Visualization of information for increased efficiency
Visualizing an effect mapping report

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Abstract

Effect mapping is a method often used by companies in order to try to tie together the business goals with the users and their needs. The results of the effect mapping is often presented in long reports, with an additional effect map attached to it. Unfortunately, few clients tend to read these reports that they later are supposed to base future decisions on. This thesis aims to examine the efficiency in readers’ perception of information, specifically the information from effect mapping. It evaluates if the understanding and perception, as well as the participation, could be improved by developing a digital web based version of the information. The objective of this study is to determine if a visualized web version of the effect mapping is more efficient than the original paper report version. The purpose is to help consulting firms improve the communication with their clients, that the clients will take part of and consume the information provided by the effect mappings that are delivered in a more efficient way. The process started out with workshops that were a foundation for a prototype. The prototype was developed based on the theoretical framework of this thesis, and created from a specific example of a traditional effect mapping report. The prototype was tested and evaluated before compared to, and evaluated with, the original paper report version of the effect mapping. The findings are that a web based, visualized presentation of the effect mapping is more efficient than the original paper report version. Not only did the participants of the study find the correct information in a shorter amount of time, but the user experience was also enhanced. The findings in this study are useful for firms that want to present results of effect mapping to customers who do not tend to spend time reading the full reports, but would rather get a quicker overview. This study can be used as a point of departure for future research, by testing it on other reports or firms.

Keywords: Effect mapping, visualization, usability, information visualization, digitalization, report visualization
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1 Introduction

Effect mapping is a method often used by companies in order to try to tie together the business goals with the users and their needs. A basic point is that a system’s purpose first occurs when it is used. By having consistency all the way from the business goals, through the target groups, down to the functions that need to be built, the companies can be sure that they are building the right things.

An effect mapping consists of multiple steps where the purpose and the goal with the project is first developed. Then a target group analysis is done with the help of workshops, surveys and interviews. The whole picture is supplemented with surrounding exercises and workshops such as risk analysis, competitor analysis and visitor statistics. The effect mapping is then presented as a report with a complemented effect map which looks like a mind map, see Figure 2.

In this master thesis, the effect mapping is visualized before it is evaluated and compared to the original report and effect map. The comparison is focused on the efficiency of when the users are retrieving information from the effect mapping. The analysis in this thesis also treats the thoughts and experience when using both the visualized web prototype as well as the original effect map in the form of a report.

1.1 Problem statement

Some consulting firms in the IT sector does project planning with effect mapping in order to find and describe a problem with its solutions and effects. The plan and the effect map is then delivered to the clients in the form of a report that often tends to be around 50-90 pages long. The company that is working with this effect mapping method is often asked to create a shorter version of this report to their clients, since few tend to read it. This is just an example of the problem that occurs when the society gets more efficient and people do not have the time to read long reports. The problem presented is that a vast majority of the information is rarely read and interpreted, and the clients ask for summaries instead. This creates an idea to create a simpler, more effective and time-friendly way of receiving the information as a user.

Consulting agencies within the IT and design sector with the job to create new, beautiful and inspiring solutions, are starting to realize that they need a new way of delivering information that corresponds to their beliefs and their work.

1.2 Knowit Experience

This study is conducted together with Knowit, which is a consulting firm with over 1800 employees in the north of Europe. Knowit is divided into three different categories; Experience, Insight and Solutions. This master thesis is done in collaboration with Knowit Experience in Linköping, Sweden. Knowit Experience is a full-service communication and technique agency that creates user experiences through web, mobile and social medias in order to help other companies or organizations to reach their business goals.
2 Objective

The objective of this study is to evaluate if a visualized web version of the effect mapping is more efficient than the original paper report version.

2.1 Purpose and goal

The purpose with this project is to help consulting firms improve the communication with their clients. The purpose and goal is that the clients will take part of and consume the information provided by the effect mappings that are delivered in a more efficient way. In other words, the creation and result of this study will be a substitute to how the impact mappings are presented today.

A sub purpose is to help the consulting firms in the IT sector and their clients to make better decisions based on the information given. A side effect of the solution will hopefully be that the company can more easily show what they can deliver in order to get more clients. This study will not evaluate or treat the effect mapping itself, but it will focus on visualizing the report of an effect mapping and at the same time try to improve the effect map before comparing it to the original report version of the effect mapping.

2.1.1 Knowit’s involvement and goal with the project

Knowit has several purposes with this project and the main purpose is to improve their communication with their clients. The goal is to visualize the information of the report to make it easier to comprehend, which then helps in order to make better decisions based on the information.

A sub goal with this study and its result is marketing, which means that they want the impact-mapping presentation to mirror their work and that they can show the presentation or visualization in order to attract more clients. The client and the receiver of the report often has a person in charge of the project and with the solution, the hope is that this project-leader shares the impact mapping with his or hers colleagues to increase the participation in the project.

