, along with the methods mentioned also used Slack (Slack, 2020). Slack is a chat tool for business and their everyday communication. Slack was considered to be an easy way for several people, who might not be geographically close, to have discussions and get updates in subject based channels. Another perceived benefit was that it was possible to search among the conversations held to retrieve information leading up to a decision. A challenge regarding communication that company 4 tackled, a company that have had a vast growth in number of employees over the last five years, was to make sure that the right person was involved in discussion and decisions. The interviewee had been new to the job for approximately two years and prior to that the position did not exist at the company. The interviewee felt that it was challenging to stay updated on discussions and decisions that concerned their work. The interviewee expressed that discussions and decisions had to be actively searched for in order to stay updated. It was explained that this was another reason why the interviewee liked Slack, as the user could follow a hashtag, a channel, where discussion about a topic of interest were held and decisions were taken which helped but that was felt not to be enough.

Company 5 had also grown a lot during the last couple of years and the interviewee explained that they thereby had gone through organisational changes. These changes affected the line of communication and by whom what decisions should be made. Who should attend what meetings had therefor also changed to some extent. The organisation had gone from a rather informal structure where individuals were trusted to take decisions on their own, to a more official structure where there was a procedure surrounding decisions. Meetings were the primary way to discuss and take decisions.

Interviewees at company 6 expressed that meetings were a central part of the communication flow at their organisation, as at the other organisations studied. However, meetings were also considered to be an issue due to the time spent in meetings that took time away from other tasks they had to do. At the interview with the project managers, issues regarding communication between different professional groups within the organisation were also

discussed. One of the project managers expressed that; “Sometimes it is difficult for me, as a project manager, to get product managers to understand what is required from us as a project team. They only see what is important for them, which is often more geared towards technical aspects, rather than meeting the budget, which I see as important as a project manager”.

The interview with the person leading the project office for an international project consisting of several smaller projects, explained that meetings were important, not only to have the project members talk with each other, but also for the different project managers to get time to speak, “Give them broadcasting time” were the choice of words. Also, the head of the project office brought up the fact that many that attended meetings run by the project office were poor at explaining the “Why” of something. This often led to frustration among the employees that were to perform a task, at any level in the organisation. This individual presented in the interview the most rigorous process for meetings with sending out meeting invitations with an agenda with a clear goal for the meeting.

Documentation of project operations was acknowledged as important for both knowledge transfer and to be able to go back and refresh memory. Yet, documentation was rarely managed in the structured way intended, according to the three interviewees. To overcome some of the issues regarding knowledge transfer through documentation, company 6 had a mentorship program put into place with the goal to transfer tacit knowledge of senior staff to newly hired staff. An unofficial form of documentation was said to be emails, it was not only used for communication but also as a way of documentation that could be used to retrieve information about what had been previously said.

3.3.2.3 Common denominators

Interviews with companies 1, 4, 5 and 6 all indicated that to get the right level of detail of an answer a combination of several communication tools was used or that one type of medium was preferred over another. In interviews at company 6, it was explained that in order to receive a quick high-quality response an email would be sent prior to a face to face meeting. If that was not possible, a phone call was considered the second-best alternative, to talk about the issue or question and then ask the person to send an email with the full response, to get a documented response. Also, the interviewees expressed that a response through a phone call is quicker but of poorer quality compared to a written response, when the responder has more time to think through the response. However, the interviewees at company 1, 4, 5 and 6 stated that the response quality depends not only on the choice of medium, but the complexity of the topic to be discussed and with whom. If contacting an expert regarding a question within his or her field of expertise, a phone call would be better, since the expert might not need a lot of time to prepare an answer. Thereby, a response through phone call would be quicker, enabling follow up questions to be asked directly, which was expressed to be desirable.

The desire and understanding of the importance to document was identified in all interviews, at all companies. However, there were also issues as employees did not document decisions, actions and deviations etc. using the desired tools. Different actions had been taken at the different companies to counteract the ‘human factor’, but a lot of knowledge remain tacit, leading the different organisations to be dependent on persons with prior first-hand experience. Also, it was evident that all interviewees preferred face-to-face meetings rather than any other form of communication.

3.4 Discussion and conclusion

The explorative study provided a set of reference points how meetings are conducted and factors that influence communication that are of importance for the rest of the study. Firstly, it should be mentioned that only persons in leading positions were interviewed which resulted in a narrower data set. However, it gave a vital input from individuals in positions that need good

communication from others and are themselves persons that distribute information to others. The persons interviewed, due to their positions, they become a factor for good communication within an organisation which is of interest for the thesis. Secondly, several different types of meetings with different purpose were observed, providing the thesis with a wide set of references rather than a deep understanding of any single meeting type. Since not a larger quantity of meetings were observed of each meeting type, such as Pulse, it might not be possible to draw any conclusions about any single meeting type. Therefore, conclusions will be made from what have been observed across different meeting categories.

3.4.1 The perception of meetings

When it comes to meetings the persons interviewed seem to have a sort of “love hate” relationship with meetings since they are acknowledged as an important part of an organisation’s operations but also something that take time away from other tasks. An article in Harvard Business Review (Perlow, Hadley, & Eun, 2017) describes a study they conducted where manager and others in leading positions within organisations were interviewed. Meetings were then often described as a “necessary evil”. The time spent in meetings has increased during the last decades (Lindgärde, 2019) which makes it important that they are worthwhile. However there seems to be a general problem as they are perceived not to be.

In a Swedish article in “Ny teknik” (Delaryd, 2019) a representative from “Svenska Möten” is interviewed saying that it is often the person leading the meeting that perceives the meeting time as valuable. Since the explorative study only included individuals in leading positions who were often the ones leading the meeting, it is plausible that they have a more positive attitude towards meetings than their team. In addition, it is often those that perceive the meeting as valuable that do not follow up with the meeting attendees, asking if they felt that the time was well spent. When looking at the report from “Svenska Möten” (2018) regarding meeting culture in Sweden, it is only 27% who believe that individuals present at the meetings are those concerned with what is being presented or discussed at the meeting, making it understandable that theoretically 74% do not see the meeting as valuable.

Meetings can be an effective tool for communication and when applied correctly and can shape communication within a group and an organization positively (Perlow, Hadley, & Eun, 2017). How to apply what meetings and at which frequency need to be decided in the individual organisation. The main problem with today’s meetings is according to Harvard Business Review (Perlow, Hadley, & Eun, 2017) that meetings are too frequent, poorly timed and badly run. To contradict this the article and one of its sources (Scott, Rogelberg, & Kello, 2007) state that it is important to prepare for a meeting and to have a clear agenda and purpose for the meeting that are communicated in advance to the meeting attendees. During the observations and interviews conducted in this exploration study this was one of the things that were identified not to be done.

Meetings at the companies observed seem to be an important part of the company’s internal communication. Only a few of the meetings observed had a clear meeting agenda that had been distributed to the attendees before entering the meeting. It seemed as though the meeting participants relied on the project manager to lead the meeting or that the meeting organically discussed issues or shared information. Since we, the observants, were not able to take part of the meeting invite or emails sent in relation to the meeting it was not possible to confirm how much information the meeting participants had actually received. However, in the post-meeting interviews the answers varied but the most common reply was that they did not receive a meeting agenda or that they did not know if they did.

What was evident at the meetings observed is that people like to have something that clarifies what is talked about and allow individuals at the meeting to gather around a meeting board of

some sort were they could point and reference to things that others at the meeting could see. This is what is described to be one of the benefits of visual planning (Lindlöf, 2014). However, status and action updates were added so that the whole meeting could see them only in one case, at company 3 were they used a Yolean board.

3.4.2 Growth effect communication

Both company 4 and company 5 had grown a lot during the last couple of years. Company 5 mentioned changes that they had made affecting the communication, among which what type of meetings were had with whom. In the interview company 4 did not express that they had made any organizational changes and the interviewee expressed concerns about having to “chase down” conversations that they felt were important for them to be a part of. The position was fairly new to the company, approximately two years, which could indicate that the statements made were reflections of that the organisation itself had not matured in a way where it was clear to the majority of the staff the job of the interviewee. In addition to this a possible reason could have been that enough organizational changes had not been made to make up for the growth of the company that today have 490 employees.

As concluded by Mintzberg (Mintzberg, 1979) the complexity increases as an organization grows larger leading to that certain changes need to be made to continue to operate effectively. The theory suggests that with an organisation of up to 40 individuals more informal ways of communication is feasible but when the organisation grows larger a more formal structure is needed. This might give support to company 5 that had grown to 68 staff and recently had to make changes. It is therefore also possible that company 4 had not successfully made the changes needed when the company have grown larger.

3.4.3 Yolean, a flexible tool not used to its full potential

At the companies that used the Yolean tool it was during the observed meetings used in different ways and at different types of meetings. At only one of the companies, company 2, there was any interaction with the Yolean tool during the meeting and at company 3 a screen shoot of the Yolean tool was used in a Power point document. Thus how the tool is used varies a great deal but the observations also indicate that the use of the tool has not been optimized by the user. Tasks, actions, questions and answers was not added during the meeting but done after the meeting. During the interviews it was said that notes were nearly exclusively added to the Yolean tool by the CEO at company 1, head of the department at company 2 and the project manager at Company 3. That there is not a collaborative effort to update the tool might be a result of a lack of routine, knowledge of the tool, management style or, and possibly in combination of or a result of, lack of engagement from the team members. The lack of collaborative effort to update the tool might pose as an issue for a collaborative project.

3.4.4 Conclusion

In summary, the interviews and observations show that communication is an issue in organisations. The data also show that meetings are not always considered worthwhile by all staff involved which can indicate that the right people are not at the right meetings. Although meetings can be a powerful tool, if used right, for communication and to drive a project forwards. However, the exploration study showed that the meetings were often not executed correctly. The meetings were unplanned, the agenda was not communicated beforehand, and all attendees were not concerned with what was being discussed. This indicates that meetings are not executed in a way where a meeting can reach full effect. Further, tools to support meetings are not used or are not used in a way in which the benefits become evident. If comparing the findings against the literature, it is evident that there are issues that seem to recur outside this study as well.

The implications of the findings are that meetings play a central role in the running of a company and if they are improved, hence the running of the organisation will be improved too. An improvement should involve a decrease of misplaced information and time spent in irrelevant meetings, and a better definition of role responsibilities. Further, the theory also supports that organisational growth impacts the communication, as observed at two of the studied companies. Therefore, the size of the organisation effects the communication and thereby also meetings.

Collaborative engagement was observed to have positive effects whilst using a visual aid, as visual management also states. If supporting groups with routines that can support collaborative engagement, visualisation may contribute to positive results.

Part 2: Development

The second part of the thesis project is labelled development and includes the main user study and the development of concepts and prototypes.

4 User study at FlexLink

Having investigated communication challenges in other companies, the next step in the process was to carry out a study at FlexLink. The study focused on two projects at FlexLink. The projects studied were similar in the way that they were conducted at the same department within FlexLink and under the same project manager, and further that the customer was the same large American company. However, the characteristics of the projects were not identical, and the project team members differed to a certain extent.

4.1 Aim

The intent of the user study was to investigate how the project teams at FlexLink communicated, internally and with external parties. The aim was to identify user needs and requirements as a foundation for idea generation and concept development for a solution targeting the identified challenges.

4.2 Method

This section will present the methods used in the user study. The methods are presented in a chronological order, yet some methods overlapped. A user journey, though not in its entity and only elements of it, were used since not all, but some, benefit the study.

4.3 Data collection

4.3.1 Observations

The user study commenced with observations of internal departmental meetings, internal project meetings, Skype meetings with other company sites and Skype meetings with the customer. A total of 11 meetings were attended with meeting times ranging from 20 minutes to 2 hours. Each project team consisted of three to five people with functions such as project manager, mechanical engineer(s), and electrical engineer(s). In one of the projects studied, one construction engineer was based in Poland, which was not unusual. In both projects the head of the department was also involved. However, this is not usually the case, yet these projects required his experience on the customer. The department meetings were held with nine participants, including the head of the department, project team functions, as well as purchasing and application, functions that are not included in the project teams.

During the observations focus was put on what tools were used throughout the meeting, for example how notes were taken, if there were any documents or similar used, what type of issues that were handled, and questions posed and how answers were given.

4.3.2 Unstructured interviews

To clarify certain things observed during the meetings, five unstructured interviews were held. These interviews addressed the overall project process, practicalities, and the interviewees' personal opinions about the communicational challenges at the department. The interviews were unstructured, meaning that questions were asked shortly after they emerged, and many questions were open to their character, and the interviewees could elaborate freely on the answer. The interviews were conducted with the head of the department, project managers, and a mechanical engineer. Diversity was an important factor when choosing interviewees as the concept developed should apply to all or many of the different roles at the department. As

there are both native Swedes and foreign, non-Swedish speaking, staff at the department, the interviewees chosen represented both categories.

4.3.3 Thematic analysis

The data collected during the observations and interviews was analysed by means of a thematic analysis. The method was used to categorise the observations and quotes. The categorisation was conducted on two levels. The first level was to what communication the observation or quote referred to, for example internal communication or communication between FlexLink and the customer. The second level concerned what content the quotes or observations referred to, for example problems related to a digital drawing or lack of meeting documentation. The categorisation was followed by a deeper analysis to identify what needs for improved communication the data yielded. The analysis revealed what needs emerged in the different situations. The thematic analysis yielded in two project process illustrations (see

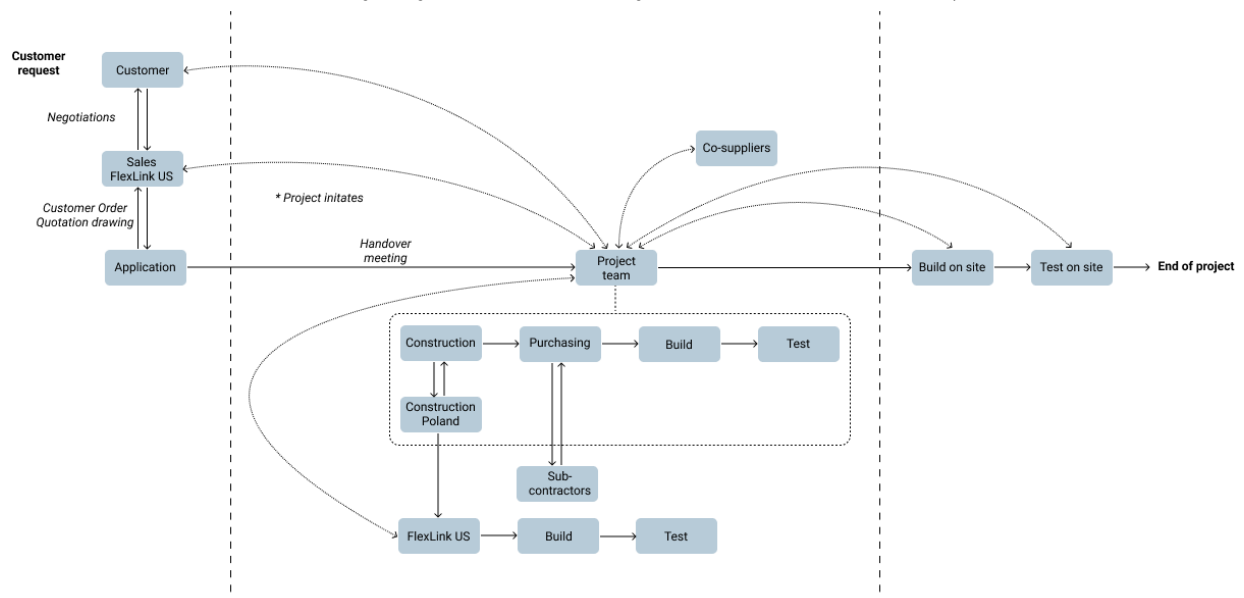


Figure 17 and Figure 18) as well as the table of user needs (see Table 1).

4.4 Findings

The analysis was based on data from 11 meeting observations and five unstructured interviews. Further, conversations on and research regarding the company history and culture were continuously carried out during this phase, to have a better chance of grasping subtle underlying factors of certain routines or behaviours.

FlexLink has grown from being a small business with all employees gathered in one office, to an international large size company within their sector. FlexLink now has many offices around the world, covering many different time zones, as well as several social and work cultures. Also, different company sites use different tools, such as a variety of CAD tools, resulting in a need to convert drawings and models when exchanging files. These factors add complexity to the activities and can be problematic in collaborative projects. Additionally, FlexLink compete on the market with very short lead times, yielding a need to work quickly and, in the current situation, take decisions on incomplete grounds, in order to deliver on time. Short lead times are a factor affecting the whole company and the two projects studied were no exceptions. To help understand the project processes two diagrams were drawn to illustrate the project timeline and how the communication flows.

4.4.1 Project 1

The figure presents the communication flows of project 1. The left part of

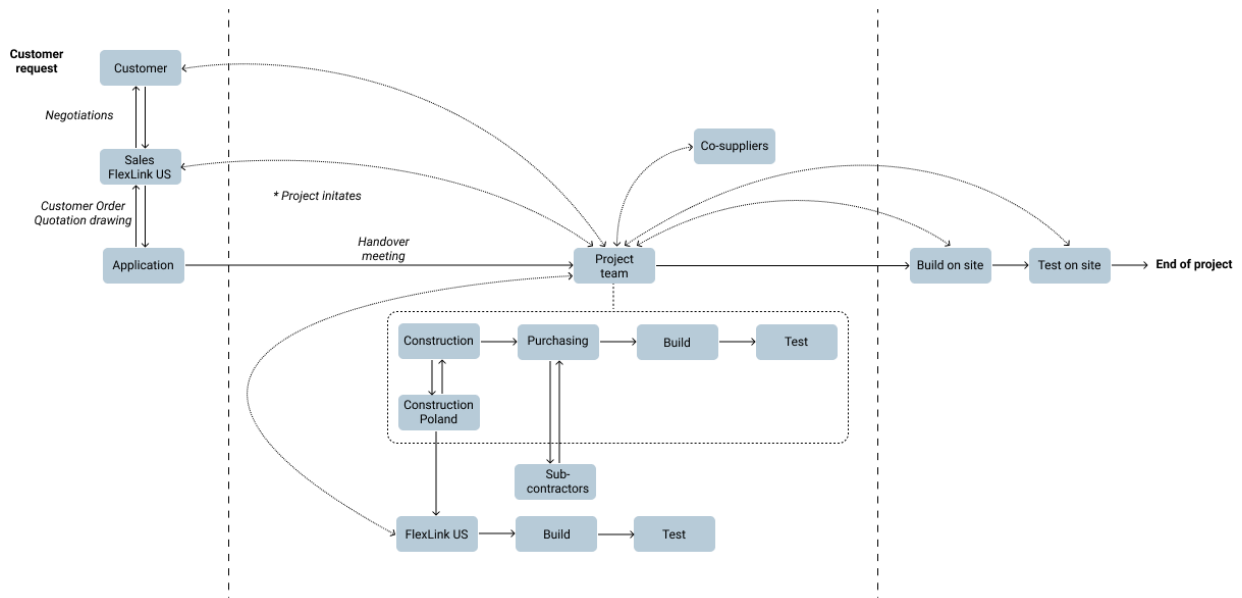


Figure 17 shows the initial communication between the customer, the sales department in the US, and Application, which is the person(s) making the quotation drawing, i.e. the initial drawing of the production system to be designed. The communication goes back and forth starting with the customer request and ending with the customer accepting the quotation drawing. A project is then initiated, and the project team may start working.

The construction team will review the quotation drawing, make necessary changes to optimise the flow and sort out details for the unique solution. It is not unusual that the construction team is located both in Gothenburg and at the company site in Poland, collaboratively producing the final design. In the meantime, Purchasing is placing orders for material and parts that will be needed when the line is to be built and tested. The production line will be connected to machines that are supplied by another company, putting additional requirements on the design, meaning that the specifications of the machines must be communicated to FlexLink. In this project, there will be tests on two different sites, in the US and at the company site in Gothenburg, adding a bit more complexity to the project process. Throughout the project, there will be continuous communication between the project team, the US sales unit and the customer.

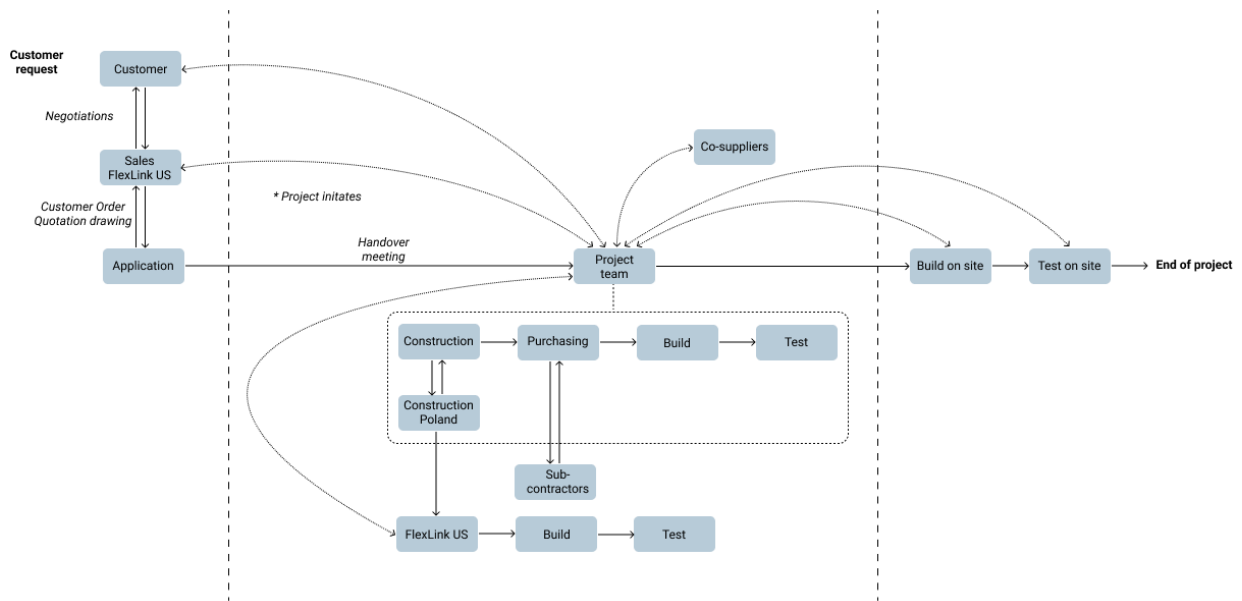


Figure 17: Project process of project 1.