2.2 Delimitations

The prototype will only be developed for desktop to start with, in order to finish the project in time. The desktop version is chosen because of the fact that users today reads the effect mapping on a printed version or on a desktop computer. The study aims to measure two solutions that are as equal as possible. These solutions are; the original report version of the effect mapping, and the web prototype developed in this study. This means that the versions of the effect mapping were not purposely different in size, and that both the original report version and the web prototype had about the same visual size in relation to the screen.

This master thesis and study built the prototype of the effect mapping based on a single example made by Knowit Experience for their client Väderstad. The author read multiple examples but got the full version of this one and therefore the study is restricted to that specific company even if it can be applied on many more.
3 Methodology

The methodology chapter contains information about the method that was used in this master thesis study. At first, the design process will be described, including the different parts that were contained within that process. The methodology also presents the prototyping, as well as how the testing was planned and took place.

3.1 The Design Process

During the process of this master thesis an iterative design process has been used. As seen in Figure 1, a design was developed before prototyping that design. That prototype was evaluated and revised by doing the process again and again until the designer is satisfied, time runs out or no more problems occurs in the evaluation.

![The iterative design process](image)

Figure 1: The iterative design process

In the book Design Thinking[3], seven stages of the design process are presented.

- **Define:** This is all about defining the problem and the target groups. If the problem is understood and defined, the more precise solutions can be developed.

- **Research:** This stage is about researching if there is work done on the same or similar problems before, and if there are any obstacles or solutions already identified.

- **Ideate:** This is the stage were the ideas are starting to develop with the purpose to fulfill the end-users needs. This is often done with workshops and brainstorming sessions.

- **Prototype:** This stage is about developing the ideas into prototypes. This is done in order to visualize the ideas and to get a feeling for the design and its functions.

- **Select:** This stage is about selecting one of the prototypes that fits and fulfills the needs of the users and the purpose the best.

- **Implement:** This is about implementing the design and the prototype before delivering it.

- **Learn:** This stage is done in order to help the designers improve and maybe even identify future improvements for the solution. This is often done through feedback from the users or clients.
3.2 Define

During the early stages of this study the problems were defined with the target groups. The problems were different depending on the target groups.

The first group that was identified were the clients, customers and end-users of the effect mapping. Within this group, the qualifications and traits of the persons were varied. The first target group consisted of the project leaders from the clients' end who were working with this effect mapping through the process. The second group was the bosses on the client side, that were going to be involved with the end-result and from that information base future decisions. The third group that was identified were the people at the IT companies who were working with, and developing the effect mapping.

All of these target groups had different problems, but the main problem was that is was too much information that was difficult to process. The second target group had the problem that the information was to hard to process, which made them request a summary of the results in order for them to read and base their decisions on. The third target group, the people developing the impact map, felt that they produced the information in a too complex and unnecessary way, and that it could be much easier and faster to do the research and the effect mapping with the help of a framework. Instead of writing a whole report they could fit the data in interactive graphs and illustrate it in a way that mirrors the competence and the work that these companies has.

3.3 Research

An early realization of this study was that there were not any direct similar studies to be found, not any similar work that studied the possibility to visualize text reports in order to gain efficiency. The research focus then moved to the design of a high content web page.

3.3.1 Literature Study

In the initial phase of the study, a large amount of literature was read in order to get an understanding if similar studies had been done before, and to collect information about how to proceed with the study. The literature mainly consisted of articles found on Google Scholar[7], the webpage of Umeå University[22], Florida Atlantic University’s database[21], and books. In order to find relevant articles the searches consisted of "Information Visualization", "Visualization of text documents" and "Content analysis" etc. The literature study was done in order to build a foundation for the theoretical framework for this project.

3.3.2 Information visualization

The information in focus during this study is the effect-mapping done at Knowit, which is reports for different projects that consists of large texts, graphs and number but also correspondence and similarities between different target groups. Visualization has been used during this study, and the effect-mapping that has been visualized is a report done by Knowit for the company Väderstad AB.

3.3.3 Study and sorting of an existing effect map

An important part when designing a web-prototype as a substitute for an effect map, is understanding the effect map. This prototype was based on one made by Knowit Experience for the company Väderstad. Therefore, a part of the research was to understand the effect map and every
part within it. After reading and understanding the information, two workshop sessions were held. The first one together with one of the authors of the effect map in order to sort out and prioritize the information and parts in the original report. This could then be used when designing the web prototype and the order of the information. The second session was a meeting with a representative and the client from Väderstad in order to prioritize the information that needed to be visualized in the web-prototype.

An example of the existing way of presenting an impact map is presented in Figure 2. The measurable goals are presented on the left, these goals will help fulfilling the purpose of the new website for Väderstad. The purpose is presented in the middle, and on the right side, all target groups are shown, including information about them, their needs and how to fulfill those needs.

### 3.3.4 Meetings & Presentations

At the start of this study, a presentation was held by Knowit Experience about the effect mapping method. During the presentation, the effect mapping method was described with information about how it works, the purpose and the wanted effects of using the method. The example shown were an effect mapping done by Knowit Experience to the client Väderstad.

The meeting with the representative and the client from Väderstad was not only about prioritizing the information from the effect map but also a meeting in order to understand what Väderstad, as a client, thought of the effect map, who and how they used it today.

During this study, many smaller meetings and tests were held with the team at Knowit Experience. These were good sources of information and professional input to the study.

### 3.4 Ideate

The first ideas were created with paper and pencils, sketches drawn in order to visualize all the ideas that popped up. These sketches were later discussed with senior interaction designers in order to get their professional point of view on the design ideas. Workshops were held, which are described in more detail in the "workshops" section of this thesis.

#### 3.4.1 Workshops

The workshops that were held during this study were done in Swedish, since that is the native language for all participants as well as the researcher. This choice was made in order to maximize the flow of the workshops and to help the participants think more freely with no obstacles in the language.

The first workshop were done in order to sort out the most important information from the original report of the effect mapping. This was done together with colleges that had been working on the development of the effect mapping. All sections and parts of the report were identified and sorted in order of importance. This was done with the aspect of the different users. The importance could differ depending on the user of the report, for example the most important part for a CEO, that is going to base decisions on the information, might not have the same perorations as the developer of the effect mapping.

In order to generate ideas, an idea-generating workshop was held. In this workshop, employees at Knowit Experience in Linköping that had been working with effect-mapping before participated. The focus of this workshop was the navigation possibilities for the project. At an early stage in the
Figure 2: *This is what the impact map looks like today. It is attached to the companies’ reports as a PDF file.*

process, this was realized to be a problem since the web site would contain too much information that would make it difficult to navigate through.

This workshop lasted for one hour and was planned as following:
• 5 minutes presentation of the theme which was the navigation.
• 10 minutes open brainstorming.
• 5 minutes classification, where we sorted all the ideas into groups.
• 5 minutes choice of group to continue focus on.
• 5 minutes priority of ideas within the chosen group.
• 10 minutes answer the question: Why why why?
• 5 minutes exemplify
• 15 minutes design studio

The workshop started with 5 minutes of presentation of the theme, which was the navigation of the website. After the presentation, there was an open brainstorming on a whiteboard, with different ways of navigating a site. All the ideas that came forth were then categorized in different groups of themes. After that, one of those groups was chosen to continue working with. The content in that group was prioritized in order to choose the most important, and most possible to develop, options to continue with.

After choosing some of the ideas to continue working with, the groups asked themselves the question “why” a few times around every idea. What came out of that exercise was then put on paper which was passed around to all the participants, in order to expand the solution space again. As a last step in this workshop, there was a design studio where all the participants got to sketch individually for a minute before presenting the results. The last step was iterated three times and all ideas were presented.

3.5 Prototype

In the book Design Thinking the author states that “A prototype gives the design team and client the ability to visualize and handle a design concept, to get an idea of its physical presence and tactile qualities”. This can be done with very simple paper prototypes to very high defined and interactive prototypes, all of which have been used in this study.

A technique for Lo-Fi prototyping is to develop a prototype with paper. The design is then used by a human that is familiar with the design in order to simulate interactivity for the test person. The Lo-Fi prototyping is not only useful in the way that it is easy and quick to illustrate and visualize ideas, but it is also a good way of testing and finding errors, another plus is that it also has a low cost.

When the iteration process continued and the design developed, Sketch App was used to create the Hi-Fi design and for making that design interactive. There were a couple of tools to choose from. The tools that were looked at for making the design interactive was Marvel App, Invision, Atomic, Webflow and Origami. All the alternatives seemed to have about the same competence but Atomic was chosen as a primary tool to make the prototype interactive.

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1 Read more about Sketch App at: https://www.sketchapp.com/
2 Read more about Marvel App at: https://www.marvelapp.com/
3 Read more about Invision at: https://www.invisionapp.com/
4 Read more about Atomic at: https://www.atomic.io/
5 Read more about Webflow at: https://www.webflow.com/
6 Read more about Origami at: https://www.origami.design/
3.6 Select

When selecting which design that will be continued to development there is a key for that decision which is "fitness for purpose" which means that the design that fits and fulfills the requirements that meets the needs and purpose of the site, will be chosen.

3.7 The Testing

In this study, there have been two main tests. The first one was a user test in order to evaluate the design of the web prototype. During the development of the design there have been multiple smaller tests but a bigger test when testing on several different persons.

The main objective of this study was to evaluate if a web version of an effect map was more efficient than the original report version. This was done with a main study where the two different versions of the effect map were compared and put against each other.

![Figure 3: Figure of the test and evaluations that has been made in this study](image)

3.7.1 Design Test

The design test was done on eight individuals which are all working or studying interaction design and web development. They were asked to look at the design and answer a couple of questions about their thoughts on the design. They were asked to think out loud about all of their actions on the site. This was done in order to find errors, problems or improvements in the design. The results of these tests are presented in the results section.