4.4.2 Project 2

The project process for project 2, shown in Figure 18, is similar to the process of project 1. Project 2 does not include the site in Poland, all construction work is done at the Gothenburg site. Also, the building and testing will be performed solely in Gothenburg. However, the customer of project 2 is more concerned about this project, compared to the customer of project 1, meaning that they require closer communication generally and want to engage in detailed decisions as well as more generic ones. This is explained by the project being of a new characteristic for the customer, meaning that the project is breaking new grounds for the customer.

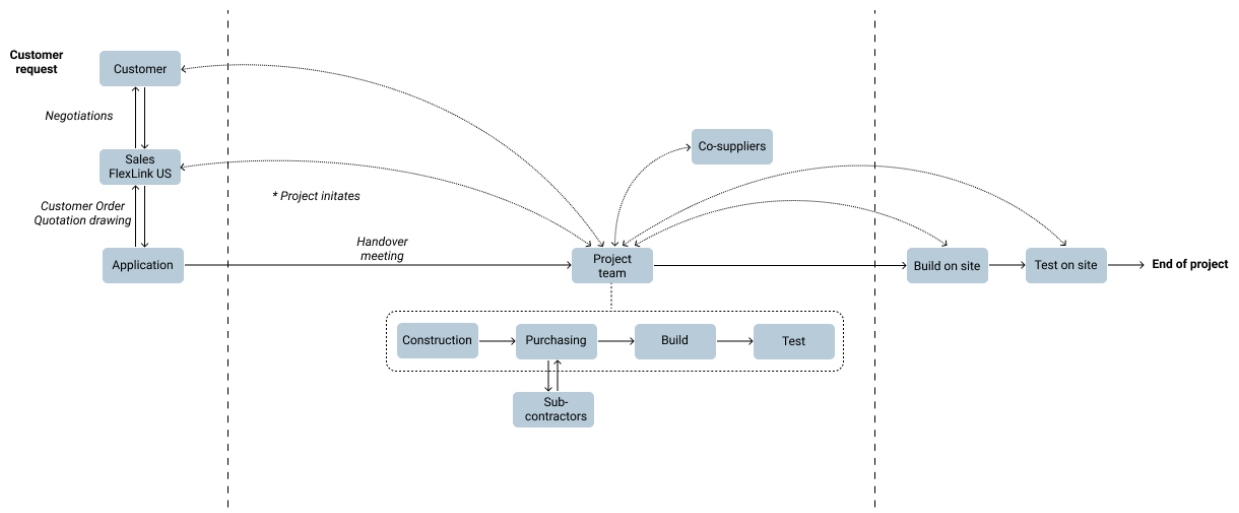


Figure 18: Project process of project 2.

4.4.3 Project process analysis

Although the project process pictures roughly illustrate the intended project procedure, in reality the process often deviates from that intended. Due to FlexLink's ambition to have very short lead times, certain materials and parts must be ordered before the project is initiated, otherwise FlexLink would not receive them in time. Therefore, these purchases cannot be documented within the actual project, but instead in another project budget.

The importance of a high pace in projects also results in team members feeling that they must take decisions based on incomplete information, as they feel as though they do not have time to await answers to their question(s).

Contradictory to an evident need, FlexLink does not have a routine for clarifying uncertainties with the customer in an organised and efficient way. For instance, the team members are usually not completely sure about what is to be discussed in specific meetings, as the habit of making a meeting agenda or equivalent is non-existent. This is contradictory to good practice as explained in section 2.4.

An illustrative example of how this can cause problems occurred during one of the meeting observations. A customer meeting in project 2 was scheduled for an afternoon, yet there had been no meeting agenda exchange. About 20 minutes before the meeting starts the customer sends a list of items to be discussed and decided upon at the meeting. The project manager, after receiving the list, must call for an urgent internal meeting to go through as many of the items as possible before the meeting with the customer. The team members seem stressed and anxious about how their, somewhat unclear and not completely thought through, responses will be received by the customer. The meeting, a telephone conference, starts and the team members are using sign language to communicate internally without the customer hearing. This showed the negative stress that is caused by trouble shooting meetings that are a result of calling together the entire group last minute, creating stress and anxiety for the group (as was explained in the section on “Meetings for problem solving” 2.4.2). A lot of decisions were made at this meeting, yet only documented in personal notebooks, if at all, by the group at FlexLink. It was later discovered in one of the unstructured interviews that this type of situation was not uncommon.

4.5 User Needs and Requirements

The interviews and observations at FlexLink revealed a number of problems associated with communication, such as poor foresight and communication of problems or questions.

Three main user groups were identified: FlexLink Gothenburg site, FlexLink external sites and the customer.

A: FlexLink, Gothenburg site

B: Customer

C: FlexLink, external sites (Poland and US)

The needs and requirements of each of these groups were extracted using thematic analysis and are presented in Table 1.

Table 1 - User needs and requirements based on the initial study.

Nr	User needs	A	B	C
1	Need of continuous communication throughout the project	x	x	x
2	Need to feel in control of development process	x	x	
3	Need for communication of questions and issues in advance	x	x	x
4	Need to transfer documentation and files	x	x	x
5	Need of documentation for handover	x		x
6	Need for delivery confirmation of digital communication	x	x	x
7	Need of notification of received digital information	x	x	x
8	Need of knowledge transfer from previous projects	x		x
9	Need for support to sort between projects	x		x
10	Need for workload clarification, long term and short term	x		
11	Need for better meeting documentation	x		x

12	Need for standardised way of keeping meeting minutes	x		x
13	Need for sharing meeting minutes	x	x	x
14	Need for synchronisation	x		x
15	Need for clarification of whom needs what information	x	x	x
16	Need of quick and complete answers	x		
17	Need to be flexible according to lead times from co-suppliers and sub-contractors	x		x
	Requirements			
18	Requirement to have short delivery times	x		x
19	Requirement to be flexible regarding changes in design and prerequisites	x		x

5 Iteration 1

After completing the user study and formulating user needs and requirements, the actual development of a digital communication tool was initiated. This chapter, Iteration 1, includes a description of the design process and the initial design proposal.

5.1 Aim

The aim in this phase was to generate ideas based on the identified user needs and requirements and thereafter chose an idea to develop into a concept. To get an indication of the accuracy of the user needs and proposed solution, four individual feedback sessions were conducted with end users.

5.2 Method

Iteration 1 included two main steps. The first was to develop an initial concept through idea generation and rapid prototyping to achieve a digital mock-up. The second was to test the concept with the end users.

5.2.1 Idea generation

Several methods and tools were tested during the ideation phase, yet, not all proved to be useful in this case. The methods used were brainstorming, visual brainstorming, mind maps, and use cases (Brandenburg, 2018).

The use cases mapped several different types of usage, before a meeting, during a meeting, and after a meeting. The use cases also showed how the solution needed to differ based on if the user was the supplier or the customer.

Parts of a user journey was created to address the communication flow and channels.

5.2.2 Digital mock-up and user feedback

To enable user feedback at an early stage, a quick digital mock-up was designed. The mock-up was presented in four individual sessions along with a brief presentation of the reasoning behind it. This served as an early concept validation to give an indication of how accurate the identified needs and the proposed solution were.

5.3 Design process

The process consisted of three steps, the creation of company and customer personas, the description of the (modified) user journey, and third the design of the concept functionality and interface.

5.3.1 Personas

To support the concept development process personas representing FlexLink and the customer were created. The personas were introduced adjacent to the user journey to maintain the user focus when developing the concept.

Personas are way to describe the intended users through a fictional character that shares similar characteristics as the actual users (Teo & Dam, 2020). Based on the observations and interviews 4 personas were created to symbolise the users. As the concept targets collaborative projects personas of both the supplying company and the customer had to be drawn. The personas represent characteristics, goals, needs and feelings of the users and were used as a support when identifying needs as well as a mediating tool during idea generation.

FlexLink personas



Tina, 31

Tina is project manager of both project 1 and 2, although she does have a few other projects on her plate as well. She has previously been working for FlexLink in Italy but is based in Sweden since the past two years. She understands Swedish but only speaks a little, therefore she speaks English at work. She is a very organised person that likes to have control of the situation, traits that makes her a good project manager that keeps track of all the things her co-workers need to do in her projects. Orderliness is very important to Tina, when she doesn't have her duties sorted out, she feels stressed and fears that she will forget things that will have an impact on her projects and her co-workers.



Jesper, 44

After graduating university Jesper has been working as a mechanical engineer at FlexLink. He has been a part of numerous different projects and is considered an expert within his field. Jesper takes quite some pride in his work, always trying his very best and never giving away anything mediocre. As he is one of the best in his field, he is usually working in more than one project at the time, resulting in him being overcrowded in work some weeks. As there is usually hard to find someone else to help to ease the workload, Jesper tries to plan his time well to not have to work overtime. As time management is of high importance, both for Jesper himself and FlexLink in general, he really dislikes when customers or co-suppliers do not communicate clearly or make last minute changes that affect the projects. Even though work sometimes can be stressful, he likes his job and has a lot of fun with his colleagues, both at the office and during the weekend.

Customer personas



Mark, 44

This is Marks first shot at really impressing his boss. He has worked within the co-operation for many years, but this is the first time he oversees a project that will change the way they produce their products. He is nervous and many nights he lays awake thinking about all the aspects of the project and if everything is being done correctly. He has ordered new parts to replace old once from the supplier before but never a whole new system, especially not one as unique as this one.



Steve, 44

Despite his younger age, Steve has been a part of several large projects at different sites, owned by FlexLink, to develop and improve the production capacity. In several of the projects he has first handily been in contact with, and collaborated with, their supplier that they are using for this project. He has been very happy with the supplier that have delivered high-quality solutions on time, he trusts the engineers that work there. Steve has a lot on his plate though and wants clear communication of what is promised throughout the project and what information he might assist with about the site to the supplier. He has little patience though for questions being asked twice!

5.3.2 User journey

The user journey (Grocki, 2014) served as an inspiration for the design process as it seemed applicable for a digital design solution. To illustrate the current communication flow of questions, answers and decisions a timeline was constructed, shown in **Fel! Hittar inte referenskölla..** Focus was put on questions and answers as they have proved to be driving mechanisms in projects both according to theory, (see 2.3 and 2.4), and the user study. As described in section 2.5, the quicker a response is given the higher the quality of it is perceived (Jayachandran, Hewett, & Kaufman, 2004). Therefore, the response frequency is not only important for the actual project proceeding but also for the experienced project proceeding and the impression of the project counterpart.

Ideas of how the question-answer frequency could be increased were generated using mind maps, brainstorming and visual brainstorming. An idea of a collaborative meeting agenda that was communicated in advance evoked and was further developed. The communication flow when introducing such a tool is shown in **Fel! Hittar inte referenskölla..**

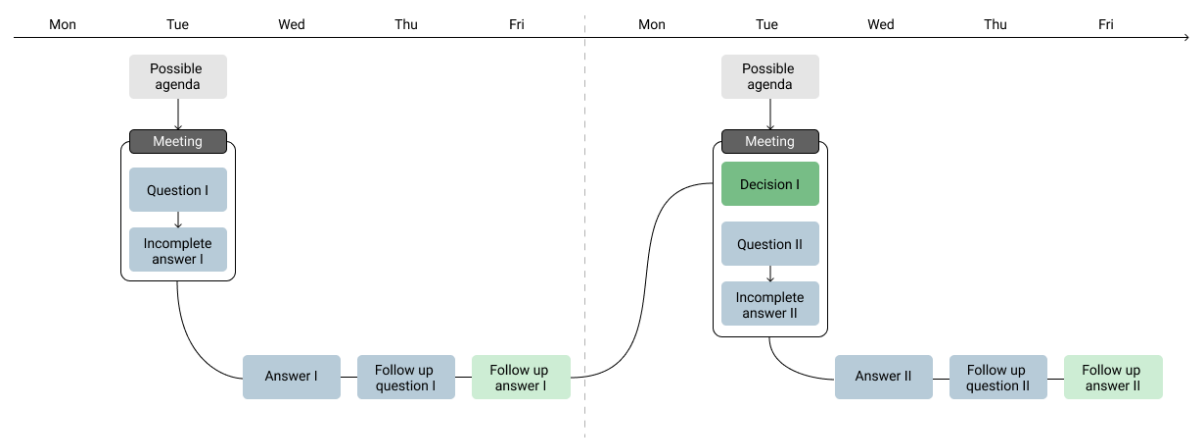


Figure 19: Illustration of the current communication flow.

Fel! Hittar inte referenskölla. visualises the general communication flow in projects at the chosen department. The upper flow is the current situation and the lower is a hypothesis of how it could be if the concept was to be implemented. Currently, there is seldom an agenda communicated beforehand, not for internal meetings nor for customer meetings. It happens that customers send meeting items to be discussed to FlexLink, often no earlier than about 20 minutes before the meeting start, resulting in quick internal meetings to clear out things to be able to give an adequate response to the customer (as described in section 4.4). What is more common is that there is no meeting agenda at all, aggravating preparation for FlexLink and the customer. As a result, questions brought up during a meeting may be discussed but a complete answer cannot be given, and no decision can be made. Instead, answers are given through mail, which generally yields in one or multiple follow up questions causing the final and complete answer to be even further delayed. As the final answer is delayed, so will the decision related to it be too.

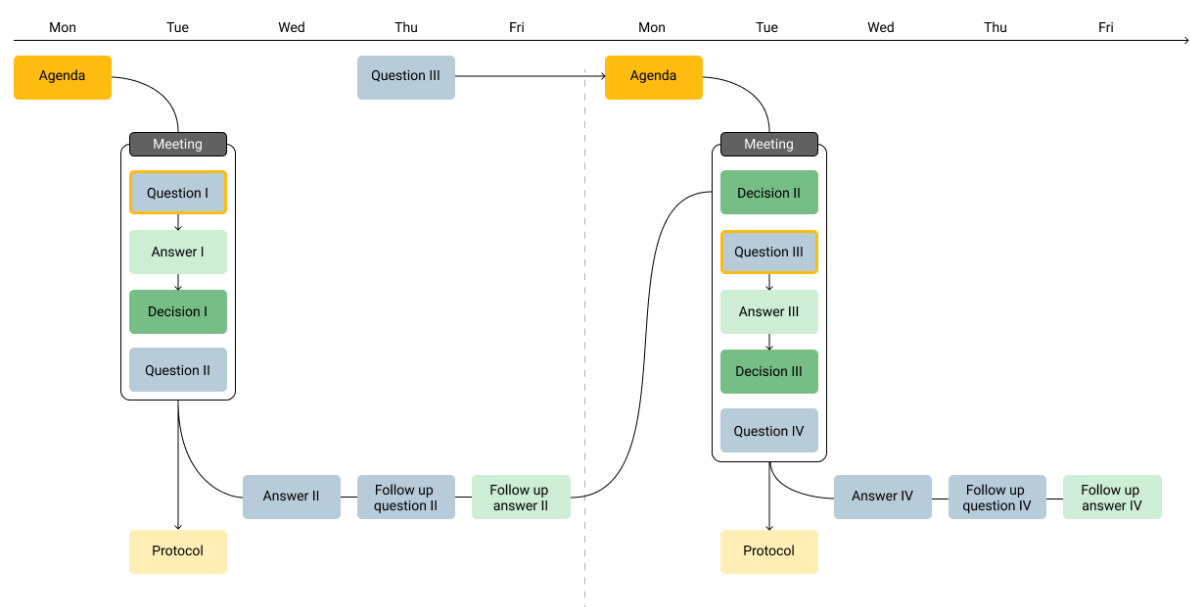


Figure 20: Illustration of the desired communication flow.

Considering the hypothetical result of the concept, shown in **Fel! Hittar inte referenskölla.**, the frequency of questions and answers is much higher. As meeting agendas will be collaboratively created, gathering issues to be discussed beforehand, both parties will have time to prepare answers to the issues. This is also supported by literature on meetings and quality of meeting which states that a meeting agenda should be shared approximately 24 hours before a meeting (LeBlanc & Nosik, 2019). Thereby questions can be discussed and answered during a meeting and a decision could possibly be made based on the answers. Based on logic, there could be new questions arising from discussions during meetings and the mail communication between meetings should therefore not be eliminated, yet the concept does not include any designed changes in the existing (e)-mail correspondence.

As shown in **Fel! Hittar inte referenskölla.**, a pre-communicated meeting agenda will aid the possibility to give complete answers during meetings, and thereby benefit the quality and efficiency of the meetings. Additionally, the concept will produce a meeting protocol to be shared with both customer and FlexLink, facilitating tracking of issues as well as providing a cohesive project documentation to be used during the project and potentially as learning material for future projects.

5.3.3 Design process of functionality and interface

During the idea generation, both physical and digital concept ideas emerged. As the solution aims to aid an international team, the physical concepts were excluded, as they simply could not support communication across the globe sufficiently. The first design proposal was created in a visual brainstorming session, with the aim to display the basic functionality of the concept. The proposal was made to explore what type of functionality that could be useful and how it could be organised. At this stage, neither aesthetics nor visual presentation were considered. The aim was to communicate functionality in an initial prototype to receive early feedback from the users at FlexLink.

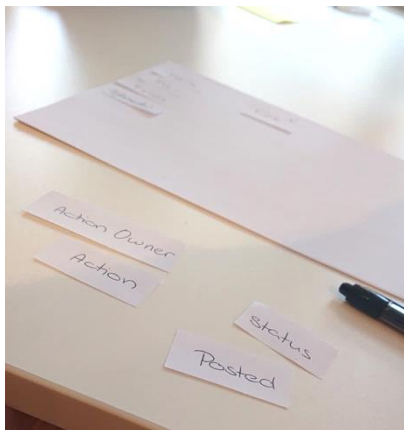


Figure 21 - Image of physical prototype in progress

First a simple physical prototype was made to test how different functionalities could be placed on a screen. This was done using a white paper representing the screen and cut out notes, each representing a function (see Figure 21). These were used as a mediating tool for idea generation of what further functionalities are needed and were to place them in the interface.

The next step was to create a digital prototype created in Figma to further develop the visual appearance of the prototype and to better represent the functionalities. This was then the prototype, shown in 5.4, presented for initial feedback from project members at FlexLink.

To guide what frames to design, different use cases were used. Use cases are paths that describe different tasks or functions to be performed in the tool (Usability.gov, 2020).

Throughout this process the following use cases were used:

- General
 - Enter tool
 - FlexLink
 - Customer
 - Open project

- Create new project
 - Add user
- Between meetings
 - Receive overview of project
 - Navigate between projects
 - Search for projects information
 - View current agenda for next meeting
 - Add issue
- During meeting
 - Showing viewing file during meeting
 - Handle meeting point
 - Open issue
 - New issue (added between meetings)
 - Add new issue during meeting
 - Close meeting

A full presentation of the different use cases is found in

5.4 Design proposal

The main idea of the concept, as presented in **Fel! Hittar inte referenskölla.**, is to shorten the lead times of answers and thus decisions by creating a collaborative meeting agenda to be communicated in advance of the meeting. As each employee at the department normally handles more than one project at a time, a possibility to navigate between projects is needed. As the projects involve both the customer and FlexLink, both parts must be able to access the project documentation. Therefore, the concept took the form of a shared digital platform where meeting issues can be added beforehand, meeting minutes can be produced and seen by all meeting participants during a meeting, and meeting protocols generated and saved.

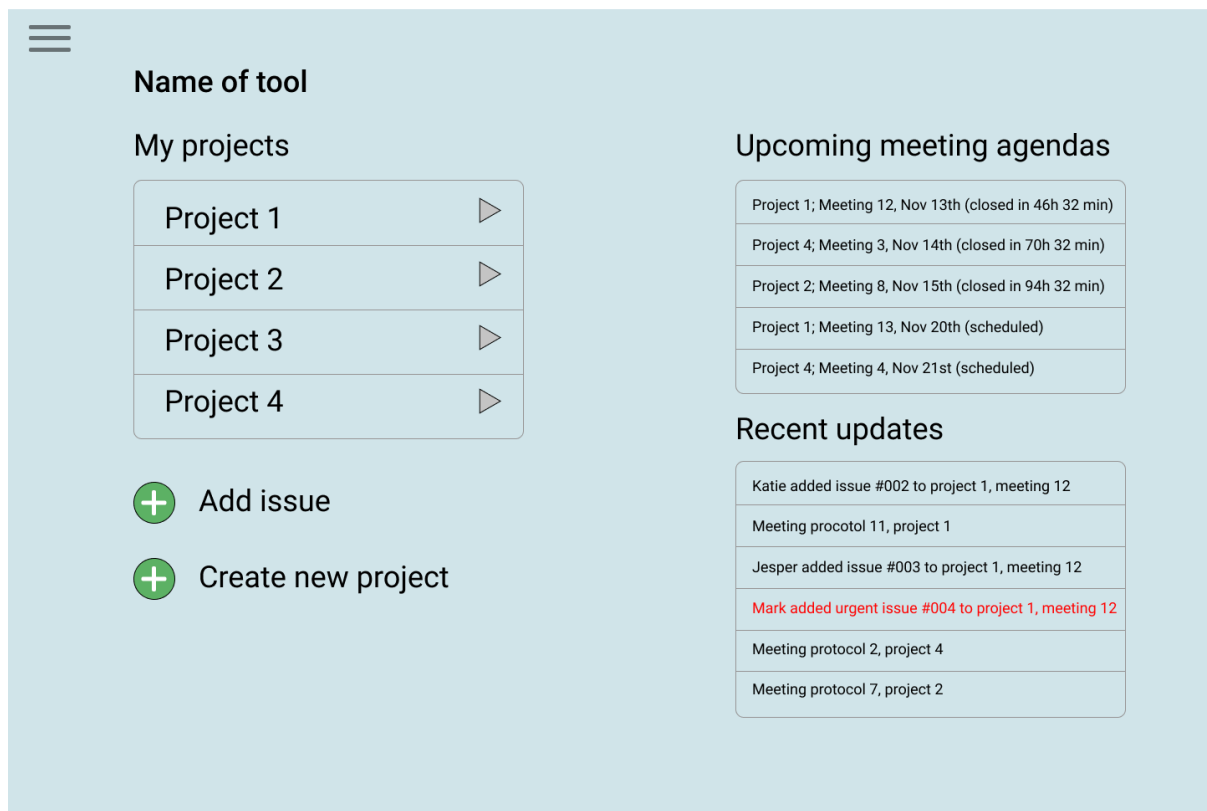


Figure 22: Starting page of initial design proposal

The starting page, shown in Figure 22, displays the individual user's projects, upcoming meetings and recent updates, including meeting protocols and issues added by other users. Issues of high importance should be highlighted to draw attention and not be accidentally unnoticed.