3.7.2 Pilot tests

Before the actual tests took place there were a couple of pilot tests made in order to identify vague, uncertain or inexplicit questions in the test. The results of the pilot tests were taken into account to further develop the prototype before testing it and comparing it to the paper report in the actual test.

3.7.3 Web prototype vs. Original report

The main goal of this study was to evaluate if a web prototype is more efficient than the original report of an effect map. This was done by dividing the test group in two, where one group got to do the test when using the web prototype. The other group did the same test but used the original report.

All participants where first given a short brief about what an effect map is and also a short description about the company that the effect map was created for, in this case Vänderstad. They
were also given a scenario in order for them to understand why they did the test. After the information given, the participants got thirteen questions they should find the answer for in the prototype or original report. One measurement was the amount of time it took to find certain information, therefore the researcher kept track of the time during the test. The researcher also used an audio recorder during the tests, in order to record the oral responses from the "thinking out loud" part of the test. The time was recorded in order to measure the efficiency of answering the questions by the participants. The audio were recorded in order to save the data and go back to listen to the participants’ thoughts and, or questions.

The questionnaire consisted of three sections, the first section consisted of easy questions about the person. The participants were asked about their age, gender and occupation. The second part of the form included the thirteen questions were they were able to search for the information in the prototype or paper report, depending on the test group. An example of a question that was asked is "What is the purpose with Vaderstad’s new website?" and the participants then had to find the right answer. During the first thirteen questions the participants had the possibility to look up the answer to every question.

In the third section, the participants were given two new questions where they no longer were allowed to look up the answer. These two questions were developed in order to see how much the participants remembered after they had been asked to check for certain information in the first thirteen questions. The questions can be found in full in Appendix A.

During the tests, the test leader (the researcher) was filling out an observation schedule in order to save the observations about how the test was going and the participants’ reactions to each question. The data recorded were if the participant felt frustration, hesitation or if he or she found it easy or difficult to complete the task etc. See the observation schedule in Appendix B.

After the test, the participants were asked a couple of questions about the experience they just had. These questions were answered in person by voice and the questions regarded their experience and their thought about the prototype or report. For example they were asked "How did you experience the use of the web prototype?". These questions were asked in order to get the participants to answer freely and openly about what they thought. See all questions in Appendix C.

3.7.4 Think Aloud testing method

Think Aloud method is a method that is based on the idea that the test person thinks out loud. The test persons comment every action they do and try to explain their thought process out loud. The definition of this test is:

In a thinking aloud test, you ask test participants to use the system while continuously thinking out loud — that is, simply verbalizing their thoughts as they move through the user interface. [16]

This is a test that differs depending on the test person. Sometimes the facilitator needs to help the test person keep the monologue going by inducing and even ask a question or remind them to speak out loud. [16] This method is an easy way to let the facilitator discover what the test person experiences and thinks. If the test person fails or misinterprets something in the design, it becomes clearer for the facilitator what and where the problem is. The thinking aloud method is also beneficial in different ways, it is: cheap, robust, flexible, convincing and easy to learn. [16]
4 Theory

This chapter will elaborate on the theoretical framework for this study. It starts off with the two main concepts, effect mapping and efficiency, and proceeds with additional relevant theories. The theories presented are used for the development of the prototype.

4.1 Effect mapping

An effect mapping, also referred to as impact mapping, is a method with the purpose to help a project reach, and control, the wanted effects and impacts of a product. With effect mapping, the goal is to find the solutions that create a specific response or impact on the user. There are different roles and responsibilities in order for these effects to arise.[18]

An effect map is the result included in an effect mapping report which looks similar to a mind map. It includes information about the purpose, goals and the target groups with their behaviour, their requirements and needs. This effect map is preferably created at the start of a project, maybe in the idea-phase or the pre-study. The map is then used as a base in the IT-project in order to help and guide it to reach its wanted effects.[18]

The effect map answers the following questions:

- Why is this product being built? What is the purpose?
- Who can create the wanted effects? Which are the target groups?
- What do the target groups want and need?
- How is the product being built? What changes give the wanted effects?[18]

In order to answer these questions, there might be a need of different analyzes like target-group analysis, risk analysis, competitor vernissage etc.[18]

The effect mapping is a method that results in both the map itself but also a report. The reports is a classical report that is around fifty pages and more. It is this report together with the map itself that has been visualized in a prototype during this master thesis.

4.2 Usability effectiveness & efficiency

The definition of usability set by The International Organisation for Standardization (ISO) is:

"The effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments." [ISO DIS 9241-11][9][6]

In Sweden, the translated word of both effectiveness and efficiency are one and the same, so the difference between the two might not be that clear depending on where you are from. Therefore, this study includes the descriptions and definitions of the words used in the definition of usability[9][6].

- Effectiveness - The users can achieve their specific goals in a particular environment with accuracy and plenitude. In easier words, the user should accomplish the task.
- Efficiency - The amount of resources spent on completing the task. The user should accomplish the task with as little effort and time as possible.
• **Satisfaction** - It should be satisfying to use the product, both for the user and the people that are affected by it.

The problem for designers can be how to measure these terms, how effectiveness, efficiency and satisfaction be measured.

### 4.2.1 Effectiveness

The more direct definition of effectiveness is:

> The accuracy and completeness with which specified users can achieve specified goals in particular environments. [ISO DIS 9241-11](http://example.com)

The definition makes it quite clear on how effectiveness could be measured. A user could be given a specific task and the test facilitator could observe if the user can finish it or not. A higher or lower effectiveness is the success to failure ratio in completing a task. A task is either finished or not finished, but small and easy tasks are easy to measure while the more complex tasks might need some work to measure. Therefore, it might be a good idea to break more complex tasks down to sub-tasks in order to easier measure the success of the effectiveness.

### 4.2.2 Efficiency

The more direct definition of effectiveness is:

> The resources expended in relation to the accuracy and completeness of goals achieved. [ISO DIS 9241-11](http://example.com)

Efficiency for a user can be measured in a number of different ways.

- The amount of time needed to complete the task
- The number of actions required to complete the task
- How much time that is spent to look for information in the document
- How much time is spent on dealing with errors
- How much time is spent on online help [6]

To measure the time a tasks takes to get completed is easy, it is harder to measure the effort it takes. Therefore, it might be a good idea to measure the number of actions needed to complete the task, and that can show a correlation between time spent, and actions taken.

### 4.2.3 Satisfaction

The more direct definition of satisfaction is:

> The comfort and acceptability of the work system to its users and other people affected by its use. [ISO DIS 9241-11](http://example.com)

It might be difficult to measure satisfaction, but it can be done based on the observations of the user. It can also be measured by questioning the user after the test, and see how the attitude and the willingness to use the product again is, by asking the user to rate the answer between 1-5, for example. If multiple users are asked and the answers correspond somewhat to each other, it is possible to get a more objective, rather than subjective, response. [6]
4.3 Information Visualization

Information visualization is a graphical representation of data generated via computer. The idea is to present complex information for the users in a more transparent way. Information visualization that is interactive demands that the interaction design is intuitive for the user with no problem to learn and understand.

Information visualization has a purpose to give the user the ability to gain insights. This means that the user can view an entire set of data as a whole at a glance, to gain this insight and the ability to see patterns or hidden connections in the information.

4.4 Designing for Human Centered Design

From the very first computers, to the first smartphones and until now, the design in Human Centered Design (HCD) has been improved. In this section, this thesis will focus on the design for HCD in computers but it will start with some basic examples from everyday life of how designers can simplify and ease the everyday life for the consumers.

When a user interacts with a product; digital or physical, he or she needs to figure out how the product works, what it does and the different possible interactions with it.

A couple of concepts will briefly be described that needs to be taken into consideration when designing these products. These are fundamental psychological concepts of discoverability, which means that these concepts helps a user figure out how a product works.

When determining how to use a product or system that we have never seen before, the user needs affordances, signifiers, mappings and feedback.

4.4.1 Affordances

Affordance can be explained as a quality of an object, or environment, such as a user interface, that allows someone to perform an action. Affordances define what actions are possible. There are multiple examples of this, but one is a chair that allows a person to sit on it, the chair then has good affordance. Another example of affordances is the push plate on a door that shows the user to push it, or the handle which indicates to the user that the door must be pulled. This is often designed poorly and even at the entrance to the Umeå University Institute of Design, the doors have handles on both sides which make users try to open the doors by pulling in the wrong direction, when they need to be pushed. A button that is inviting to press has good affordances.

4.4.2 Signifiers

Compared to affordances that show what actions are possible, signifiers show where and how the actions should take place. A screen might use affordances to show that the user can touch it while the signifiers shows where on the screen different actions can be done.

4.4.3 Mappings

Mapping is a term that points to the mapping of the correspondence between different elements. If the mapping is done with spatial correspondence, it is easier to understand how to use them. For example, if the light switchers in a room corresponds to the lights’ placement, it is easier to understand which light corresponds to which switch. The same goes for driving a car, if you turn the wheel to the right, the car will turn to the right.
These mappings can be different depending on different cultures [17], and for example discussions can arise about what is wrong or right such as with Audi’s control knob that the user needs to turn left in order to go down in a list on a screen [4]. On the Internet, there are a lot of discussions about this and the first generation of the iPod did it the other way, that the wheel needed to be turned right to go down a list [20] [23].

4.4.4 Feedback

Feedback is the communication of the result of an action. It is the same if a user pushes a digital button, a button at a street crossing or in an elevator. The feedback is giving the user information that the action is being processed and handled [17]. Feedback can not act in delay, if so, people tend to give up or get frustrated. Therefore the feedback must be immediate.