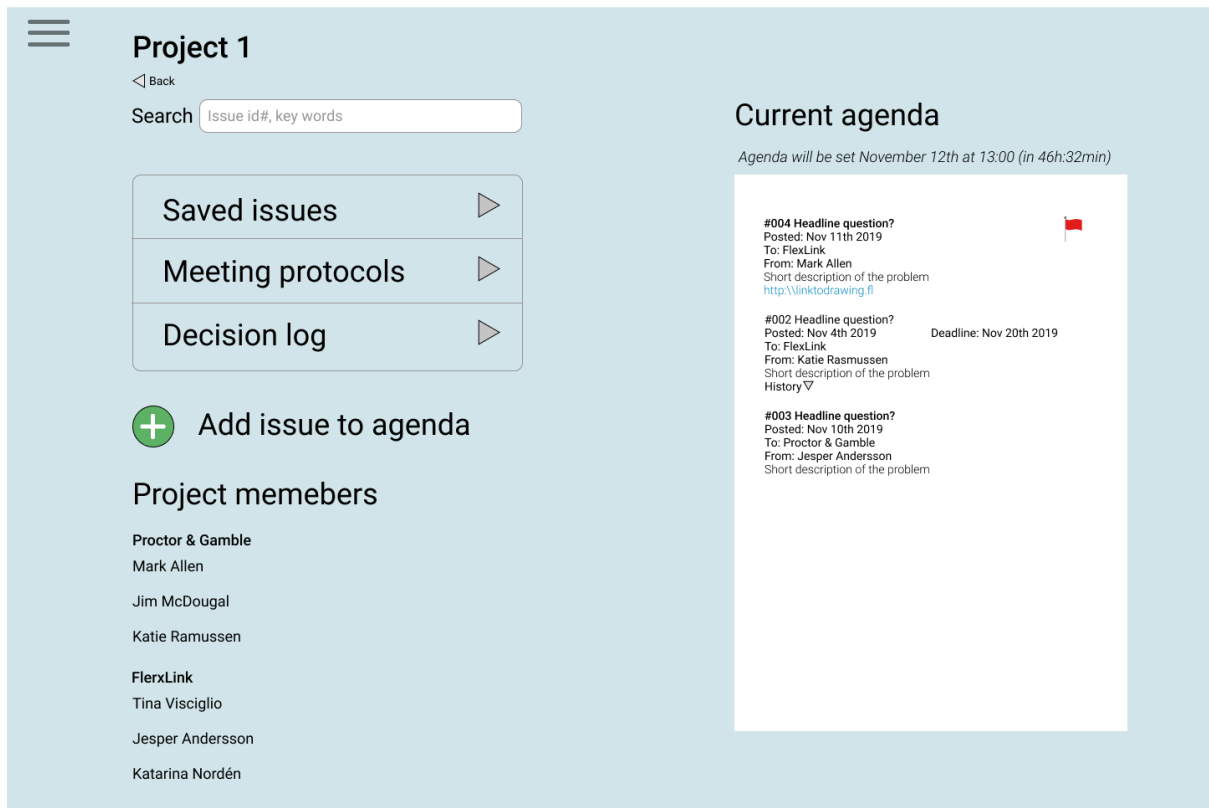


Figure 23: Home page of a project.

Figure 23 shows the (hypothesised) home page of project 1, displaying the current agenda and when it will be set before the meeting. High importance issues will be marked with a red flag and will be prioritised at the beginning of the meeting agenda. Open issues from previous agendas will contain a history of answers, decisions and/or actions, that will be displayed in a drop-down menu. The project home page will also have links to the project meeting protocols and decision logs.

Project 1

Back

Add issue to agenda

Headline:

To:

Proctor & Gamble

Description:

Importance:

☒ Normal
 ☐ High

Save for later

Confirm

Saved issues

Headline question?

To: Proctor & Gamble

Importance: Normal

Short description of the problem, might be more than one row, might even be three or four.

Edit

Confirm

Current agenda

Agenda will be set November 12th at 13:00 (in 46h:32min)

#004 Headline question?

Posted: Nov 11th 2019

To: FlexLink

From: Mark Allen

Short description of the problem

<http://linktodrawing.fi>

#002 Headline question?

Posted: Nov 4th 2019

To: FlexLink

From: Katie Rasmussen

Short description of the problem

History ▾

Deadline: Nov 20th 2019

#003 Headline question?

Posted: Nov 10th 2019

To: Proctor & Gamble

From: Jesper Andersson

Short description of the problem

Figure 24: Addition of new issue to meeting agenda.

An issue may be added to the agenda, as shown in Figure 24. When doing so the user needs to (i) give the issue a headline, (ii) mark to whom the issue is aimed, (iii) add a description and (iv) select importance. The user may save the issue for later or confirm it to the meeting agenda immediately.

Project 1; Meeting 12

Time: 00:12:48

Close meeting

Name of tool

My projects

Project 1

Project 2

Project 3

Project 4

+ Add iss

+ Create

#004 Headline question?

Posted: Nov 11th 2019

To: FlexLink

From: Mark Allen

Short description of the problem

<http://linktodrawing.fi>

Answer:

Decision:

Action:

Deadline:

Comments:

☐ Close issue

Select reason

Save

#002 Headline question?

Posted: Nov 4th 2019

To: FlexLink

From: Katie Rasmussen

Short description of the problem

History ▾

Deadline: Nov 20th 2019

#003 Headline question?

Posted: Nov 10th 2019

To: Proctor & Gamble

From: Jesper Andersson

Short description of the problem

Connected

MA

Mark Allen

JM

Jim McDougal

KR

Katie Rasmussen

TV

Tina Visciglio

JA

Jesper Andersson

KN

Katarina Nördén

Meeting agenda

Nov 13th (closed in 46h:32min)

Nov 14th (closed in 70h:2min)

Nov 15th (closed in 94h:2min)

Nov 20th (scheduled)

Nov 21st (scheduled)

tes

2 to project 1, meeting 12

project 1

03 to project 1, meeting 12

ue #004 to project 1, meeting 12

ject 4

ject 2

Figure 25: Agenda template for making of notes during meeting.

During a meeting the meeting coordinator selects the issue to be discussed and can make notes in the fields of predefined categories; answer, decision, action, deadline, and comments. The view will be shared with all meeting participants. An example of such view is shown in Figure 25.

The screenshot displays the 'Project 1; Meeting 12' interface. At the top, there's a header with the title 'Project 1; Meeting 12' and a 'Close meeting' button. Below the header, the interface is divided into three main sections:

- Left Sidebar:** Contains a 'My projects' list with 'Project 1', 'Project 2', 'Project 3', and 'Project 4'. Below this are buttons for '+ Add issue' and '+ Create'.
- Central Form:** Displays a list of issues. The top issue is '#004 Headline question?' posted on Nov 11th 2019 by FlexLink, from Mark Allen. It has fields for 'Answer:', 'Decision:', 'Action:', 'Deadline:', and 'Comments:'. Below these is a 'Close issue' button and a 'Select reason' dropdown menu. The dropdown menu is open, showing options: 'All actions completed', 'Irrelevant', 'Added my mistake', and 'Other'. Below this, there are two more issues: '#002 Headline question?' and '#003 Headline question?'.
- Right Panel:** Titled 'Connected', it shows a list of participants with their initials and names: Mark Allen (MA), Jim McDougal (JM), Katie Rasmussen (KR), Tina Visciglio (TV), Jesper Andersson (JA), and Katarina Nordén (KN). Below this is a 'Meeting agenda' section with a list of dates and times, including 'Nov 13th (closed in 46:32)', 'Nov 14th (closed in 70h 2 m)', 'Nov 15th (closed in 94h 2 m)', 'Nov 20th (scheduled)', and 'Nov 21st (scheduled)'.

Figure 26: Reason selection for closing of issue in agenda template during meeting.

If an issue is marked as closed the reason for it must be selected. The options are; all actions completed, irrelevant, added by mistake, or other. A drop-down menu for such selection is shown in Figure 26. If the issue is not marked as closed, it will be transferred to the upcoming meeting agenda.

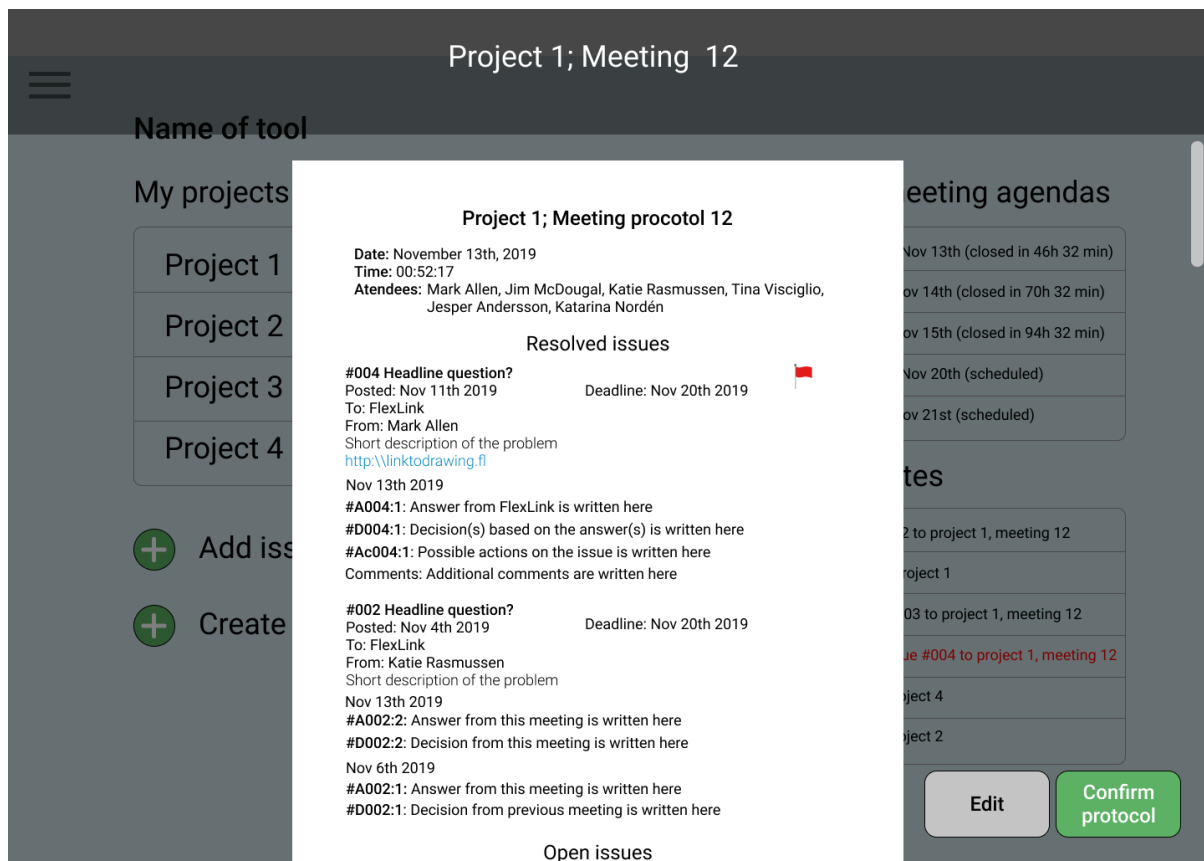


Figure 27: Meeting protocol generated after end of meeting.

When the meeting has ended, a meeting protocol will be generated, shown in Figure 27. The protocol must be confirmed by both the customer and the supplying company before closing the meeting. If anything has been added incorrectly, it may be edited before confirmation.

5.5 Test of design proposal

The test of the concept was conducted through four individual feedback sessions with the head of the department, two project managers and one mechanical engineer respectively. The interviewees were chosen as they are all intended end users, part of the projects observed and represent three different points of view. The two project managers also claim to have different managing styles, which is why interviewing both was desired despite their shared role.

As the initial proposal was only a visual representation of the concept, the test was not interactive but a presentation of the concept to receive feedback. The presentation consisted of Figure 23 to Figure 27 and the concept was explained as in the text in 5.4. The sessions were individual as subjective and personal opinions from each end user were desired. Individual interviews also minimise the risk of the interviewees to be influenced by others in their responses.

After introducing the concept to the interviewees, questions and follow-up questions were asked and discussions followed each question where appropriate:

- What do you, as a representative of "FlexLink", think about this type of tool? Is it something positive or something more negative?
- What do you feel of what was presented? Could it be useful or is there potentially missing for it to become useful?
- Do you think that it could be useful to have several people editing the same document, similar to google docs?
- How do you think your customers would react to a tool like this one?

- When an issue should be closed, is it desired to categorize an issue with something other than:
 - Added by mistake
 - All actions completed
 - Irrelevant
- Is it of interest to see after a meeting was had, how long the meeting was?

The overall response from the interviewees was positive, especially from the two project managers. The fact that all project members could add meeting issues was a very welcomed function, as well as the idea of the setting of the meeting agenda 24hours before the meeting. Some key factors that were emphasised regarding how the tools should be implemented were that it must be well integrated with existing digital tools, such as calendar and email. The ease of use was also brought up as an important factor, especially for the customer, as they tend to not want to use any other tools than those they already use, according to one of the interviewees.

Cohesiveness in meeting structure for both internal and external meetings were also brought up, followed by a wish for the concept to include internal meeting agendas too. Wishes for the tool to help with structure and organisation of the project were also expressed. The head of the department especially asked for an overview of all the projects and a way to quickly check the status of the projects as well as specific issues. Additionally, smaller requests were made for specific functions, such as assigning an action to a certain project member, having a short summary at the end of the meeting of the issues treated, and the possibility to undo and possibly redo a decision from the past.

5.6 Evaluation against user needs and requirements and design implications

With the user feedback as a foundation, an evaluation of the concept vis-à-vis the user needs and requirements were conducted. The needs considered to be fulfilled are marked with ✓, the needs that are partly fulfilled but in need of further development are marked with -, and the needs or requirements that are not applicable are marked with N/A, in Table 2.

Table 2: Fulfilment of needs. A: FlexLink local site, B: customer, C: FlexLink external sites.

Nr	User needs	A	B	C	Fulfilled
1	Need of continuous communication throughout the project	x	x	x	✓
2	Need to feel in control of development process	x	x		-
3	Need for communication of questions and issues in advance	x	x	x	✓
4	Need to transfer documentation and files	x	x	x	-
5	Need of documentation for handover	x		x	✓
6	Need for delivery confirmation of digital communication	x	x	x	N/A
7	Need of notification of received digital information	x	x	x	N/A
8	Need of knowledge transfer from previous projects	x		x	✓
9	Need for support to sort between projects	x		x	✓
10	Need for workload clarification, long term and short term	x			-
11	Need for better meeting documentation	x		x	✓
12	Need for standardised way of keeping meeting minutes	x		x	✓
13	Need for sharing meeting minutes	x	x	x	✓
14	Need for synchronisation	x		x	-
15	Need for clarification of whom needs what information	x	x	x	✓
16	Need of quick and complete answers	x			-
17	Need to be flexible according to lead times from co-suppliers and sub-contractors	x		x	N/A
	Requirements				

18	Requirement to have short delivery times	x		x	
19	Requirement to be flexible regarding changes in design and prerequisites	x		x	

Needs that are only partly fulfilled by the concept are # 2, 4, 10, 14 and 16. The project team would achieve better organised issues, and a better overview of the current situation in the project, which potentially could make them feel more in control of the development process. As the tool would be owned by the supplying company, there are additional factors affecting whether or not also the customer will feel in control of the development process. The customer must have access to the right information in order to feel well informed. However, as the customer is not as involved in the process as the project team, full insight might result in confusion and (actually) a feeling of not being in control. This aspect needs to be further investigated.

Need #4 is not fulfilled, by definition, but the concept allows for links to construction drawings and similar to facilitate the meeting flow. Still, there will be a need to share files outside of meetings, which is not included in the concept at this stage. Clarification of workload, long- and short term, i.e. need #10, can be considered partly fulfilled since the idea of an individual action list is included in the concept. However, this need requires a more extensive solution, such as a resource planning tool, which is outside the scope of the thesis project.

Needs #14 and #16 are related in the sense that both are partly fulfilled through the hypothetical impact of the concept, i.e. the increase of the question – answer frequency. If issues are communicated in advance, FlexLink and the customer both have time to prepare before the meeting and the answers and decisions will be more accurate and valid. As the concept increases the transparency of the development process the need for synchronisation will be fulfilled to a larger extent than in the current situation. However, the concept does not suggest a higher frequency of meetings and therefore there might still be a need for synchronisation and a need for answers between meetings. As described in 2.4 having too frequent meetings is not desirable since this can cause attendees to feel that meetings are unnecessary and not something beneficial, which they are if done correctly. Therefore the goal should be to first hand increase the meeting quality.

Needs #6, #7 and #17 are not covered by the concept at this stage. Needs #6 and #7 are related to the current situation and the digital tools used. The introduction of a new digital tool, such as the concept proposed in this thesis, these needs might not be relevant anymore. As the concept in the thesis does not include any kind of message functionality between user, these needs are considered not applicable. Need #17 concerns the communication with co-suppliers and sub-contractors, which could be included in the concept. However, the data collection has concentrated on internal and customer meetings, why the concept targets this type of communication. Therefore, other needs have to be taken into account during the upcoming iterations.

In summary though the feedback from the end users indicated that the proposed solution could be helpful in projects, therefore it was decided to continue developing the concept. The design implications were taken into consideration when proceeding into the second iteration.

6 Iteration 2

In this iteration, an interactive prototype was designed to perform user tests.

6.1 Aim

The aim of iteration 2 was to be able to carry out user tests in real meetings. The goal was to identify (potential) more needs and requirements by testing the concept functionality in a realistic setting. Method

6.2 Method

6.2.1 Participants

In this iteration the main participant was one of the project managers, which was the person interacting with the prototype. The other project manager also participated in the test but only as an observer.

6.2.2 Materials (Prototype 1)

An interactive prototype was created in Microsoft Excel, (see Microsoft Excel in appendix). The software was chosen as it enables adding text during the test, which is not (according to the authors' knowledge) possible with the software aimed to design wireframing. The software favoured quick prototyping that could support the basic functionality of the concept.

The tests were executed live during a real scenario, a meeting with FlexLink US, as it was argued to give the most valid feedback (Stanford University, 2019). The hypothesis was that the prototype to test feedback would yield in a discovery of new requirements and that the test would reveal usability problems. Lanoue (2015) states that user tests are a great way to identify incorrect assumptions about user behaviour and that it helps in the process of finding interaction problems, misleading navigation and unwanted features.

Like the first design proposal, the purpose of the prototype was to allow testing the functionality, therefore little focus was put on the aesthetic aspects of the interface. The focus was to test whether the categories worked well when making notes, and if the desired information was presented. The functionality tested in the prototype is the making of notes during a meeting. The function of adding of meeting issues was excluded from the prototype as it demanded extra contribution from FlexLink, both the local site and the site in the US. Instead, meeting issues were collected in advance and added manually before the meeting to simulate an automatically generated meeting agenda.

A section for general notes were added on the right side of the Excel sheet, shown in Figure 28, a feature that was not included in the initial concept. The feature was added in case the test person felt like the pre-decided categories did not fit the notes to be made. Other functions that were not part of the initial concept were the possibility to add a new issue during a meeting (by a button with a "+"-sign at the top of the screen) and the possibility to get a meeting summary at the end of the meeting as a suggestion (a button named "Summary" also at the top of the screen). Another small addition was to assign an action to a certain project member, called "action owner" placed below "action". These additions all originated from the evaluation of the concept in previous chapter (see 5.6).

Meeting #1

Summary

+

General Notes

Project	1
Date	12/11/2019
Duration	

Attendees	Company US	Company SE
	.	.
	.	.
	.	.
	.	.

Posted	Issue	ID#
1/Oct/19		1
From/To	Description	
-		
-	Link	
Action	Answer	
Action owner	Decision	
-		
Deadline	Comments	
8/Nov/19		
	Status	
	-	

Posted	Issue	ID#
8/Oct/19		2
From/To	Description	
-		
-	Link	
Action	Answer	
Action owner	Decision	
-		
Deadline	Comments	
8/Nov/19		
	Status	
	-	

Posted	Issue	ID#
17/Oct/19		3
From/To	Description	
-		
-	Link	
Action	Answer	

Figure 28: Prototype 1 during meeting.

Project

1

Date

12/11/2019

Duration

0

Attendees

Customer

Flexlink

•

•

•

•

Action

0

Owner

-

Deadline

8/Nov/19

Issue

0

Answer

0

Decision

0

ID#

1

Action

0

Owner

-

Deadline

8/Nov/19

Issue

0

Answer

0

Decision

0

ID#

2

Action

0

Owner

0

Deadline

8/Nov/19

Issue

0

Answer

0

Decision

0

ID#

3

Figure 29: Prototype 1, meeting summary.