Informative feedback is very important since non-informative feedback can be worse than none feedback at all. A sound that is only a short signal, a light that flashes once is often misinterpreted or missed completely. On the other hand, too much information can have a negative effect on the purpose of feedback. Continuously flashing lights, beeping sounds, voice commands etc, can be both irritating but also dangerous depending on the situation. If the user receives too much information, the user can instead ignore the feedback or turn it off, which could mean that the important feedback and messages would be missed. [17] Feedback has to be planned and prioritized. The more important messages need to be obtrusive and non important messages the opposite.

4.4.5 Conceptual Models

A conceptual model is often used in digital formats such as in computers or phones, and it is a way of describing how something works. For example we use folders, files and icons in order to keep track and organize the information we have on our computer systems. It does not need to work like that within the system, but it helps the user understand how things work and keep it organized [17].

4.5 Testing and evaluating usability

There are different ways of finding a problem that needs fixing. A usability problem can be found before the product is developed and a problem can be observed or not observed. In order to find these usability problems early, the design has to be evaluated [10]. Figure 4 shows an effectiveness tree for finding usability problems. Some usability evaluation methods (UEMs) simply identify the problems, while some actually suggest solutions to the problems. Solving a problem might add more problems or leave the performance the same, but the goal is to reduce the number of problems for the user [10].

In Figure 4, the different paths a problem or the evaluation of a problem can take, is visualized. As seen in the figure, the first path gives the most preferable outcome. PredictedUsabilityProblem → Observed → Changed → FewerProblems.

There are two outcomes (3 and 6 in graph) that create more problems than observed in the first stage. These are outcomes that the designer and the developer must try to avoid, especially scenario 6 which had no observed problem to start with but the outcome ended with more problems than in the beginning. Scenario 2, 5 and 7 are just wasted time and effort [10].
4.5.1 Heuristic Evaluation

An heuristic evaluation is used in a iterative design process. When prototyping a method called heuristic evaluation allows the developer to assess and evaluate a design and usability without the expense of the user[14].

The goal with heuristic evaluation is to find problems in the usability of a design through a methodical inquiry or inspection of the usability in a user interface design.

4.5.1.1 Evaluators  The evaluation uses individual evaluators in order to find user problems, and research shows that a test that uses more evaluators will find more of the existing problems.[14] It also depends on the knowledge and expertise of the evaluators. Studies show that 14 novice evaluators are needed in order to find more than 75% of the usability problems, while it only needs three to five usability specialists in order to find 74-87% of the problems. If the usability test uses evaluators that are experiences specialists, only three evaluators are needed in order to find between 81-90%.[15] So, in order to find as many problems as possible in a time and cost efficient way, the best way would be to use highly experienced usability specialist as evaluators in the usability test. Different types of evaluators tend to find different problems which leads to the conclusion that the best way to find as many problems as possible in a time and cost efficient way is to use different
types of evaluators.\[14\]

4.5.1.2 How it is conducted Heuristic evaluation is done individually without a conversation between the evaluator and supervisor until after the test. The evaluator inspects and uses the interface alone while he or she often is asked to think aloud and communicates their thoughts verbally. The supervisor often records the test, observes the usage and or even writes a report at the same time. The observer can help the evaluator if he or she gets problems if the prototype has bugs etc, but should avoid interaction between them to keep the test as unbiased as possible and keep the possibility to recognize mistakes the user makes when using the interface. After the test the evaluator and the supervisor will have a discussion and evaluation about how the test went.\[14\]

4.5.2 Result of a heuristic evaluation

What can be seen after using the heuristic evaluation method is often a list of problems with the usability. It can be problems in the interface or, in a high-fidelity prototype, actions that do not work because of back-end problems. The result does not contain answers to how to fix the problems but only the identification of the problems, even though many problems has obvious fixes to them.\[14\]

A problem with testing in general is that the test does not pick up minor problems such as different placement of the same information on different screens. Heuristic Evaluation is shown to identify more of these smaller problem than other usability tests.\[15\] Smaller problems like these causes inconsistency and confusion and should be removed.\[15\]

4.5.3 Design for human cognition

There are three levels of processing information, the visceral level, the behavioural level and the reflective level. They are working together and one of them could easily destroy future usage of the product. If just one of the levels is disappointing, a user is less likely to use the product again, than if every level is satisfying. At the same time, one very good experience with the product could make up for past or future failures. In order for long term enjoyment of the product, all three levels must be qualified.\[17\]

The visceral level of processing information is sometimes referred to as ”the lizard brain”.\[17\] This visceral level takes use when making fast and subconscious judgements on the surroundings and environment. For example, if the environment is safe or not etc, and this is done automatically.\[17\] In a design, the visceral level is about the first impression of a site or a product. Is the user’s impression or sense of the design pleasant, harmonic or muddled etc. The first impression has nothing to do with the usability of the product, it is more about the attraction and the willingness for users to stay on a site or in the design. Visceral responses is often overlooked by developers, engineers or other logical people but everyone uses their visceral level even if it is wanted or not. That is why most users prefer some products over others even though they are just as competent and easy to use.\[17\]