6.2.3 Data collection

Qualitative data was also collected through observations made of the project manager's interaction with the prototype during the meeting and a feedback session that followed the meeting. In addition, the participants filled in a questionnaire consisting of a Semantic Differential Scale. The participant who interacted with the prototype also answered a Self-Assessment Manikin.

6.2.3.1 Semantic Differential Scale

To measure the users' response to the prototype a semantic differential scale (QuestionPro, 2019) was made in two versions, one for the person using the prototype and one for the observer. The scale measures how the test persons experienced the prototype in use. Additionally, the test person who was making notes in the prototype also filled in a small survey regarding their feelings about being observed by the other team members during the test. Question 5.1 and 7, in the semantic differential scale, were solely for the test person managing the prototype, and question 5.2 was the alternative question for the observing test person. The fifth question was included to measure the perceived workload, as explained in 2.4.7.

1. How did you interpret the overview of the template?

Unclear ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 Clear

2. How did you interpret the overview of each issue?

Unclear ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 Clear

3. How did you experience the structure of the template?

Cluttered ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 Organised

4. How did you experience the navigation in the template?

Complicated ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 Easy

5.1 How much focus did it take to make notes in the template?

No focus ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 All my focus

5.2 How did the display of the template impact your ability to follow the meeting?

Distracting ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 Supportive

6. How did you experience the template as a whole?

Obstructive ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 Supportive

7. How did you feel about others observing you making notes?

Uncomfortable	☐	☐	☐	☐	☐	☐	☐	Comfortable
Inefficient	☐	☐	☐	☐	☐	☐	☐	Efficient
Anxious	☐	☐	☐	☐	☐	☐	☐	Confident
Stressed	☐	☐	☐	☐	☐	☐	☐	Calm
Annoyed	☐	☐	☐	☐	☐	☐	☐	Content
	1	2	3	4	5	6	7	

6.2.3.2 Self-Assessment Manikin

The Self-Assessment Manikin (SAM) is a tool to measure an emotional response in an easy and quick way (Bradley, 1994). It is a non-verbal tool with graphical descriptions that measures emotions in three dimensions: valence, arousal, and dominance, in response to an object or an event. The valence dimension, also called the pleasure dimension, ranges from a smiling figure that illustrates high valence to a frowning figure that represents low valence. The arousal dimension ranges from an illustration of a wide eyed and excited figure that shows high arousal, to a sleepy figure that represents the lowest level of arousal. The third and last dimension is the dominance dimension, which is illustrated by figures of different size, that relates to how large one feels in a certain situation meaning the level of control that is experienced. The tool may be used on its own or in combination with other evaluation tools or complimentary interviews. The SAM tool is illustrated in Figure 30.

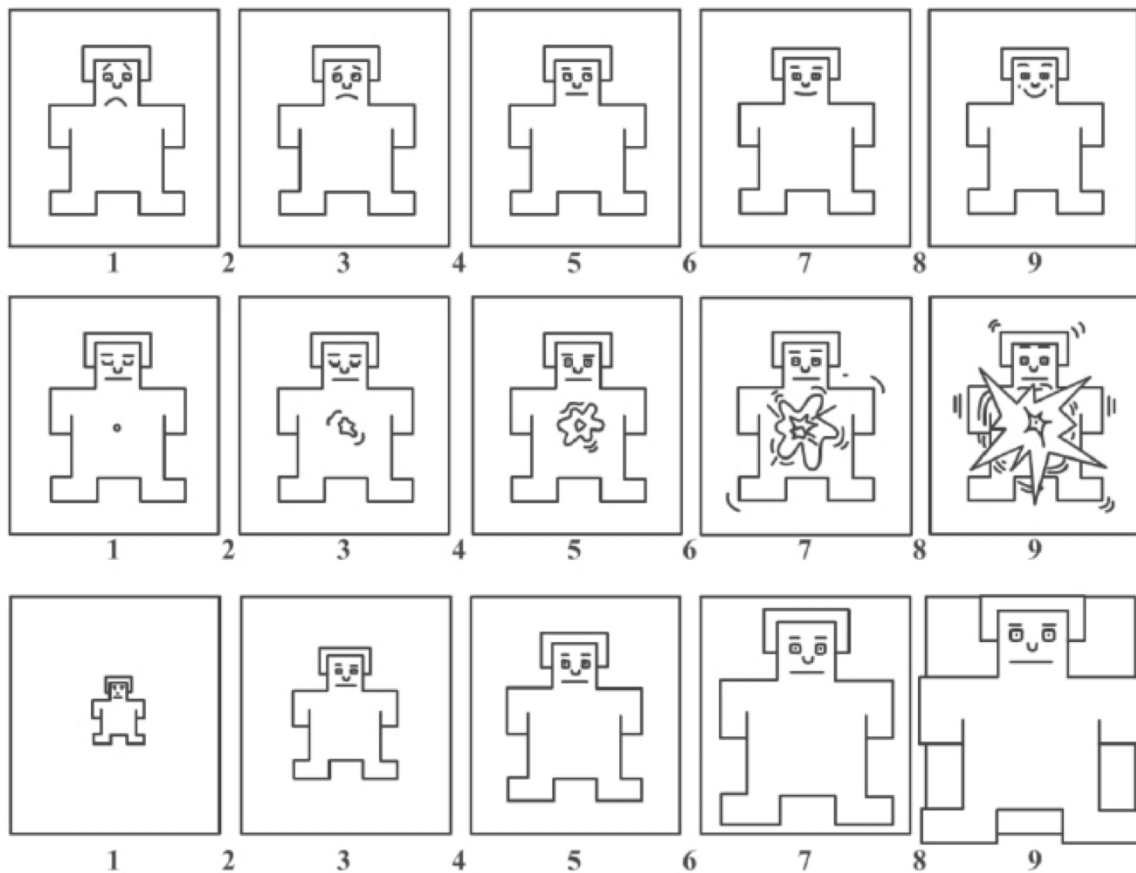


Figure 30: The Self-Assessment Manikin.

6.3 Prototype 1

The prototype was made in Microsoft Excel to enable participants to add text during the test. The program favoured quick prototyping that could support the basic functionality of the concept.

The test was conducted in two meetings where the first meeting served as a pilot meeting. The pilot meeting was a shorter meeting than normal, approximately 20 minutes. The project manager was alone in the meeting room and the prototype was not screen shared. However, the brief meeting gave the project manager a chance to interact with the prototype in a real scenario to get a bit more familiar with it. The pilot test also gave some new input, such as that the meeting issues seldom are discussed in order, complicating the making of notes in the prototype.

The main test was conducted during a real meeting the following day: a Skype meeting with a colleague at FlexLink US. This time there were two colleagues joining the project manager in the meeting room; another project manager and the head of the department. The project manager used the prototype to make notes during the meeting and the computer screen was displayed on a TV screen in the meeting room for the observers. Only the participants at the Gothenburg site was aware of the tool being used, it was not at this stage shared with the US site colleague. Immediately after the end of the meeting, the participants filled in the prepared questionnaire and were encouraged to give additional feedback.

The prototype was prepared with meeting issues from a shared document between the Gothenburg site and the US site, as well as notes from the previous meeting. A total of 16 issues were noted in advance, one was added during the pilot test meeting. During the meeting, four additional issues were added, which yielded in a total of 20 issues present in the prototype.

However, the meeting did not discuss all issues but only seven issues in the pilot meeting and eight issues in the main test meeting.

Unlike the pilot test meeting, the project manager chose to screen share while taking notes. The prototype was immediately noticed by the US representative, who had neither been informed about the thesis project nor the prototype test. The immediate response was “*What is that? I really like it!*”. The US representative further expressed that he would like a tool like that as he finds it very hard to manage projects through emails.

After the meeting, the project managers were asked to fill in the semantic differential scale and the Self-Assessment Manikin, the latter only by the project manager who managed the prototype. The head of the department was only present during a short while of the meeting, and therefore stated that he could not fill in the questionnaire as he did not pay enough attention to the tool.

6.3.1 Results

The general impression of the concept was that it had potential to be supportive, yet, it did not provide an overview of the issues, which resulted in a lot of scrolling as the issues were not discussed in order. Also, the project managers thought that there were too many options of where to make notes for each issue. However, the overview of each issue was perceived clearer than the overview of the whole agenda.

Overall, the results from the semantic differential scale were rather centred, just scoring above or below neutral. The scores that stood out were that the prototype demanded a lot of focus from the person interacting with it and, as previously mentioned, that the overall overview was not clear which was a little distracting for the participants when they tried to follow the meeting.

The project manager managing the prototype also filled in the SAM-scale, where the ratings were ‘5’ on valence, meaning neutral, ‘5’ on arousal, meaning medium emotional engagement, and ‘2’ on dominance, meaning a feeling of being controlled in the interaction rather than having control (see Figure 31). The desired SAM-score would be a high score on valence, a low to medium score on arousal, and a high score on dominance.

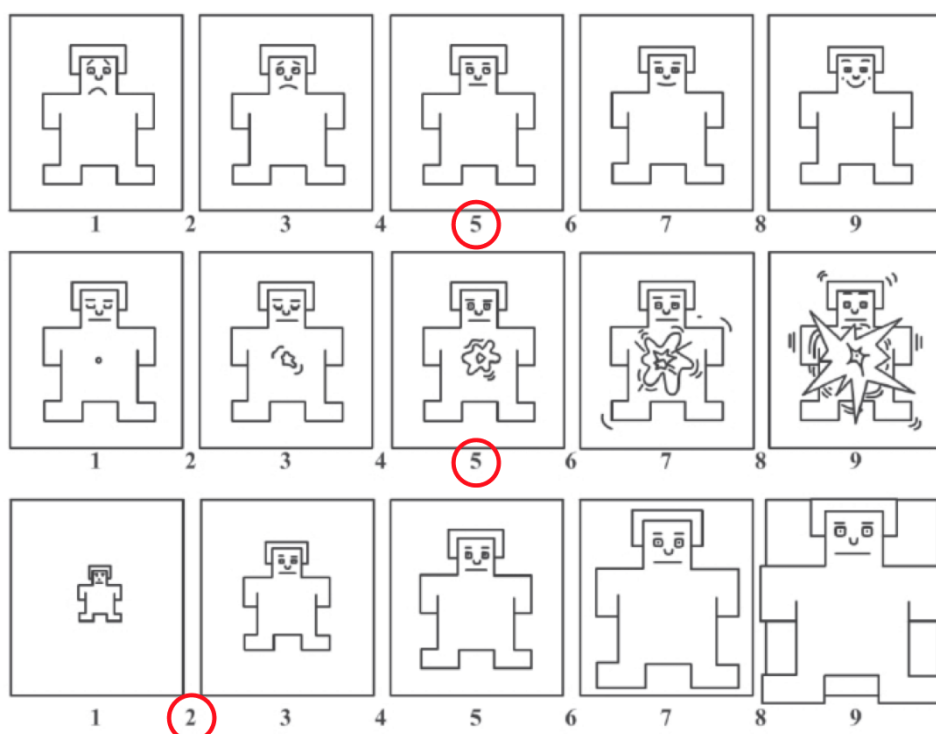


Figure 31: Results from the Self-Assessment Manikin, iteration 2.

6.3.2 Conclusion and design implications

The test of prototype 1 gave much valuable input and new requirements on the concept were revealed.

When observing the test, it became clear that all meeting issues on the list were not discussed. Furthermore, the issues were not discussed in any specific, pre-decided order, resulting in difficulties when navigating in the template. The requirements to get a clear overview of all the issues and to quickly get to the desired issue to make notes were thereby identified. A template with an overview of all issues that fit a normal sized computer screen, without scrolling, would possibly make the template less distracting and more supportive. As it would facilitate navigation and not demand scrolling, hypothetically it would demand less focus from the team member managing the template.

The test also showed that there were excess categories for making notes as only the answer category was utilised for each issue. It was expressed that it was hard to know where to put certain information during the meeting, and therefore most of the information were put in only one category, as the nature of the meeting gave little time to sort the information. By reducing the number of categories, the decision-making process of where to make a note would be facilitated, and thus demand less cognitive resources. Also, after the test, feedback was given that a single issue might have multiple actions with multiple action owners, which yielded in a new requirement too. The display of issue status was not considered clear enough, and a more visible and clear display of issue status was desired.

To conclude, new requirements were identified regarding the number of free text categories, the overview of issues, the display of issue status and tools for prioritisation of issues during the meeting.

7 Iteration 3

In this iteration, a new interactive prototype was made based on the test results and feedback from iteration 2. Just like the previous iteration, the duration of this iteration was very brief, and the testing was conducted in the same way.

7.1 Aim

The aim of iteration 3 was to produce a new and updated version of the concept in terms of an interactive prototype and to conduct further tests. Also this test was conducted during a real meeting. The goal was to identify even more needs and requirements but also to evaluate the design changes made based on the results of iteration 2.

7.2 Method

The methodology used in this iteration was identical to the methodology of iteration 2, with the addition of the creation of macros in Microsoft Excel.

7.2.1 Participants

In this iteration the main participant was, once again, the project manager, who was the person interacting with the prototype. The other project manager also participated in the test but as an observer. In this test the construction engineer from the project team participated as well, also as an observer. The meeting was with the same US colleague as in iteration 2, but no input was collected on their views or experiences.

7.2.2 Materials (Prototype 2)

The second prototype was designed in Microsoft Excel, as iteration 2. To enable more advanced functions in Microsoft Excel, macros can be used. In this prototype macros were used to collapse and expand cells, add cells on command, and copy cells to another sheet on command.

Several changes were made to prototype 1 based on the design implications from iteration 2. First, the issues were compressed as a list to provide an overview of all issues in the meeting agenda (see Figure 32). The issues could be expanded by clicking at the “+” sign (to the right on the screen) where further information could be added. This change in design was implemented as a solution for the lack of overview experienced in iteration 2. Also, the compressed issue list should eliminate scrolling and facilitate the navigation between issues.

Second, each issue contained fewer fields for notes, to facilitate the decision-making of where to add text. Instead of fields for description, answer, decision, action and comments, this 2nd prototype only provided one field for information. Further, the user could add an action or decision by clicking on “+ Action” or “+ Decision” (see Figure 33 and Figure 34). This design change reduced the number of text boxes, a wish expressed in iteration 1, which could help the user to find the right focus in the interface.

Third, each issue could contain multiple actions or decisions, unlike prototype 1 where each issue was restricted to one action and one decision. Fourth, as this second prototype provided multiple actions to an issue, each action had their own action status. The status could be “To do”, “Doing”, or “Done”, inspired by the Kanban model used in Trello (Atlassian, 2020). To enable multiple actions to an issue was a feature explicitly asked for in previous iteration, but the action status was not. However, the action statuses introduced to the prototype are widely used in other similar tools and therefore included also in this design.

Lastly, the issue status was shown more clearly in this prototype, compared to its predecessor, through colour indicators across the whole issue banner. Completed issues were marked green, issues that were irrelevant, added by mistake, or closed for another reason were blackened,

and open issues remained lit. This design change targeted the prioritisation problem and aimed to facilitate the overall interpretation of the issues in the agenda.

Summarise				
ID#: 1	Issue:	Headline 1	Status:	Open issue +
ID#: 2	Issue:	Headline 2	Status:	Actions completed +
ID#: 3	Issue:	Headline 3	Status:	Open issue +
ID#: 4	Issue:	Headline 4	Status:	Open issue +
ID#: 5	Issue:	Headline 5	Status:	Irrelevant +
ID#: 6	Issue:	Headline 6	Status:	Actions completed +

Figure 32: Issue overview in prototype 2.

Summarise				
ID#: 1	Issue:	Headline 1	Status:	Open issue +
From/To Posted Last edited Link - 2019-11-20				
Information + Action + Decision				
Action: 1.X Action description Action Owner Deadline 2019-11-21 Status Doing				
Action: 1.X Action description Action Owner Deadline 2019-11-21 Status To do				
ID#: 2	Issue:	Headline 2	Status:	Actions completed +
ID#: 3	Issue:	Headline 3	Status:	Open issue +
ID#: 4	Issue:	Headline 4	Status:	Open issue +
ID#: 5	Issue:	Headline 5	Status:	Irrelevant +
ID#: 6	Issue:	Headline 6	Status:	Actions completed +

Figure 33: Issue 1 expanded with two actions added.

Summarise

ID#: 1	Issue: Headline 1	Status: Open issue	+
ID#: 2	Issue: Headline 2	Status: Actions completed	+
ID#: 3	Issue: Headline 3	Status: Open issue	+

From/To	Posted	Last edited	Link
-	2019-11-20		

+ Action
+ Decision

Information

Decision:

Decision date: 2019-11-20
Signed off by:

ID#: 4	Issue: Headline 4	Status: Open issue	+
ID#: 5	Issue: Headline 5	Status: Irrelevant	+
ID#: 6	Issue: Headline 6	Status: Actions completed	+

Figure 34: Issue 3 expanded with decision added and drop-down menu for issue status.

7.2.3 Procedure

The test was conducted in a similar way as in previous iteration, i.e. during a meeting with FlexLink US, where the prototype was screen shared with the US representative and shared on a big screen in the meeting room at the Gothenburg site during the complete meeting. The duration of meeting was approximately 30 minutes, which was also the scheduled amount of time. The attendees of the meeting were the project manager, the US company representative, and the construction engineer. The latter was not present during the previous test, which might have had an effect on the test results, a matter that will be discussed in the next section. The prototype was prepared with 12 issues, retrieved from the shared list. The project manager got a chance to review the prototype briefly before the meeting and was informed about the design changes.

After the meeting, the project manager and the construction engineer filled out the evaluating tools, i.e. Self-Assessment Manikin and the Semantic Differential Scale.

7.3 Results

During the meeting, one new issue was added to the prototype, all issues got a status update as their default status was undefined. Two issues got the status “All actions completed”, one issue was market as “Irrelevant”, and the 10 remaining issues were marked with “Open issue”. Further, seven actions were added during the meeting, all assigned to a certain team member, and with a deadline. Also, three decisions were made, however only two were “signed off by” the project manager and one was left without any note of who signed it off. Unlike the previous test meeting, the meeting followed the issue order throughout the whole meeting.

The project manager responded very well to the second prototype. The overview and the possibility to add multiple actions to an issue were brought up as good design changes. This meeting followed the issue order of the agenda, which was a result of the improvements in the overview of issues, according to the project manager. The applicability and usefulness of addition of multiple actions to an issue were proven immediately, as the function was used many times during the test. The construction engineer, who had not seen the first prototype, was not

as positive. The construction engineer was rather hesitant to share any thoughts and would not express neither positive nor negative opinions about the solution. (S)he expressed that some of the vague responses was due to the lack of involvement in certain issues and therefore little attention had been paid to the prototype displayed on the screen.

Despite the construction engineer's indifference to the prototype, the Semantic Differential Scale showed improved results. As desired, the assessments of the structure, the navigation and the overview of the template were improved. Also, the ability to follow the meeting was supported by the template and was the category that had improved the most. The demand of mental focus to make notes in the template had decreased, which was an improved although still not a satisfactory result. However, that the template demands a lot of focus could be explained by the project manager's unfamiliarity with the template. It is likely that less focus would be demanded to make notes when being familiar with the template. The only impaired result was the interpretation of the overview of each issue. A motivation to this was the choice of colour for decision, shown in Figure 34, as it was the same nuance of green as the issue status "Actions completed". When multiple actions had been added to an issue, the participants expressed that it was hard to visually keep them apart, as the actions were placed close to one another and with the same background colour, shown in Figure 33.

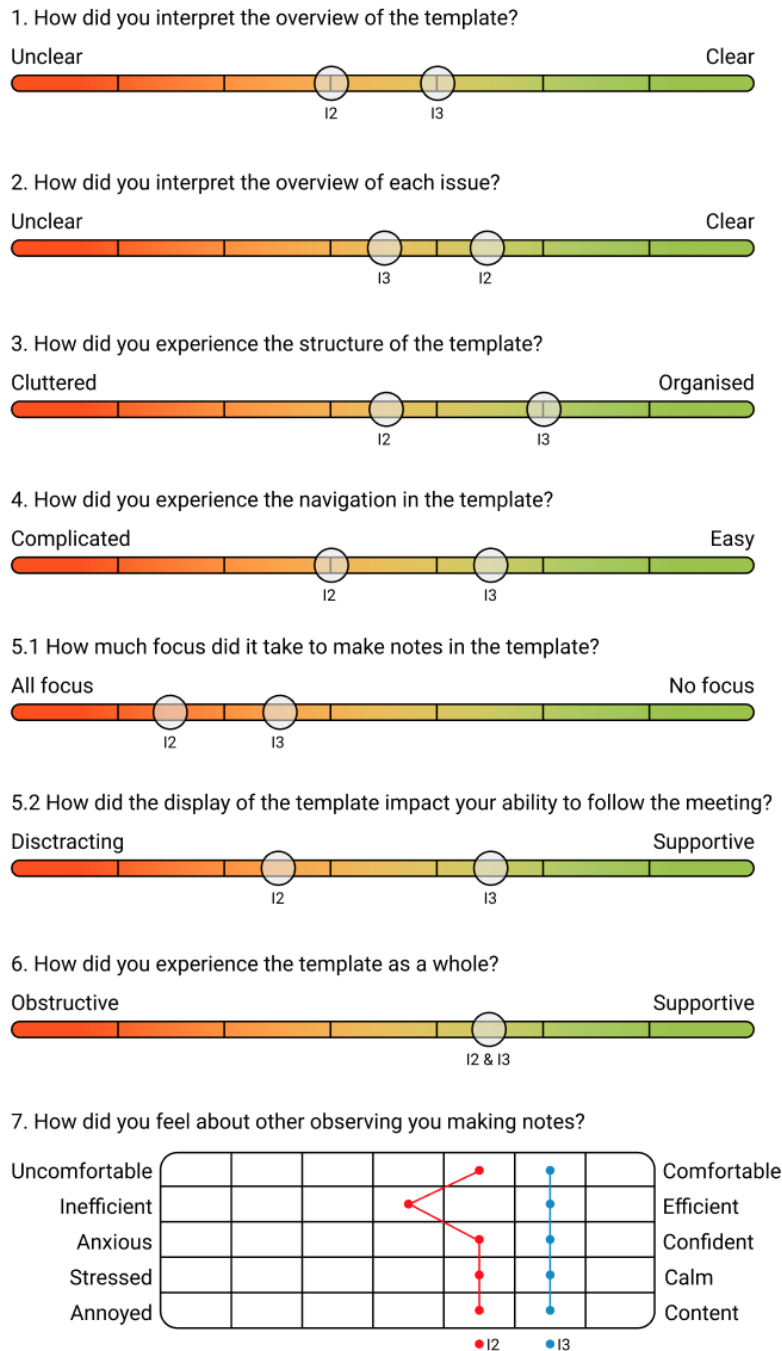


Figure 35: Semantic Differential Scale responses. I2 = Iteration 2, I3 = Iteration 3. Red = Iteration 2, Blue = Iteration 3.