The behaviour states is something a person learn automatically. This level contains actions in a subconscious level. It takes place when we do sports and the reactions is to quick in order to be consciously controlled, when we talk, but we do not know where the sentence will end and the mouth just keeps going etc. As mentioned, actions like these can be learned and the designers’ challenge is to know and react to that every action of a user is expected to have a response. This is controlled by the designer with feedback. Depending on the information in the feedback, the user
can feel satisfied, disappointed, relieved och frustrated. If the user does not get any feedback, the feeling of frustration appears. Even if the feedback is negative, it is important to give the user the feeling of reassurance and possibly even control if the feedback has the right information.[17]

The reflective level of human cognition is the conscious level, where the brain processes and analyze the information before but mostly after an action is made and the response is returned. It is in this state we evaluate actions, its responses and even try to predict the future. In this level of processing information, the designer’s work might be the most important. In this state the user put blame, responsibility or praise etc. The user reflects on the conscious actions, and remembers when deciding if the he or she wants to recommend the product or not.

4.6 Brainstorming & idea generation

A brainstorming and idea generation can be used both when finding problems as well as in the phase of problem solution.[17] A brainstorming session should be structured in order to maximize the result of ideas and their value[3].

In a brainstorming session, it is important that the participants are in a free-of-critic environment[3]. In the book Design Thinking[3] there are a couple of rules during a brainstorming session and an idea generating process.

- The first, and the most important thing is that it is not allowed to critic another idea or person. If so, it prevents participants to raise their voice and suggesting solutions or ideas. No idea is a bad idea.
- Avoid an administrator involved in the process, he or she might disrupt the flow of ideas.
- If an idea seems like the best one, choosing that instantly should be avoided, but instead, one should continue to generate a quantity of ideas for the time that is set out for the process.
- Have a set time limit for the process and parts within the process.
- Thanks to the first rule, the participants must not be afraid of coming up with bad ideas. It is important to let the ideas flow, even if they are weird or odd.
- The administrator should make sure that all participants are involved and contributing, and not let one person be dominating in the session.

Don Norman says in his book The Design of Everyday Things[17] that he would like to add another rule which is: Question Everything! He means that no questions are stupid, since they are presumed to have an obvious answer. This makes the other participants in the session to answer the obvious answer, but when there is no obvious answer there might be a problem. Solutions to problems are often discovered through stupid questions.
5 Results

5.1 Results from the information priority workshop

In this workshop the information of the report were divided in sections and listed. The following sections contained in the original effect mapping were identified:

- Summary
- Background
- Methodology
- Impact mapping
- Google Analytics
- Competitor Vernissage
- Survey Subsidaries
- Web Survey
- Content Analysis
- Information structure
- Maintainability
- Non-functional requirements
- Project planning
- Conclusion
- Appendix

With an open brainstorming session, where no idea is a bad idea, some of these sections were merged together or replaced. Some sections were decided to be excluded since they were not important enough for the users. In the workshop the discussion often ended up in that these sections differ in importance depending on which user we want to target. For example the CEO of a company did not prioritize the same sections as the person who developed the effect mapping. A conclusion from the workshop was that it would be best to have personalized information showing in the web-prototype depending och who the user were. For example: if a CEO of a company, that is basing decisions on the information, is visiting the effect mapping, he or she will be shown information based on the position of being a CEO. If a member of the development team for the effect mapping visits the site, he or she would be shown information based on his position. This created the idea of a portal, or a login version that could help sort between the different users of the effect mapping. This was not developed in the prototype but instead a list was created that would fulfill and meet the most needs of the general visitor of the effect mapping. This list of sections were prioritized and rephrased to:

1. Short description
5.2 Results from idea workshop

The categories that were identified in the idea workshop where: vertical menus, category menus, shape menus, portal, and dash-sections. The participants chose to continue working with the category menus.

There were discussions about target group entrances to the site, together with categories in a list menu. In the "why why why" part of the workshop the participants thought that this solution would help:

1. The user gets an overview and will find relevant information quicker.
2. Target groups find what they are looking for.
3. The users understand and receive information quicker.
4. More people can receive the information.
5. Helps the user base decisions on relevant information.

Figure 5 below shows the result when passing around a paper with post-its between the participants in order to generate ideas of how to achieve an effect of the use of categories. The picture shows a post-it in the middle which is the effect and the other ones around it are descriptions of how to reach that effect. In the picture the effect is to increase understanding of the information. The solutions to that are:

- Clear summaries
- Pictures
- Graphs and statistics
- Help/explanation texts.
- Log of decisions.
- Simplicity

This was done on multiple effects by using categories. This helped create ideas of how to design and implement certain functions in order to achieve the right result.
5.3 Results from the research on original report

When researching the effect map made for Väderstad, a sorting on the content was made to understand how it works and what it contains. The content of the effect map was categorized and resulted in the following sections:

- Summary
- Background
- Impact mapping
- Google Analytics
- Competitor vernissage
- Survey subsidiaries
- Web survey
- Content analysis
- Information structure
- Maintainability
- Non-functional requirements
After two brainstorming sessions, one with the author of the effect map and the client and receiver of it from Väderstad in another session, we shortened this list down. During those two sessions, there were discussions about what could be fit in the same sections, what was the most important and what was unnecessary.