The ratings from the SAM-scale, Figure 36, showed clear improvement too. The valence score increased to '7', the arousal had a slight increase to a '6' and the dominance score was '5'. The third dimension, dominance, had the greatest increase, yet, has the lowest score. As it is desirable to get a high score of dominance, the result should still be improved to have the user feel in control of the template.

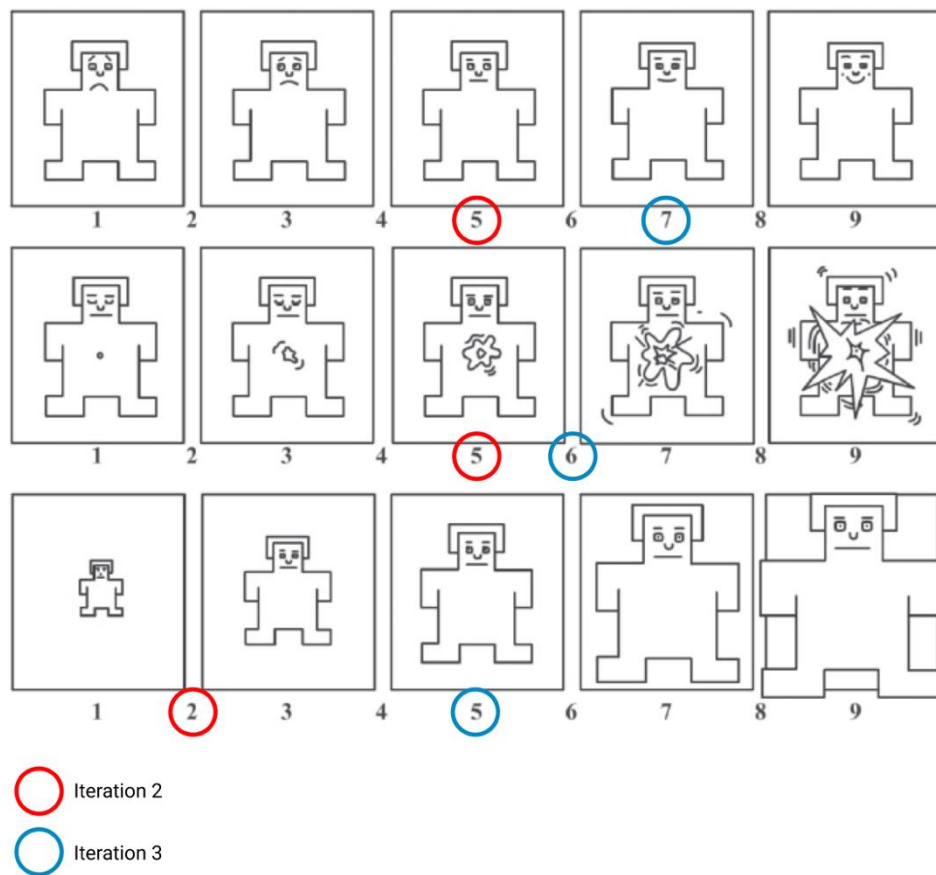


Figure 36: Results from the Self-Assessment Manikin, iteration 2 & 3.

7.4 Conclusion and design implications

The greatest change from previous meeting observations, including the prototype test in iteration 2, was that this meeting followed the issue order proposed in the template. To discuss the issues in order facilitates the process of making notes and also to follow the meeting on the screen. It is believed that this phenomenon was a result of the full overview of issues shown to all meeting participants during the meeting. The meeting pace was also calmer and more focused than in previous meetings and the group waited for the template administrator to finish making notes before moving on to the next issue when needed. Thus, the ability to follow the meeting was supported by the display of the template which presumably was related to the issues being discussed in order.

As this prototype could not provide prioritisation of issues the participants once again asked for such functionality. Therefore, this requirement must be considered in the next iteration. The reduction of free-text boxes was a welcomed design change, however, there was still a lot of clicking and typing to be done during the meeting, such as changing status, filling in when last edited, posted and deadline. When asked, the participants agreed that it would be helpful to have certain fields pre-selected, for example, “open” to be the pre-selected status for a new issue instead of nothing being selected, shown as “-” in the prototype.

Other problematic aspects observed in the test were that the project team did not seem to use the “From/To”, but preferred to assign an issue owner instead. Mentioned was also that an issue may have more than one owner, for example two colleagues that need to collaboratively solve an issue, rather than an issue in form of a question from one project member to another.

Lastly, this second prototype did not provide a properly designed summary page, which was noticed and requested by the participants. Such a page should therefore be included in the concept and it should display both open and completed issues and what actions and decisions that have been taken during the meeting.

8 Iteration 4

This iteration was the last iteration including an interactive prototype that was tested. Like iteration 2 and 3, this iteration was conducted during one week and a test was performed during the same weekly meeting with the US colleague.

8.1 Aim

The aim of iteration 4 was to produce the third and last interactive prototype and conduct the last user tests. The prototype updates were to be evaluated and analysed and serve as a basis for the development of the final concept.

8.2 Method

The methodology in this iteration was the same as in previous iterations.

8.2.1 Participants

In this iteration, there were four participants; the project manager who made notes in the template, the construction engineer, the other project manager and the US colleague. This time, the US colleague also filled in the semantic differential scale and was separately interviewed for additional qualitative data collection. All participants had seen a previous prototype at least in one meeting.

8.2.2 Materials (Prototype 3)

The third and last prototype was an updated version of prototype 2 and it was programmed in Microsoft Excel.

The design changes made were based on results from previous prototype tests and feedback. As it was requested to indicate issue priority in both iterations 2 and 3, this prototype offered “High priority” as an issue status, see Figure 37. The status was given the colour red, as red is perceived as an alarming colour with high visibility that draws attention, (ZevenDesign, 2015). Instead of an issue being handed over from one person to another, the prototype offered one or more issue owners, see Figure 38.

Observations also showed that actions very often were updated by deleting existing an action description and then writing new text. This risked to yield poor traceability and inaccurate documentation as original information got lost. Therefore, the function “+ Action update” was introduced, which meant that actions could be updated without loss of or change to any prior information.

To not confuse decisions with the status “Completed”, the background colour for decision was changed from green to a blue shade, slightly darker than the default background, to stand out, see Figure 39. The previous test also proved that the information text for each issue was normally brief, and as a result, the information text box was reduced in size. For this prototype, the pre-selected status was “Open” instead of nothing, to reduce the number of clicks, an aspect highlighted by the participants in the test of prototype 2. The status “All actions completed” was renamed “Completed” since an issue could be closed and completed without having all actions completed. For example, an action could be irrelevant due to a new decision or an issue might not have actions at all. This design change did not yield from a proclaimed wish from any participant, but from the authors considering the logic. Likewise, “signed off by” was also removed as all meeting attendants should make a decision collaboratively and possibly be held responsible for it, not only one person. Lastly, tabs with issue lists of completed and dismissed issues were created to enhance sorting of issues when making a meeting summary at the end of the meeting.

					Completed Issues	Dismissed Issues	Summarise
ID#: 1	Issue:	Headline1	Status:	High priority	+		
ID#: 2	Issue:	Headline 2	Status:	Completed	+		
ID#: 3	Issue:	Headline3	Status:	Open issue	+		
ID#: 4	Issue:	Headline 4	Status:	Open issue	+		
ID#: 5	Issue:	Headline 5	Status:	High priority	+		
ID#: 6	Issue:	Headline 6	Status:	Open issue	+		
ID#: 7	Issue:	Headline 7	Status:	Completed	+		
ID#: 8	Issue:	Headline 8	Status:	Irrelevant	+		
ID#: 9	Issue:	Headline 9	Status:	Added by mistake	+		

Figure 37: Overview of issues during meeting.

					Completed Issues	Dismissed Issues	Summarise
ID#: 1	Issue:	Headline1	Status:	High priority	+		
ID#: 2	Issue:	Headline 2	Status:	Completed	+		
ID#: 3	Issue:	Headline3	Status:	Open issue	+		
Issue owner(s) Posted Last edited Link Information + Action + Decision					-		
ID#: 4	Issue:	Headline 4	Status:	Open issue	+		
ID#: 5	Issue:	Headline 5	Status:	High priority	+		
ID#: 6	Issue:	Headline 6	Status:	Open issue	+		
ID#: 7	Issue:	Headline 7	Status:	Completed	+		
ID#: 8	Issue:	Headline 8	Status:	Irrelevant	+		
ID#: 9	Issue:	Headline 9	Status:	Added by mistake	+		

Figure 38: Issue 3 expanded during meeting.

Completed Issues

Dismissed Issues

Summarise

ID#: 1	Issue: Headline1	Status: High priority	+
ID#: 2	Issue: Headline 2	Status: Completed	+
ID#: 3	Issue: Headline3	Status: Open issue	+

Issue owner(s)

Posted

Last edited

Link

Information

+ Action

+ Decision

Decision:

Decision date:

Action: 1.X

Action Owner

Deadline

Status

-

+ Action update

Action: 1.X

Action Owner

Deadline

Status

-

+ Action update

ID#: 4	Issue: Headline 4	Status: Open issue	+
--------	-------------------	--------------------	---

Figure 39: Issue 3 expanded with one decision and two actions added.

8.2.3 Procedure

The test was conducted during the weekly internal meeting with the project team and the US colleague (just like the two previous tests). The project manager made notes in the template shown on a larger tv-screen and screen shared with the US colleague. The project manager, the construction engineer and the other project manager were gathered in a small meeting room and the US colleague was connected by link. The meeting was approximately 15 minutes, remarkably shorter than previous test meetings even though the time schedule was identical.

The feedback session that followed the meeting lasted about 10 minutes and consisted of the Semantic Differential Scale, the Self-Assessment Manikin and time for verbal feedback from the project manager, the managerial colleague, and the construction engineer.

A separate 50 minute interview was held with the US colleague concerning the current communication process and the proposed concept. The US colleague also responded to the Semantic Differential Scale during the interview.

8.3 Results

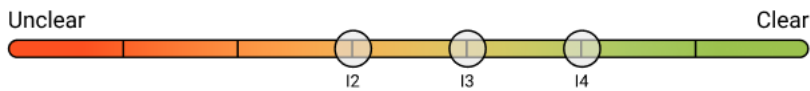
The prototype was prepared with 10 issues, all transferred from earlier meetings and all with the status “Open”. The issues had nine prior actions and three decisions also logged during previous meetings.

During the meeting, all issues were discussed, and three issue statuses were changed to “Completed”. Other notes made in the template consisted of adding two new actions. Like in the test in iteration 3, the meeting followed the issue order proposed in the template.

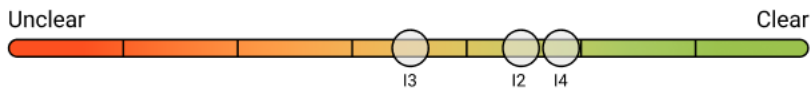
The overall response was positive from all participants. The project manager especially liked the filtering option with completed and dismissed issues. The colour update for decision was also noticed and appreciated. The action update function was never used but mentioned to be a good amendment. However, the three local participants agreed that the template was still a bit messy with a lot of text boxes to fill in. They expressed a wish for more pre-selected information to be filled in automatically, as it was perceived as rather time consuming, and some text boxes were left out a few times, as the project manager forgot to fill them in. Pre-selections for deadline and action status were requested as well as automatic fill in for decision date and last edited. The construction engineer stated that there was still a need for better separation between different actions, and actions from general issue information, as they tended to blend since they had the same background colour.

This time, the Semantic Differential Scale showed improved or unchanged results on all items. The greatest improvements were the assessments regarding the overview of each issue and how much focus was demanded to follow the making of notes during the meeting. The latter could possibly be due to the few notes made in the template during this test compared to the test in iteration 3. However, as the assessments of both the navigation and the overview of the template and each issue were improved, the design changes might also have had this desirable effect. As the visual aspects of the template was not changed remarkably from the previous prototype, it was not strange that the assessment of item 3 remained unchanged. As the assessment of item 7 remained unchanged too, it seemed like the changes were not extensive enough to impact those responses.

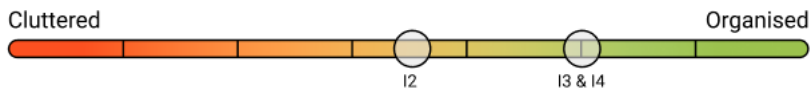
1. How did you interpret the overview of the template?



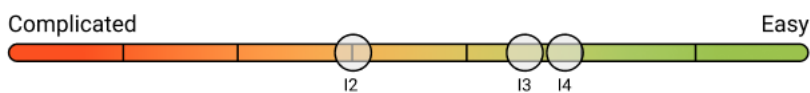
2. How did you interpret the overview of each issue?



3. How did you experience the structure of the template?



4. How did you experience the navigation in the template?



5.1 How much focus did it take to make notes in the template?



5.2 How did the display of the template impact your ability to follow the meeting?



6. How did you experience the template as a whole?



7. How did you feel about other observing you making notes?

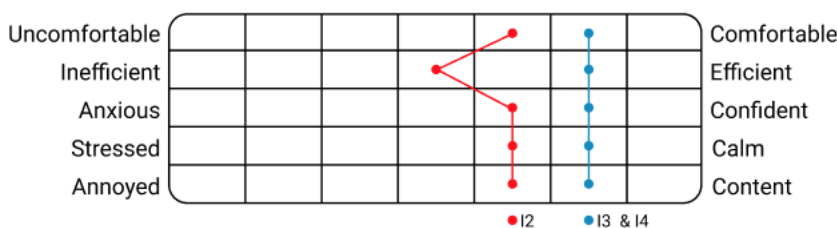


Figure 40: Semantic Differential Scale responses. I2 = Iteration 2, I3 = Iteration 3, I4 = Iteration 4. Red = Iteration 2, Blue = Iteration 3 & 4.

Just like the Semantic Differential Scale, the Self-Assessment Manikin indicated improvements (see Figure 41). The first dimension, valence, was however unchanged, with a score of '7', which was considered acceptable. The second dimension, arousal, slightly increased, with a score of '7' as well. Now, the project manager who filled in the scale explained that the arousal response was purely positive, and that the intensity of emotions was not distracting or overpowering in any way. Thus, the scale has been interpreted differently than as first intended when the desired arousal score was low to medium. Thereby, the arousal score could be considered adequate. The third and last dimension, dominance, showed the greatest change,

scoring '8'. This score was considered very good as the person who interacted with the template should feel dominant in relation to the tool.

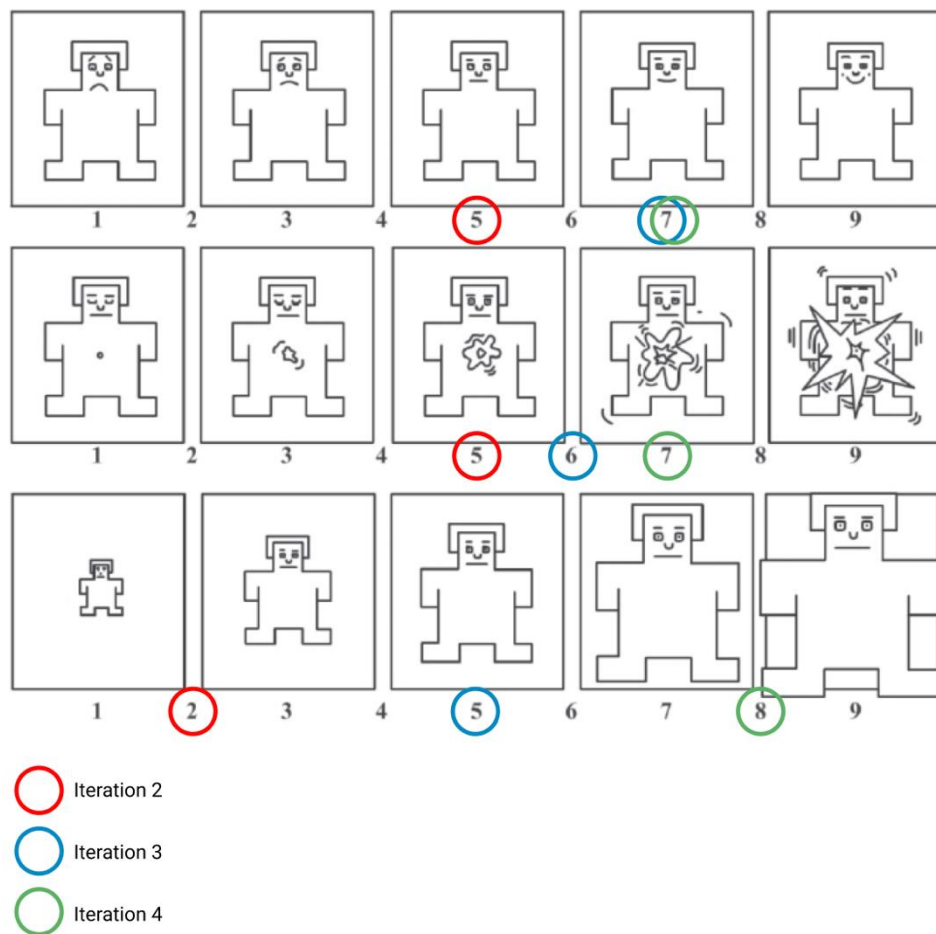


Figure 41: Results from the Self-Assessment Manikin, iteration 2, 3 & 4.

The interview with the US project member indicated that problems that were identified in the project team at the company site in Gothenburg also existed at the company site in the US. The US colleague expressed that it was very challenging to manage projects through email as things were “*all over the place*” and tended to get lost or forgotten. The proposed concept was found very interesting as it would gather much information in one platform. It was also testified that it was usually not agreed on what to write down as decisions or actions during meetings, which was found problematic. The concept would facilitate that process as all meeting attendees would see what was being written down. The US project member also highlighted the usefulness to show issue information from previous meetings in the template as it would help to recall what had been previously said and discussed.

8.4 Conclusion and design implications

This iteration showed improved results, but at the same time room for improvement. However, considering the prototype being an Excel prototype with limited design means, the results could be considered gratifying.

Conclusions could be drawn that the number of text boxes should be kept to a minimum to not make the screen appear messy and cause confusion. The template should offer pre-selections of statuses and dates, as addition of new issues, actions and decisions otherwise tend to demand a lot of clicking which slows down the note making process. Further, how to browse between issues needs to be reconsidered in the development of the final concept, as the final concept will be developed without the design constraints of Excel. Also, how to separate issue

information from actions as well as separating actions from each other have to be improved, as it was still considered poorly solved in the prototype.

9 Final Concept

The final concept was developed based on design implications from the antecedent iterations. The results from the iterations was compiled into a list of requirements, Table 3.

9.1 The concept

The final concept was a visual representation of what the collaborative meeting agenda platform could look like. It was developed in Figma, an online service for vector-based design (Figma, 2020). As this program did not hold design constraints like Excel, the layout of the concept could be further developed. The layout has been designed according to the gestalt laws of relevance for interface design; the law of similarity, the law of proximity and the law of enclosure, (Sincero, 2013).

9.1.1 Design modifications

Information that was related to each other, such as recent updates or dates for upcoming meetings in Figure 42, was grouped to indicate relation. The information was also enclosed in boxes to emphasise the relation and to help the brain perceive the information. Groups of information that were connected to each other, like the creation of a new issue, upcoming agenda issues and saved issues, were placed close to each other as the gestalt laws suggest such a layout. Certain information, such as owner, posted, deadline and status (see Figure 43, Figure 47 and Figure 48) were placed at the same place or in the same column to facilitate the “reading” of the interface. To facilitate the interpretation further text, enclosure boxes, figures and buttons were placed according to vertical and horizontal alignment. To achieve an ordered look, it was chosen to have recurrence of text size and style for headlines, sub-headlines and body text (Lundberg, 2005).

A decision was made to change the colour indicating high priority from red to orange. This decision was made based on colour psychology that says that red can stimulate quick decision making and may awake intense emotions. Orange, on the other hand, is, just like red, a colour of very high visibility, yet, perceived as less and not associated with danger to the same extent. Orange may also increase oxygen supply to the brain and stimulate mental activity (ZevenDesign, 2015).

The concept was intended to be integrated with Skype for businesses, as it was the software used for meeting calls. During a meeting, there should be one person who manage the agenda and make notes while the other meeting attendees follow the note making process on their own screen or on a tv screen in the meeting room. The interface was designed to minimise scrolling, as it was experienced to make it difficult to follow the navigation in the meeting template.

Interviews and observations showed that there was a need for a shared platform for sharing files, such as drawings or models. Therefore, the concept should include such functionality as well, however, it was not included in the final visual representation as the topic has to be investigated further and implies many technical constraints.

The proposal for solving the communication issues in collaborative projects is a digital platform shared with all company sites and the customer. The customer would only access their own project. As this thesis could not study the customer and their user needs, the concept did not include the customer interface but solely the studied company's interface.

9.1.2 Between meetings

When entering the platform, the user would first enter the home page, shown in Figure 42. The user can create a new issue to any of their current projects and confirm it to the upcoming

agenda or save it for later. On the home page, recent updates and the dates for upcoming meetings are also displayed. The functions to create a new project or invite new team members to a project are also included in the home page. In the menu on the left side, the user can browse between projects, enter the action list, (Figure 47), the issue list, (Figure 48), or see old projects in the project library. If about to start a meeting, a link to enter the meeting will appear, illustrated in the top right corner of the screen (Figure 42). The box enclosing the meeting link was chosen to have a deviating colour for better visibility.

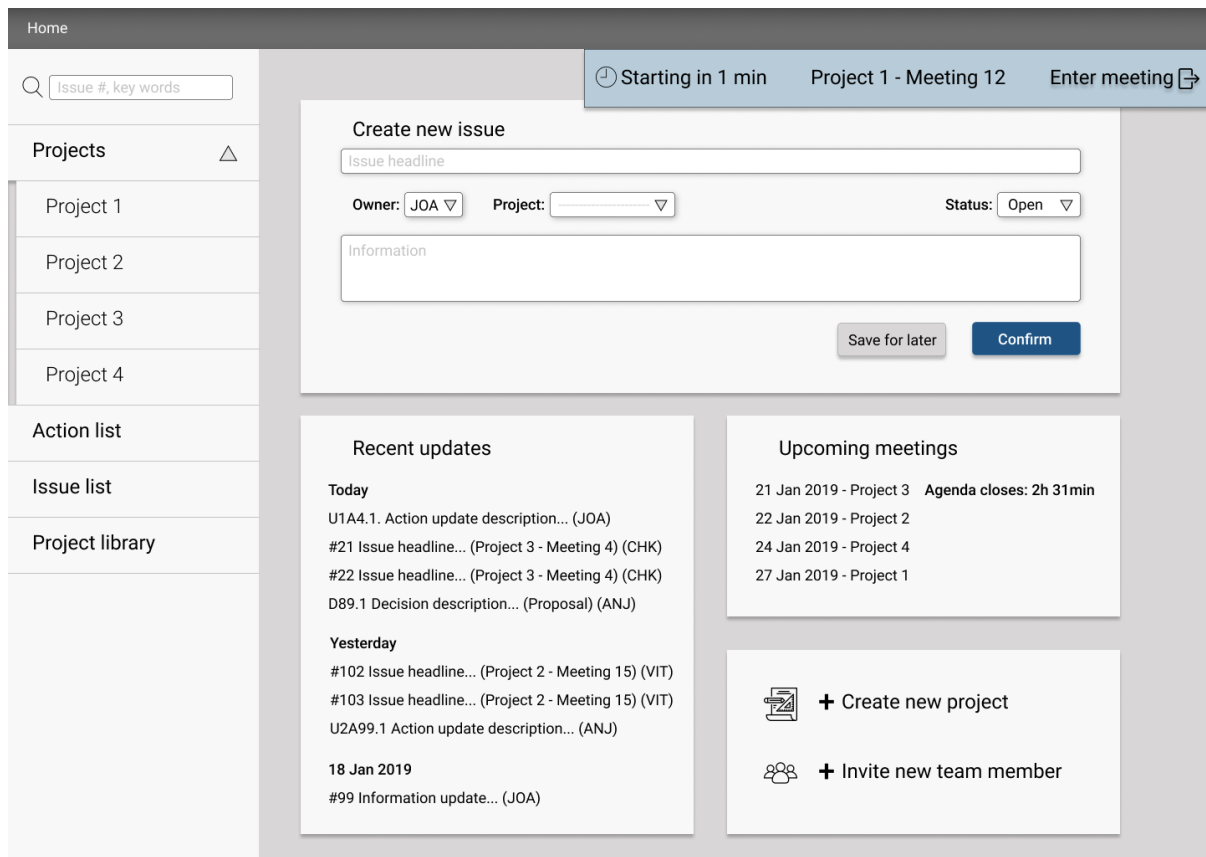


Figure 42: Home page.

The user can create a new issue at the project page as well, however at this page the pre-selected project will, of course, be the same project as the project page, in this case project 1, (see Figure 43). The project page also shows the issues on the upcoming meeting agenda, the saved issues and the project team members. The issues saved are only visible for the particular user.

The full agenda for the upcoming meeting may be viewed by clicking the link "View full agenda" at the bottom of the enclosure box for the upcoming agenda. When entering the agenda, the user can browse between all issues confirmed or transferred to the agenda. The actions and decisions of each issue may also be viewed. New actions, action updates (Figure 44), and decision proposals (Figure 45), can be added in this view. New actions and action updates will be present in the agenda during the meeting along with the date of when it was posted. The decision proposal will have to be confirmed by the meeting to be established. If there are not actions or decisions noted for an issue, the issue display will look as displayed in Figure 46. The actions and decisions are arranged in tabs as this is a familiar way of sort pages, used in many internet browsers as well as in Excel.

Projects > Project 1

Starting in 1 min

Project 1 - Meeting 12

Enter meeting

Projects

Project 1

Project 2

Project 3

Project 4

Action list

Issue list

Project library

Create new issue

Owner: JOA

Project: Project 1

Status: Open

Save for later

Confirm

Upcoming agenda

#1 Issue headline

#2 Issue headline

#3 Issue headline

#4 Issue headline

#5 Issue headline

#6 Issue headline

#7 Issue headline

#8 Issue headline

View full agenda

Saved issues

Issue headline...

Information text...

Owner: JOA

Status: Open

Confirm

Team members

Customer

Company

Mark Allen

Tina Visciglio

Jim McDougal

Jesper Andersson

Katie Rasmussen

Katarina Nördén

Steve Wahlquist

Andreas Johnsson

Figure 43: Home page of project 1.

Projects > Project 1 > Meeting 12 > Issue 4

Back

#1 Issue headline

#2 Issue headline

#3 Issue headline

#4

#5 Issue headline

#6 Issue headline

#7 Issue headline

#8 Issue headline

Issue headline

+

#4 Issue headline

Priority

Owner: JOA

Posted: 12/Jan/2020

Last edited: 15/Jan/2020

Information text regarding the issue may be written here. Information can be edited or added by clicking on the edit icon.

A4.1.

A4.2.

A4.3

+

Decisions (1)

Owner: JOA

Posted: 12/Jan/2020

Deadline: 22/Jan/2020

Status: Open

Action description

Action updates

+ Update

U2A4.1:

When clicking on botton that says "+ Update", this will appear and latest update may be written here.

U1A4.1:

Posted: 15/Jan/2020

Update description added during a previous meeting or between meetings.

Update by: JOA

Figure 44: Agenda view and addition of action update outside of meeting.

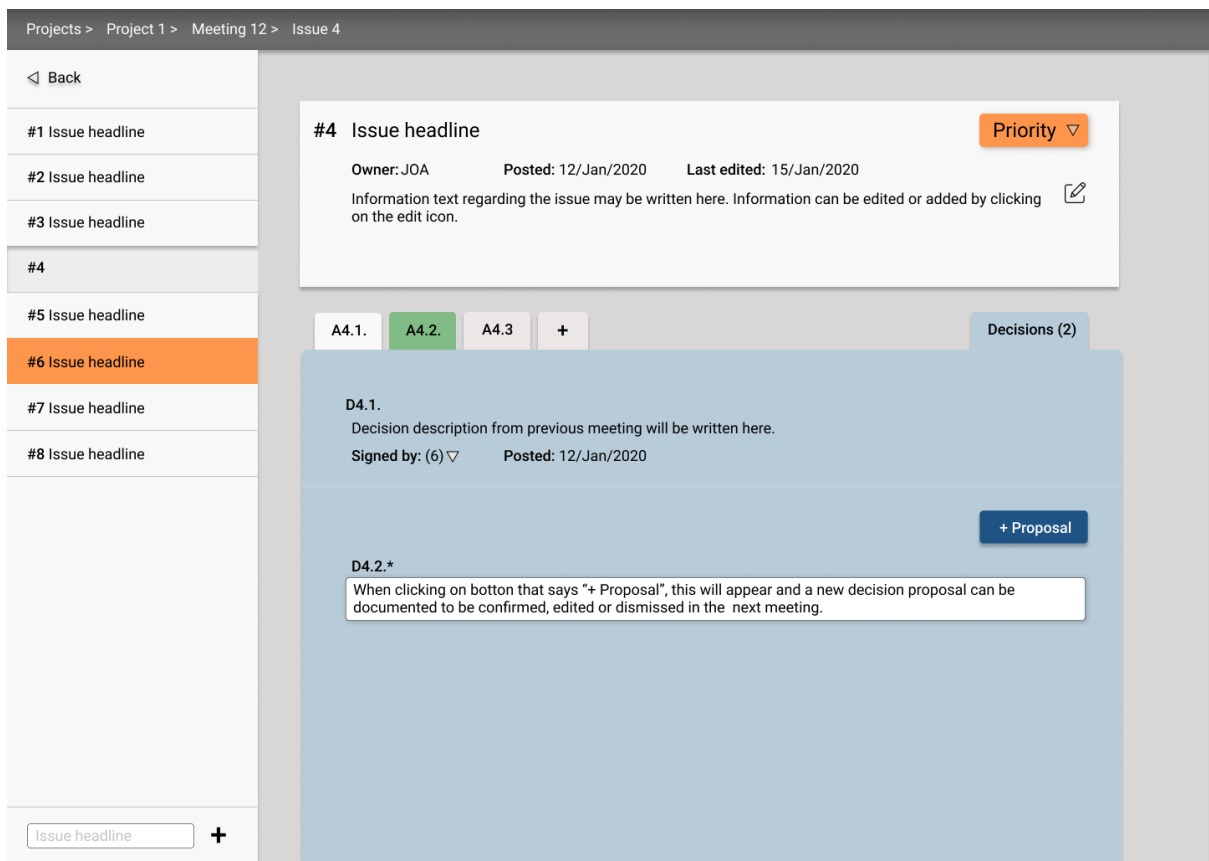


Figure 45: Agenda view and addition of decision proposal outside of meeting.

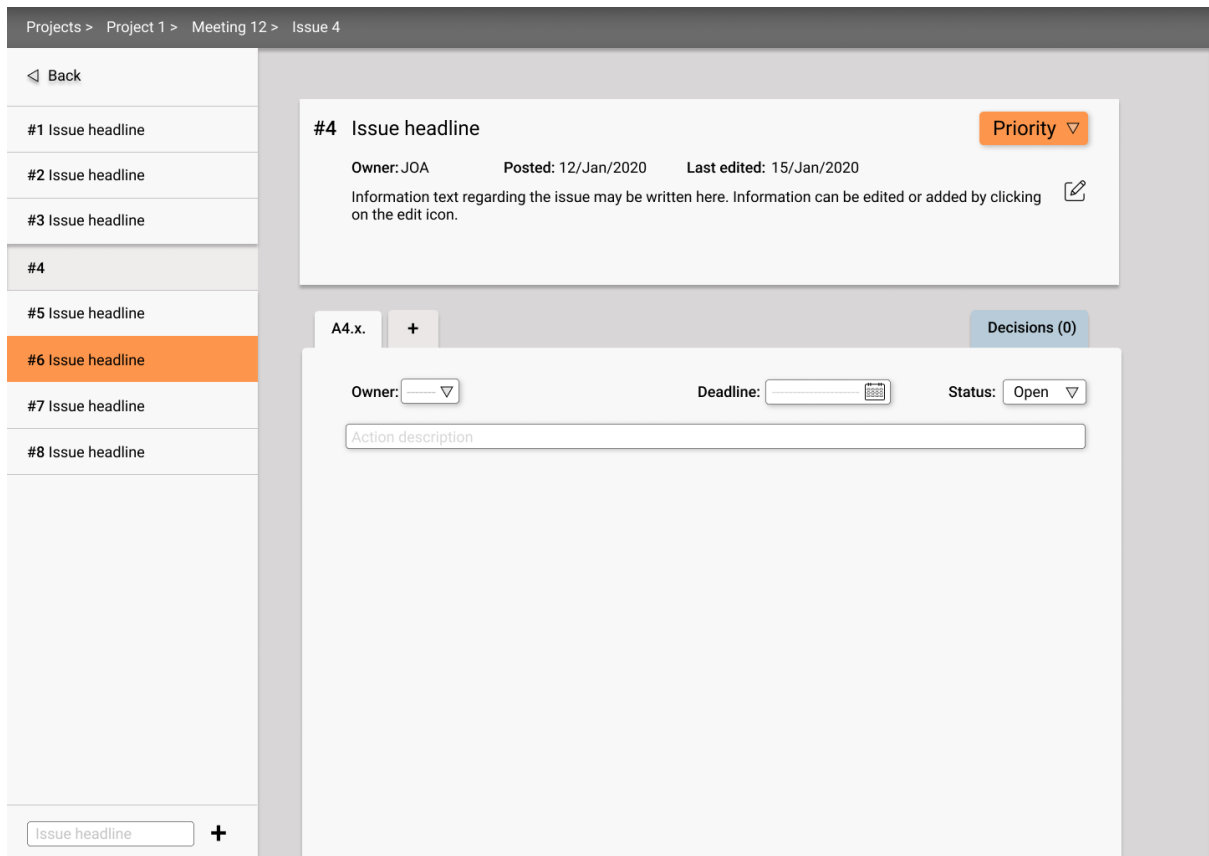


Figure 46: Addition of the very first action of an issue.

All actions can be viewed on the action list page (Figure 47). The actions can be filtered by owner, project, deadline and/or status. The issue list has a very similar view (Figure 48), the only

Home

Q

Issue #, key words

Projects

Project 1

Project 2

Project 3

Project 4

Action list

Issue list

Project library

Starting in 1 min

Project 1 - Meeting 12

Enter meeting

Action list

Owner: All

Project:

Deadline: Urgent first

Status: Open

Owner: JOA	Project 1	Deadline: 22/Jan/2020	Status: Open
A4.1. Action description			
Owner: ANJ	Project 1	Deadline: 22/Jan/2020	Status: Open
A4.3. Action description			
Owner: NOK	Project 2	Deadline: 23/Jan/2020	Status: Open
A99.1. Action description			
Owner: VIT	Project 3	Deadline: 24/Jan/2020	Status: Open
A20.2. Action description			
Owner: ANJ	Project 1	Deadline: 27/Jan/2020	Status: Open
A7.4. Action description			
Owner: ALM	Project 1	Deadline: 28/Jan/2020	Status: Open
A8.1. Action description			
Owner: WAS	Project 1	Deadline: 28/Jan/2020	Status: Open
A8.2. Action description			
Owner: JOA	Project 4	Deadline: 29/Jan/2020	Status: Open

Home

Issue #, key words

Projects

Project 1

Project 2

Project 3

Project 4

Action list

Issue list

Project library

Starting in 1 min

Project 1 - Meeting 12

Enter meeting

Issue list

Owner: All Project: Posted: Status: Completed

#008 Issue headline
Owner: JOA Project 1 Posted: 22/Jan/2020 Status: Completed

#007 Issue headline
Owner: ANJ Project 1 Posted: 22/Jan/2020 Status: Completed

#099 Issue headline
Owner: NOK Project 2 Posted: 23/Jan/2020 Status: Completed

#020 Issue headline
Owner: VIT Project 3 Posted: 24/Jan/2020 Status: Completed

#006 Action description
Owner: ANJ Project 1 Posted: 27/Jan/2020 Status: Completed

#004 Issue headline
Owner: ALM Project 1 Posted: 28/Jan/2020 Status: Completed

#003 Issue headline
Owner: WAS Project 1 Posted: 28/Jan/2020 Status: Completed

#098 Issue headline

Figure 48: Issue list.

9.1.3 During meetings

When the user enters a meeting, the agenda will be displayed (see Figure 49). The number of meeting attendees will be shown in the top left corner, along with the meeting duration.

The issues are located in a list to the left, with a colour indication of their status; off white indicating open, green indicating completed, dark grey indicating discarded, meaning irrelevant or added by mistake, and lastly orange indicating high priority. Issues that have emerged after the agenda has been set can be added by writing the issue headline and clicking on “+”, located in the bottom left corner. Ideally, this function should not have to be used, as the main idea of the concept is advance communication of issues. Yet, acute issues may emerge and the possibility of adding those to the agenda must be possible.

In Figure 49, issue #4 has been selected and the issue information is hence shown in the upper part of the display. The issue information; the identification number, headline, owner, description, status etc, is gathered in an enclosure box according to the gestalt laws, (Lundberg, 2005), to clearly separate it from the action and decision information. The issue description can be edited by clicking on the edit icon, as new information might emerge during the issue lifespan. The issue status is changed by clicking on the arrow in the issue status box. The user who manages notes can browse between the actions, decisions or add a new action. As illustrated in Figure 49, action updates can be added to an action by clicking on the button “+Update” on the tab of the selected action. The update will stay open until the meeting has ended, then the update will be locked.

If there are one or more decision proposals to be confirmed the number on the decision tab will be red. The proposal can be edited, discarded or confirmed without any changes. New decisions are also made on the decision tab where the text box for a new decision appears when clicking on “+Decision”, shown in Figure 50.

The screenshot displays a meeting interface. At the top, a breadcrumb trail reads "Projects > Project 1 > Meeting 12 > Issue 4". The top right corner shows the time "00:12:52" and a group icon with "(6)".

On the left side, there is a vertical list of issues, each with a headline and a color-coded status bar:

- #1 Issue headline (off-white)
- #2 Issue headline (green)
- #3 Issue headline (dark grey)
- #4 (selected, off-white)
- #5 Issue headline (off-white)
- #6 Issue headline (orange)
- #7 Issue headline (off-white)
- #8 Issue headline (off-white)

At the bottom left of this list is a text input field labeled "Issue headline" followed by a "+" button.

The main area on the right shows the details for issue #4:

- #4 Issue headline** (with a "Priority" dropdown menu)
- Owner: JOA | Posted: 12/Jan/2020 | Last edited: 15/Jan/2020
- Information text regarding the issue may be written here. Information can be edited or added by clicking on the edit icon.

Below the issue details, there are tabs for actions: "A4.1.", "A4.2." (selected), "A4.3", and a "+" button. To the right of these tabs is a "Decisions (2)" button.

The "A4.2." tab is active, showing:

- Owner: JOA | Posted: 12/Jan/2020 | Deadline: 22/Jan/2020 | Status: Open
- Action description
- Action updates section with a "+ Update" button.
- U2A4.1: When clicking on botton that says "+ Update", this will appear and latest update may be written here.
- U1A4.1: Posted: 15/Jan/2020
Update description added during a previous meeting or between meetings.
Update by: JOA

Figure 49: View of issue 4 and action A4.1 during meeting.

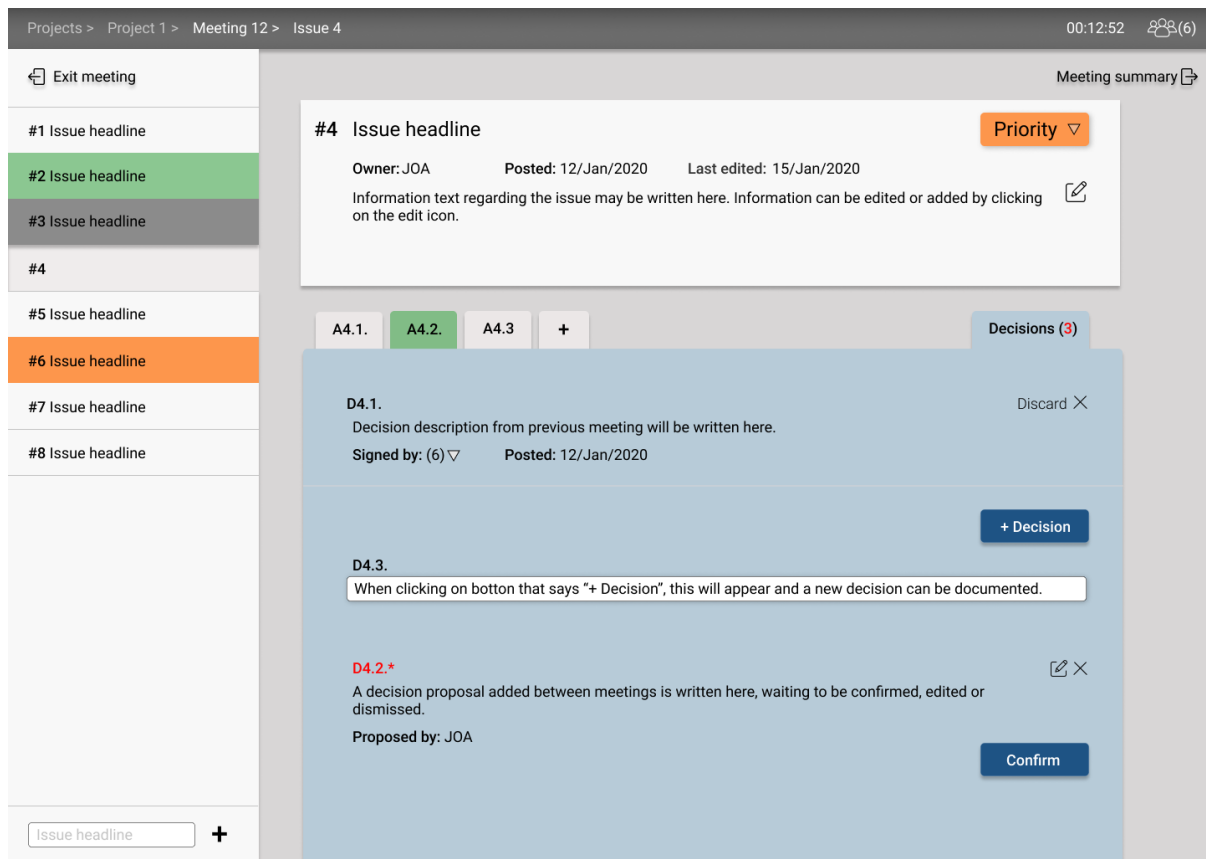


Figure 50: View of decisions and decision proposal for issue 4 during meeting.

If an attendee must exit the meeting before it has ended, the attendee may do so by clicking on “Exit meeting” at the top left corner (see Figure 49 and Figure 50), and the interface will return to the home page. An example of such a situation could be if a project team member is only concerned by the very first issues of the meeting and therefore only needs to attend the discussion of those.

When all issues have been discussed and the meeting has come to an end the user managing the agenda will click on “Meeting summary” in the top right corner. Then a meeting summary will be created (see Figure 51), where all updates done or confirmed during the meeting will be shown. The summary allows the meeting to do a final review of the updates and decisions made before confirming them to the meeting protocol. The summary will sort the information chronologically as well as on issue status; open or closed, to ease the interpretation. The issue status is indicated by the background colour of the issue identification number. When the final review is done the meeting can be ended by clicking on the button that says “End meeting” at the top right corner.

Projects > Project 1 > Meeting 12 > Meeting summary

00:32:17

Exit meeting

Back to meeting

Open issues

#1	A1.2. Action description	Owner: ANJ	Deadline: 22/Jan/2019	
#4	A4.2. Action description	Owner: JOA	Deadline: 22/Jan/2019	
	U2A4.2. Description of action update			
	D4.2. Decision description	Signed by: (6) ▾		
#5	A5.1. Action description	Owner: ANJ	Deadline: 22/Jan/2019	
	U2A4.2. Description of action update			
	D5.3. Decision description	Signed by: (6) ▾		
#6	A6.2. Action description	Owner: NOK	Deadline: 22/Jan/2019	
#7	A7.2. Action description	Owner: JOA	Deadline: 22/Jan/2019	
	U1A7.2. Description of action update			
	D7.1. Decision description	Signed by: (6) ▾		

Closed issues

#2	D2.3. Decision description	Signed by: (6) ▾	
#3	Satus: Irrelevant		
#8	D8.3.	Signed by: (6) ▾	

Figure 51: Meeting summary at end of meeting.

9.2 Evaluation

The final concept was evaluated against a list of requirements and against the personas. The requirements in the list resulting from the user studies; interviews and observations, and the prototype tests.

9.2.1 Evaluation against user requirements

Needs and requirements were identified throughout the project. The origin of the user requirements is indicated in the column "Retrieved from".

Table 3: List of user requirements, indicating the source for each requirement and an assessment to which degree the requirement is fulfilled by the final design proposal.

Requirements	Retrieved from	Fulfilled
1. General/system requirements		
1.1 The tool should support digital information sharing	l1	✓
1.1.1 Between FlexLink and the customer	l1	-
1.1.2 Between different company sites	l1	✓
1.2 The collaborative meeting agenda of a project should be available for the customer	l1	-
1.3 The tool should support learning from previous projects	l1	✓
1.3.1 Enable searching of issue information	l1	✓
1.4 The tool should stimulate the question – answer frequency within a project	l1	✓
1.4.1 Encourage advance communication of issues	l1	✓
1.4.2 Encourage preparation of answers	l1	✓
1.5 The tool should support tracking of issues throughout the whole project	l1	✓

1.5.1 Clarify responsible of action	I3	✓
1.5.2 Show decision information	I3	✓
1.5.3 Enable annulling of decision	I1	✓
1.6 The tool should be designed for first time users	I1	-
1.7 The tool should support identification of deviations	I4	✗
2. Requirements during meeting		
2.1 The tool should support the user in the making of notes	I1	✓
2.1.1 Provide adequate free text categories	I2	✓
2.1.2 Minimise manual input	I3	✓
2.2 Provide a visual overview of issues	I2	✓
2.2.1 Provide relevant issue information in overview	I2	✓
2.2.2 Have a situationally adaptive issue overview	I2	-
2.3 Facilitate prioritisation of issues	I2	✓
2.3.1 Show issue status clearly	I2	✓
2.3.2 Enhance the visual representation of open issues	I3	✓
2.3.3 Enhance the visual representation of high priority issues	I3	✓

The list includes 25 requirements. Twenty of the 25 requirements were considered fulfilled. The requirements marked with “-” were partly fulfilled or could be fulfilled. Requirement 1.1.1 and 1.2 were intended to be fulfilled, but as the thesis project could not access the customer for interviews or a thorough user study, there are likely to be further requirements on the communication tool. Since these requirements are still unknown, it is possible that the concept would not be able to be available for use of the customer. However, this aspect has been taken into consideration during the development process and the platform has been designed to give a professional and safe impression. Nevertheless, juridical aspects and IT security aspects were important aspects for both the studied company and the customer, but these aspects were outside the scope of this thesis.

Requirement 1.6, that the tool should be designed for first time users, was also considered partly or possibly fulfilled. The concept has been designed with usability aspects in mind, for it to be easy to use. Yet, the final concept has not been tested or reviewed with any end users. Therefore, it cannot be considered fulfilled, as the interface might not be well designed for the first time user.

The fourth and last requirement that was not considered fully fulfilled is requirement 2.2.2, have a situationally adaptive issue overview. The requirement was retrieved from iteration 2, during the first prototype test. The first prototype (see Figure 28) did not provide an issue overview where all issues on the agenda could be seen on the screen without scrolling. The requirement is thereby related to the design change the second prototype (see Figure 32 and Figure 33) where the function to expand and minimise an issue was added. As the final concept provided the list of issues in the left side menu, separated from the display of the selected issue, such a function was not needed anymore. Now, the final concept could be considered to provide a somehow situationally adaptive issue overview, as the user can browse the actions and decisions added to an issue, compared to the prototypes where all actions and decisions were displayed in the expanded issue.

The only requirement that has not been fulfilled at all is requirement 1.7, the tool should support identification of deviations. This requirement refers to the need of identifying when an issue is being neglected, for instance when the deadline is constantly postponed or just ends up behind. Including some type of indicator for such phenomena was discussed, but not implemented. What type of and level of visibility of such an indicator should be tested and reviewed before including it in a final concept.

9.2.2 Evaluation against personas

The final concept is support all the four personas, (see 5.3.1), in their individual needs. Tina, the project manager, should be supported with organising her projects and give her a sense of having control of the situation. The concept should also provide a good overview of the actions to be done within the projects. Jesper, the construction engineer, should also get a clear overview of actions to be executed. In Jesper's case his own personal actions were of interest more than the actions assigned to other people in the project team. As the concept stimulates better communication with the customer the risk of last-minute changes should decrease, a fact that Jesper should be very content about since it would save him a lot of double work. For Mark, the overview of all issues and actions to be acted upon should have a calming effect on him. It should make him feel like he is control of the situation, even the small details, and he should feel sure that he would have a good insight of where the project is going. Steve, on the other hand, has little need for full insight in a project, although, he should really appreciate the issues being communicated in a clear and organised way. When communicating through the concept there should be less misunderstandings, more proper documentation and the chance that the system will be delivered on time should be greater, which is the most important thing to Steve.

10 Discussion

That meetings most often are perceived as inefficient was found not only in literature, see 2.4.1, but also in the exploration phase, see 3.4.1, and in the main user study at FlexLink. However, meetings are important, not only for information and knowledge sharing, but also for building social bonds and trust. Several barriers for knowledge sharing were identified connected to meetings (see **Fel! Hittar inte referenskölla.**), one was insufficient handling and documentation of past mistakes. As FlexLink has grown as a company, the complexity and the difficulties of communication have increased and the user study showed that documentation existed but was rather inaccessible and the routines for knowledge sharing were lacking. The informal ways of communicating are no longer useful when the organisation is larger, due to the increased difficulty of keeping track of things (Mintzberg, 1979). The proposed concept would help to organise projects in terms of issues, actions and decisions. The concept should provide a structured way of communicating in collaborative projects and improve the traceability of documentation. The collaborative meeting agendas were designed to be communicated beforehand, which was supported by theory to be of good meeting practise (see 2.4). The advance communication of the agenda should support the project members to prepare for the meetings and particularly the answers to the counterpart would thereby be stimulated. As the concept would provide a visual element to the meeting, it can also be argued that it would help reasoning, problem solving and memory capacity, as explained in 2.3.1.

In both the exploration phase and at the studies made at FlexLink, all participants experienced or had experienced issues with communication. Some had made changes and implemented solutions to meet the challenges, others had not. At company 5 they had moved towards a more formal organisation structure to make it clearer who should have what knowledge and responsibilities, whereas at company 4 it was not understood by the authors that they had made fundamental organisational changes the last two years as the company had grown. This was also supported by that the interviewee expressed that they experienced difficulties keeping track of information relevant to them, supported by theory being one of the issues when a company grows past 40 employees.

FlexLink has grown from a rather small company working from just one site to now being an international company with sites around the globe in just 30 years. This could seem as a long time, although it has to be understood that FlexLink did not only go from a smaller production to a larger production of the same goods in the same country but to larger production of other goods as well, and in multiple different countries. International collaboration can open many possibilities but can also cause an array of communicative difficulties. For instance, language skills might vary and people from different cultures can have another frame of references, which put high demands on clear communication.

10.1 Process and methods

The thesis project commenced was initiated with an explorative study of six businesses within the product development industry to provide a frame of references. Although it was executed with varied methods (some companies were studied solely through interviews, others with a short observation and one with a study visit during a whole day) the end result served its purpose to indicate what type of communicative challenges that can be identified in the industry. A deeper understanding could have been achieved if the study would have been more profound and cohesive, but the circumstances at the time did not allow for longer study visits at all companies.

Even though the explorative study of the six companies yielded new knowledge and an insight into meeting types and cultures, it can be argued that the outcome steered the interpretation of the situation at FlexLink. As observations and their interpretations are subjective they are

affected by one's personal references. Thus, the exploration phase most certainly had an impact on the rest of the thesis project, but whether this was positive or negative can be debated. For example, the initial study probably made the authors more aware of and more sensitive to different types of challenges than would otherwise have been the case.

The development process was iterative. Each iteration yielded in a deeper understanding of the projects studied and the team members and thereby also new requirements on the concept. Initially the solution was inspired by the Q&A matrix, having each issue formulated as a question to be answered. In the third iteration this idea was exchanged for the concept of issues with one or more issue owners, as this proved to be more suitable for the projects studied. Yet to be investigated is if this structure is appropriate for other projects within the product development industry.

The result of this thesis project has been highly dependent on the projects and meetings studied. The department studied were said to be "an island", meaning that they had a rather specific way of working, not necessarily corresponding to the way of the rest of the organisation. Therefore, it is likely that the result would have differed if the study would have been conducted at another department at FlexLink. Furthermore, the study could only access the project teams at FlexLink and not those at the customer. As the concept is intended to be used by both parts, it is not yet complete.

A discussion regarding the impact that the observations had on the meeting attendees could also be relevant. The meeting attendees did not seem to be affected by the presence of observers; however, such impact could be hard to notice by someone not normally attending the meetings. Unlike the meeting attendees at the local site, the customer meeting attendees, connected to the meeting by link, were not aware of the presence of observer and were thereby not affected. This could be argued to have a normalising effect on the whole meeting, supporting normal proceeding of the meetings.

The outcome of an interview is always dependent on what questions are asked, hence also in this thesis project. However, the interviews conducted were unstructured, meaning that the questions asked were generally very open, along with follow up questions to make the interviewee develop their answers further. The questions were not scripted but dependent on what the interviewee chose to tell, therefore, the outcome of the interviews were more dependent on the interviewees than if the interviews would have been structured. Structured interviews would have allowed for another type of data analysis; however, the data would have been of a quantitative character instead of a qualitative, which was achieved through the unstructured interviews.

The software chosen for the prototype, Microsoft Excel, had a great impact on the design process in the second, third and fourth iterations. Excel opened up for certain types of functionality but restrained other aspects, such as form and colour. What type of design changes that were implemented in the prototypes were steered by the software, and of course the level of skill programming that was needed in the software. If another software had been used, the prototypes are likely to have appeared differently and the result would have differed too. Yet, the final concept was not designed in Excel, and the visual representation of the concept was therefore not restricted by the program.

Subjective responses were collected by two instruments of which SAM was one. The desired SAM-score was said to be high valence and dominance and low to medium arousal. The final SAM-score, the result of iteration 4 (see 8.3 and Figure 41) showed a score of 7/10 on arousal. The idea of the desired score being low to medium was based on a reasoning that high arousal might be distracting the user from their tasks. However, the project manager interacting with the

prototype and thus also filling in the Self-Assessment Manikin, expressed the score to be nothing but positive. The high arousal could thereby not be interpreted as distracting, meaning that the evaluation tool was interpreted differently than expected and that the score can be considered good. As the participants were encouraged to motivate their responses and also to give additional feedback, their emotions and opinions were clearly communicated despite this misinterpretation. If the test would have been scaled up, this type of feedback session might have been more difficult to conduct, possibly resulting in evaluation scores lacking sufficient understanding of the actual experience. Therefore, it could be argued that a tool which is more easily understood, but serving the same purpose, should have been chosen.

10.2 Implementation of concept

Meetings along with emails seem to be the main forms of communication in the studied literature but also observed in the exploration phase and at FlexLink. However, emails have limitations and should only be used to communicate shorter pieces of information where there is little risk of misinterpretation. The theory suggests a maximum of 125 words to explain an issue and if longer a meeting should be had. Unfortunately, this study was not able to cover the email correspondence between project team members and their customers. At FlexLink, however, it was observed that email correspondence concerning the project existed between meetings, and the topics were then also discussed in the meetings. Since emails were sent back and forth with information regarding projects, it poses the issue “Have the right people been informed of this information and is all email correspondence relevant to the meeting being brought up?”.

This thesis project does not suggest that emails should be replaced with the proposed tool, but that the tool allows to log and keep track of information relevant to a project and its issues in one place. The tool would not achieve this on its own but it would rely on that the users would actively add information to the tool, for it to be useful. The belief is that by letting the tool be used between meetings to create a useful agenda, this would trigger the users to more actively add information more so than if it were to be used only during meetings. There are two aspects to why this is believed to be true. Firstly, by using the tool as an agenda that shows issue information beyond a status to all attending the meeting (and also between meetings) it would, hopefully, trigger people to either feel more obligated to add the information beforehand, or they would realise that they have not when in the meeting, so it then quickly can be added. Since the tool would allow the meeting to be held in a more structured way than what have been observed to be the reality today at FlexLink, it would become more evident when information is missing. Secondly, by increasing the transparency to the customer by using this tool and letting the customer also access the tool, more information would be directly added to the tool and decrease information being passed through emails. This would also put pressure on FlexLink to use the tool and add information, but in return create a better customer experience since it would, hopefully, decrease response times and thereby increase the perceived quality of the response, as explained in 2.5. This second aspect would put a lot of pressure on the tool to provide a very positive user experience for the customer. Unfortunately, it was not possible to get feedback from any customers in this thesis project, which should be further explored if the tool is to be implemented.

10.2.1 The quality of meetings

When implementing a tool such as the one proposed in this thesis it comes with an array of different implications, some positive and some more challenging, for it to contribute to efficient communication. Since the proposed tool is a digital solution it would not only mean that it should have the right functionality and an user friendly interface, it would demand the organisation to have suitable equipment. However, the users would need to have a good understanding of the tool if it were to contribute to a higher quality meeting, as explained in 2.4.6. The tool would tackle this by aiming to have a simple and intuitive interaction where a first-time user should be

able to handle the tool. The final concept have not been tested yet and it can therefore not be concluded whether or not this is achieved. However, it can be concluded that the functions implemented are desired by the users at FlexLink and in the second and third prototype, which were most alike, the test participants quickly understood how to navigate within the tool first time using it in a meeting. It was observed that the time demanded for addition of information to the tool, although improved in the iterations, would need to be further improved for the tool to be efficient in meetings. While adding information the attention is split between interacting with the tool and on what is going on in the meeting, which not preferable as explained in 2.4.7. With increased ability to quickly add information to the tool, the time would be decreased for when the user would need split attention. It is of high importance that the tool should not be a distraction from the purpose of the meeting, but an aid to keep track of issue information.

The quality of meetings would not only be affected by how the tool during meetings but also as it would encourage project team members to post issues 24 hours before the meeting. It was observed that there was no agenda communicated before a meeting, which was also confirmed during interviews. Nor were there a structured way of how meetings were held or who had the responsibility to make notes. This probably had to do with team members feeling that it was unnecessary and a feeling of stress due to that they felt that there was a lack of time to be able to do it. Adding to that could be that they might feel that their notes were not good enough to be shared with everyone and that the notes had to be reworked after the meeting, causing the task to take time the staff do not feel they have. These are very real obstacles to overcome but that also create a snowball effect as the lack of structure will cause ineffective communication and put even more responsibility on the individual to keep track on what is going on. This is a sign that FlexLink might not have done the organisational changes necessary as they have grown, since the type of structure existing at FlexLink today do seem to work at smaller companies with fewer staff, according to theory.

If an agenda is shared 24 hours before a meeting it will give who is responsible of an issue time to look up information necessary to give an response at the meeting, similarly as the QA-matric and is also supported in theory to be good practise for meetings described in 2.4.1. FlexLink as a supplier should always strive for customer experience excellence, as they also are today, and being able to give informed answers at meetings with the customer will contribute to that. In addition, FlexLink will avoid internal emergency meetings causing stress among the staff and will be able to work in a more structured, foreseeing manner where they are able to avoid "putting out fires". This is believed to not only be good practice for external parties such as customers but also to be a good internal practise.

10.2.2 What makes for a trusted tool

It can be argued that the expression of the design and functionality are of equal importance as the technical functionalities that the tool have been created with to be perceived as a professional and reliable tool. With technical functionalities the thesis refers to everything that the user does not initially see, such as the software, servers, digital security solutions and so on. Even though it was outside the scope of this thesis, it is important to mention that the software and infrastructure supporting the tool is of importance. If the interface and functionality of the tool however does not signal to the user that the tool is safe to use, even though it might be, it might not make the user trust the tool. The perception of the tool is of great importance since it is intended to be used not only internally at FlexLink but also with customers.

10.2.3 The tool, a visual management approach

The tool developed in this thesis might not be considered a visual planning tool, however, it is believed that the tool would contribute with some of the positive aspects that visual management has been proved to have. When creating visualisation for knowledge four things

are mentioned to be of special importance: what is the function, what knowledge should be transferred, who is the receiver of the knowledge and what type of visualisation should be used. When creating the tool all these four have been considered. If one were to change such as if a different department or company was considered, the tool would have to be revised. This thesis explored the first three aspects quite thoroughly, but the last one, visualisation, not as much as the interface itself was not the focus of the research, but the functionality. The function of the tool is to keep track on the project through the issues, letting all project members be able to add information in a structured manner and so that others can take part of the information. Knowledge that should be transferred, which could be argued sometimes to be information, is regarding the issues in a project and the tasks of those issues. The receiver would be all project members, excluding the information they posted themselves. The tool would create transparency of who holds what knowledge or information.

To achieve all the possible benefits if the tool would be implemented FlexLink need to make changes to the current organisation. This is not “just another tool”, for it to result in positive changes the organisation would have to put in an effort to truly change the communication pattern in order for the tool to reach its full potential. Since this thesis only observed one department, during limited time, in only two project, what changes that would need to be made cannot be concluded. Interviews at FlexLink showed that internal and external communication is intertwined and cannot be looked at as two separate lines of communication. Coherency between internal and external communication would be key, meaning that the tool would need to be used by all counterparts.

10.2.4 The tools effect on the organisation

This was not a thesis that primarily regarded how to run an organisation as whole. However, when also considering management and the psychology that goes in to managing an organisation the tool would influence both. What have been studied in the project group at FlexLink was that they seemed to alternate between “clan control” and “output control”. The group did not, and did not seem to need, practise close supervision making them not candidates for behavioural control. From the organisation there seems to be a desire to practise output control since it allows to measure success in hard numbers. An example being if the project was delivered on budget and on time. The tool could allow for more measures to be made since more extensive documentation would be available and saved. One example of such a variable would be how long it took to solve an issue. Although the tool would allow for this to be possible, it should be done with caution to not destroy the clan mechanism that falls into play when the group are uncertain of what the task is, allowing the group to work together to solve an issue. The studied department were believed to be successful due to the high level of skills of the team members who worked autonomously to solve problems, on their own or collaboratively within the group. It is important that changes made and tools implemented would not move away from the clan control that existed when conducting the study, since it allows the group to solve issues of high complexity.

10.3 Future Work

For the tool to become fully functional there are a few things that need to be explored further. Firstly, the final concept needs to be validated, preferably over an entire period of a project, as it might reveal further requirements on the tool. The initial phases of the project, the negotiation phase and starting phase, were not studied and there need to be further research done regarding when the tool should be introduced in a project.

The research conducted in this thesis did not include the view of FlexLink’s customer, which will need further research into the needs the customer has and how the tool can offer the best experience for the customer. One aspect studied to be of importance to further explore was

what level of transparency between the two parties would be optimal. It should be noted that it is possible that full transparency could be beneficial, but that there might be circumstances where some information needs to be kept from the other party. Further research should be conducted to see what type of circumstances that could be and how to handle those. It is believed that such circumstances exist, since it has been observed that there was information that FlexLink did not want to share with their customers regarding the process of active projects. If this was beneficial or not have not been concluded. The transparency aspect of the tool between FlexLink and its customer is important but, as explained in 2.4.2 in regard to a team, that not all information needs to be transmitted to all involved in a project as it might cause more harm than good. If the tool were to be realised, further research regarding what information should be shared with the customer in a project and what should not, must be conducted. How information should be presented to the customer versus FlexLink should be researched as well.

An aspect related to transparency that have been discussed, if only slightly, was the aspect of “feeling safe” when using the tool, meaning that the tool can be considered reliable and trusted with the information that the user puts into the tool. As the focus of this thesis was not the final interface design, further development is needed to refine and improve the interface. One example being how to, through the interface design, make the user feel safe and rely on the tool. Further studies exploring what aspects of a tool such as the concept developed in this thesis would make the user trust the tool and feel safe using it.

Finally, to whom an issue should be bound to will need further research since it could not be concluded if an issue should be owned by individuals or groups, such as at function level or company level. Positive feedback was received regarding that several issue owners could be added but feedback and testing regarding at what ‘level’ these owners should be at need to be conducted. What should be said is that the intention with issue owners, in the concept developed, is to clarify between what parties an issue exist.

11 Conclusion

The final concept fulfilled most of the requirements listed and the needs of the personas were considered to be met. Now, have the research questions been satisfactory responded to?

The first question posed; “What communicative challenges are faced in collaborative projects at FlexLink?”, was investigated thoroughly throughout the whole user study. The challenges were expressed as user needs in section 0 and served as a foundation for all the iterations.

The second research question; “How can these challenges be facilitated with the introduction of a new tool?”, has been explored with the proposed solution. The main idea presented suggest that the communicative challenges can be tackled by communicating the issues in advance through a collaborative meeting agenda. These challenges could possibly have been overcome in another way, with a different type of tool, however, it was chosen to explore one strategy and test it iteratively rather than testing multiple strategies fewer times.

The third and last question; “What functionality should the tool possess?”, was investigated in iteration 1 to 4, where functions were tested and further developed. The final result and answer to the third research question was the list of requirements, see 7.2, where the desired functionality and their specifications were listed.

To conclude, the concept would facilitate the communication, especially during meetings, between FlexLink and their customers. The concept would not only provide a better structure for organisation of issues, actions and decision, it would also increase the perceived quality of the responses given by FlexLink, as quick answers are perceived more qualitative than delayed answers, see section 2.5. The actual quality of the responses, and the potential following discussion, may also be improved as the concept allows for better preparation before the meeting and provides a better display of background information and previous actions than before.

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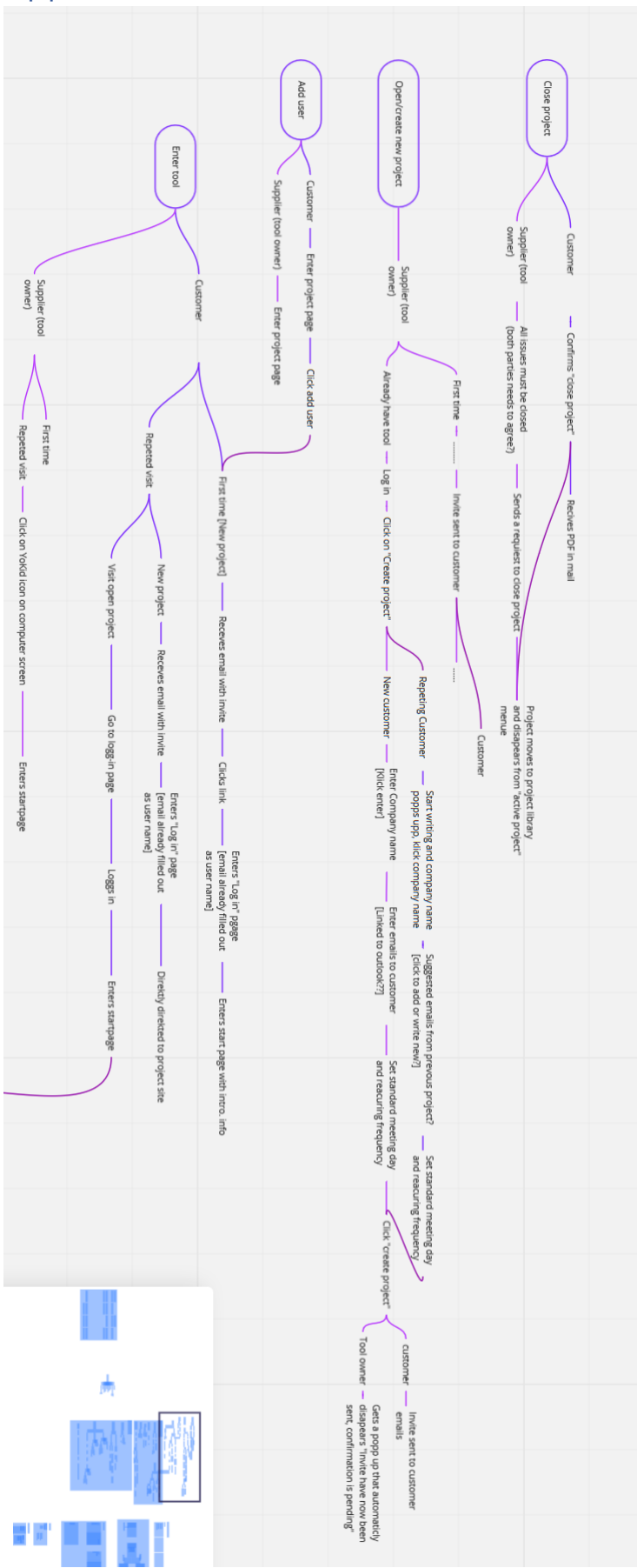
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Gothenburg, Sweden

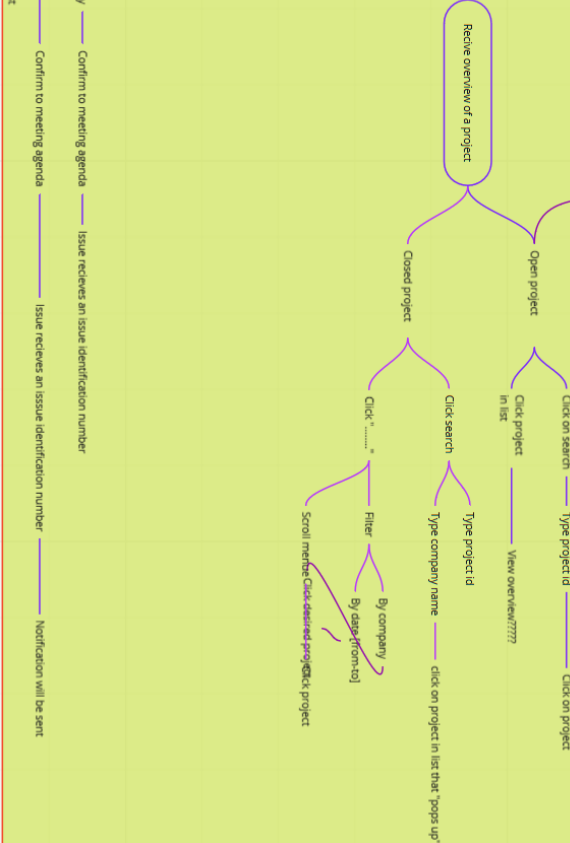
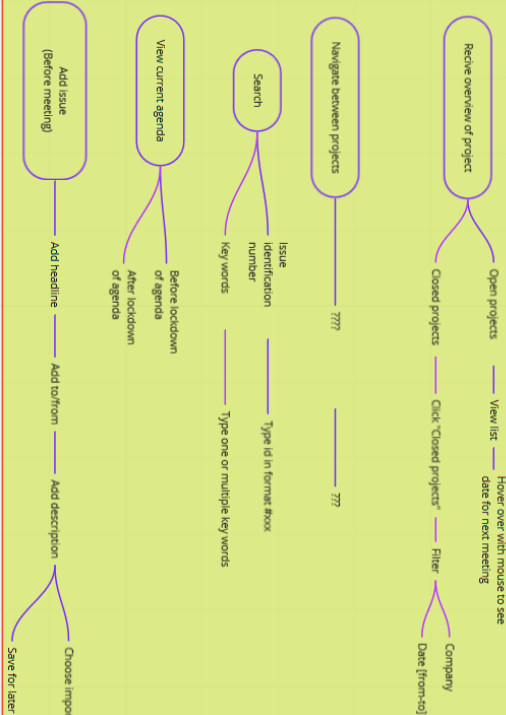


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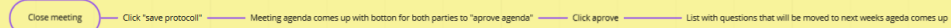
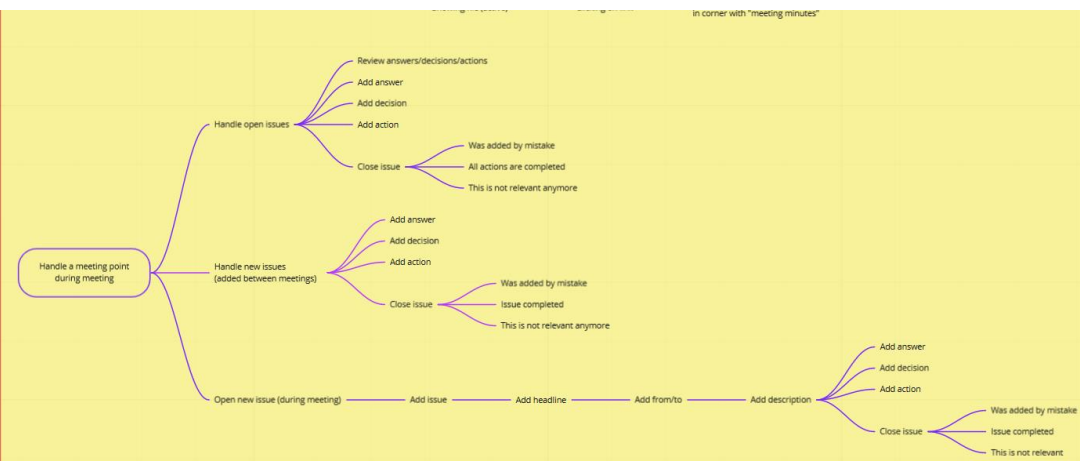
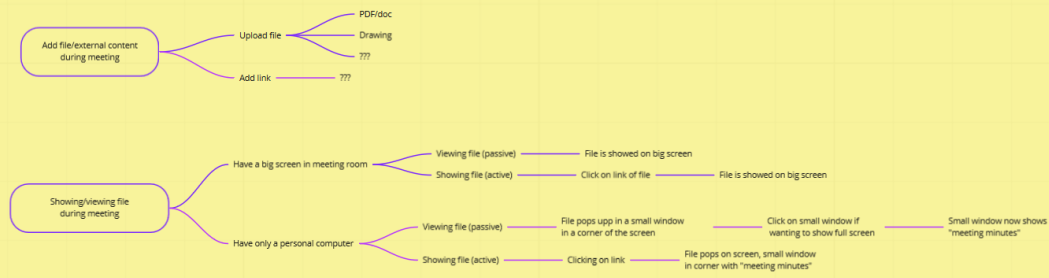
Appendix A



Between meetings



During meeting



Appendix B

Software

To run a company in the 21st century most company uses different software to ease the running of the organisation. Software can be used in many ways in the organisation and listed below are a those that this thesis project has encountered.

Yolean

Yolean have developed a software for planning of projects that is visual planning tool (Yolean, 2019). Its strength is to synchronise different teams in a project through digital visual planning that can be updated and adjusted as the project progresses. The board is used by adding “notes” that always correspond to a date and a person or group of people. The Yolean tool supports the Q&A-matrix (Olsson, 2019) that is commonly used in the construction industry to manage projects to systemise questions being asked by whom to who and the answers along with decisions taken throughout the project. The Yolean board has added features though. Notes can be added to the board with categories such as a task or a deadline.

A note can be moved to a different date, which then is registered in the software and triggers a visual mark on the note, the mark corresponds to the number of times the note has been moved. A series of other visual markings are also possible to communicate things such as when a task is marked as done. In addition to the information received by the visual appearance of the note, the note can contain a comment which is shown in a field to the right in the interface. When a note is clicked on, the comment fields opens-up. All of this is done to make documentation and trackability possible throughout the project of what, when and between whom something has been discussed in a project. This have been identified as important if a lawsuit were to happen to know what was said and done, but also to effectively keep track of what have been done in an ongoing project. Examples of the interface is shown in figure 52.

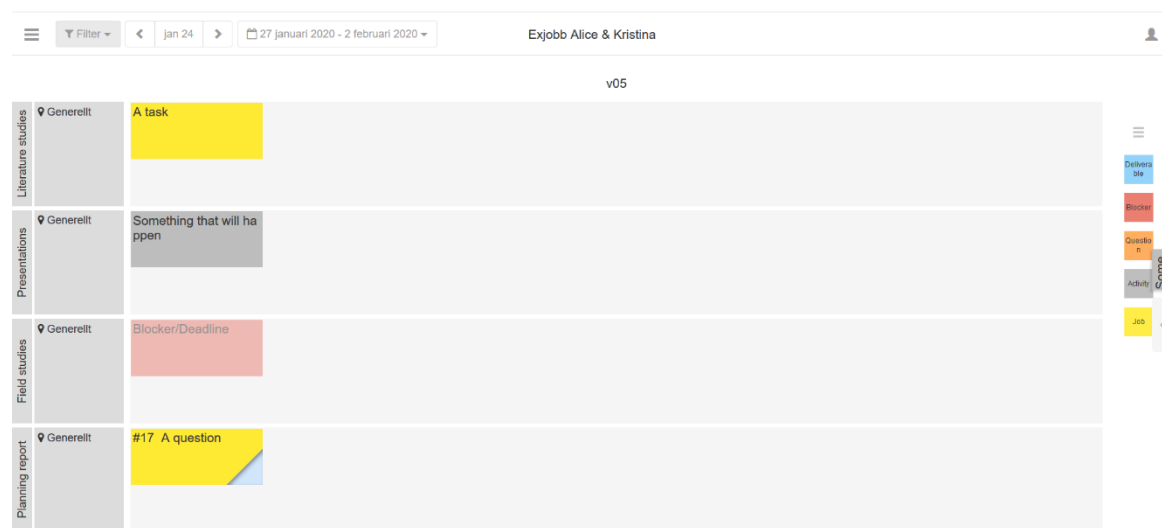


Figure 52 - The Yolean interface showing some added "notes".

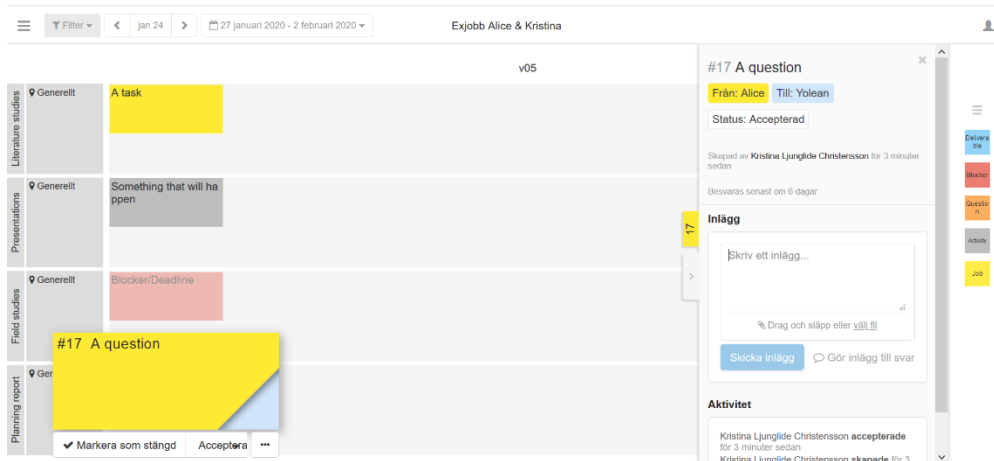


Figure 53 - The Yolean interface showing the comment field when a question "note" have been clicked on.

Microsoft Excel

Excel is a tool used to mainly handle data (Microsoft, 2019). It is used by adding information to cells that are categorised by columns and rows, each column has a letter attached to it and each row a number making each cell have a unique number. Since each cell is unique data can be extracted in different ways through equations to be used for analysing a data set or simulation. The software allows for cloud-based application were several users can be in the same document. The Excel interface is shown in figure 54.

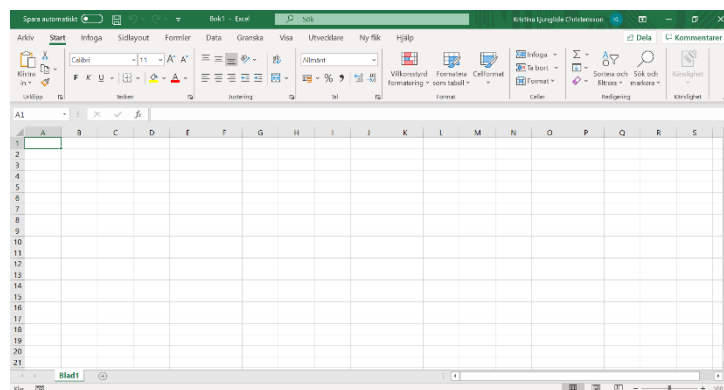


Figure 54 - Excel interface with no data added

The software have different features such as the possibility to visualise data in graphs, see figure 55, but also to use macros, see figure 56, to be able to do more advanced simulations in the program that is enabled using coding in a visual basic application.

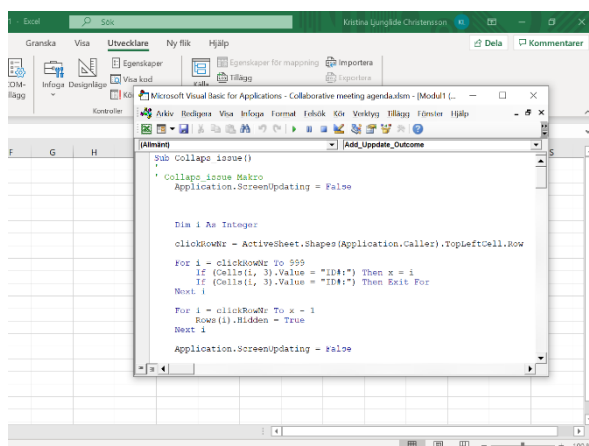


Figure 56 – VDL code enabled in excel

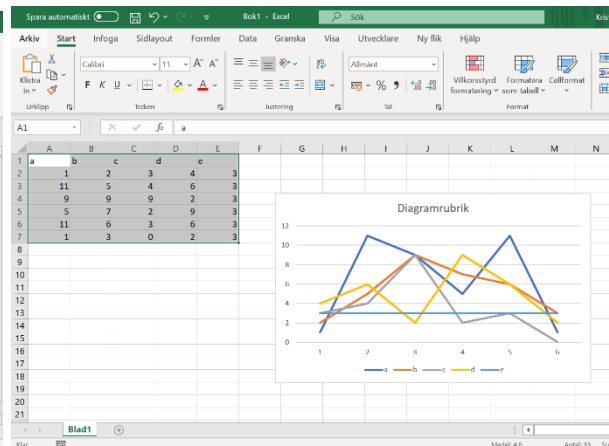


Figure 55 - Data visualisation with graphs in Excel

Slack

Slack is a tool used for businesses to create internal online chat channels to talk about different issues where people can be added to a forum or join depending on how it is set up (Slack, 2019). The name of a channel is up to the company that uses the tool and can be a topic, project group or something else that is useful for the users using the tool. Direct messages to one user are also possible.

Slack is also integrated with several other tools, not owned by slack, such as google drive, making it possible to share files through Slack. The platform also has a search function that makes it possible to search in all conversations that the user has access to, facilitating trackability. An example of the slack interface is shown in figure 57.

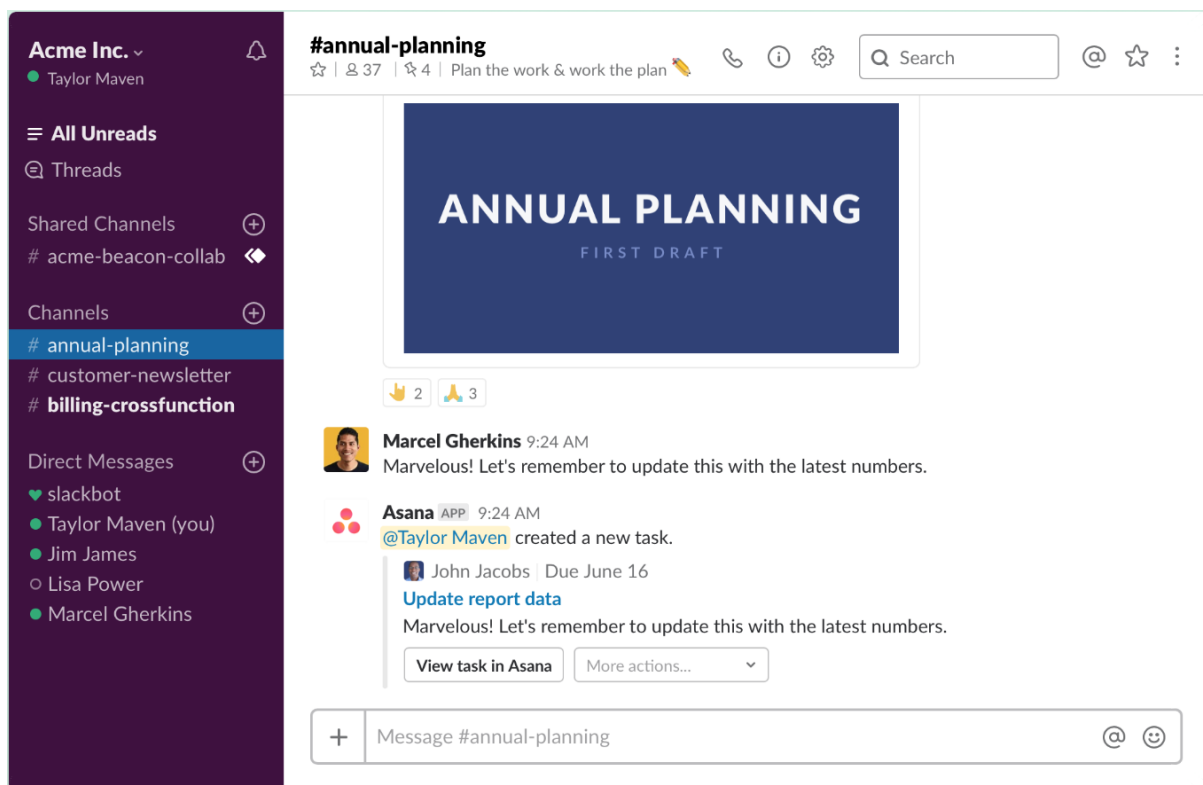


Figure 57: Example of Slack interface (Slack, 2020).