The list of what should be the content sections in the web-prototype became:

- Short description
- Target groups
- Goals
- Summary
- Effect map
- Workshops
- Recommendations
- Wireframes
- Analytics

This list later became tweaked when merging together some of the sections in to one. See the final results in the results of the prototype section below (section 5.4).

5.4 Prototypes

There are three stages of prototypes used in this study. The first stage with low-fidelity prototypes was sketches created with paper and pen. The second stage was med-fidelity prototypes developed with Balsamiq prototyping tool, and the third stage was the high-fidelity prototypes created with Sketch app and Atomic.

5.4.1 Low-fidelity Prototypes

The lo-fi prototypes were created with paper and pen and sketched down. There were not any organized user tests except for discussions and evaluations with other interaction designers and the supervisor at Knowit. Figure 6 shows some examples of how the lo-fi sketches looked like.

5.4.2 Med-fidelity prototypes

The med-fidelity prototypes were developed with Balsamiq prototyping tool. The designs took place and the final design started to take form.
Figure 6: An example of how the Lo-Fi sketches looked like

Figure 7: This is an example of what one of the med-fi prototypes looks like.
Figure 8: This is another example of what one of the med-fi prototypes looks like.
5.5 Final Prototype

After all the workshops, meetings, discussions and tests of the design, a prototype was developed. The design is done with the graphic profile of Knowit Experience in order for them to apply the same design with the same sections on other effect mappings. As mentioned, this design and the information in it is based on the effect map done for Väderstad.

The web-prototype is a "one-page" which means that all information is covered in one single, scrollable page were there is possibilities in the page to expand or hide different sections.

Figure 9: Frontpage, this is what the user first will see when visiting the effect map.

The first thing the user will see when visiting the effect map will be a title that sums up the purpose of the new website, the purpose of the study. There will then be a summary of what this effect map is about and why it has been performed and developed. There is also the purpose in full and this is in order to help the visitor and user understand what they are looking at and what to expect.

During the idea generation workshop where the focus was on navigation, the idea of a dashboard came up for discussion multiple times. Therefore, the dashboard format was later used for the summary of the project. When the user starts to scroll down, this is what the user sees. The user sees a short summary of some of the results from the study. The user can see two of the most important target groups, as well as some site goals and quick statistics of the clients’ current website.

In the recommendations the user sees the recommended actions developed from the effect mapping. The recommendations for the future website in this case. This was put early, since the interviews with both Väderstad and Knowit showed that the clients are often most interested in this and not really in what the recommended actions are based on.

The effect mapping method delivers the results in a report with an effect map, which is sometimes called impact map. See the original effect map in Figure 2. This contains the main purpose together with measurable goals in order to reach that purpose. The effect map also shows the target groups, information about them, what they want to do and how the design should help the users reach
Figure 10: Frontpage with the menu open, this is how the user will navigate on the web site. A side menu that follows were the user is on the website. This is meant to resemble the navigation of the original report but be more interactive and understandable for the user.

Figure 11: Summary, second this the users sees is a dashboard with a summary of the most important target groups, the most important goals and some statistics.

their goal with their visit.

An effect (or impact) map answers the questions ”why, who, what and how” for a project or a product. The purpose of effect mapping is to connect all the functionality to the need they fulfill and prioritize all the features, requirements and target groups. The result of an impact map should be a living document in the web project, as well in the work of maintaining the new web.
Figure 12: Recommendations of actions in order to reach the final purpose and goal with Väderstads new website, these are conclusions from the final result of the impact mapping.

Figure 13: An effect (or impact) map answers the questions "why, who, what and how" for a project or a product.

As shown in the impact mapping above, all the different target groups are presented. First in a list and when pressing a certain target group the user can receive more information about that specific target group. The target groups' needs are presented, and what they want to do on Väderstads website. The impact map also shows how the new website can fulfill those needs the user has.

In the section 'workshops and results', also shown in Figures 15 and 16, all the different work-
Figure 14: The second part of the impact map which shows the target groups, information about them, their needs and how to fulfill those needs.

Figure 15: Workshops and results with risk, idea and target group workshops together with the competitor vernissage and the content analysis.

shops with their results are collected in one section. The risk, idea, and target group workshops are presented together with the competitor vernissage and the content analysis. They are not something that are always on display, instead the user has to press a button in order to expand the information about a specific workshop they wish to read more about.

Google Analytics is a tool that is used in order to retrieve data about a website's visitors. This is used to define and save data about the target groups on a webpage like Väderstad's. This is
Figure 16: In the workshops and results section the user can read more about the specific workshops that has been done during the effect mapping.

Figure 17: Google analytics data is shown in order to understand the target groups like where they are from.

shown here in order to understand the target groups before developing a new website.

In figure 20 and 21 we see some results from a web survey that was made in order to retrieve information about the target groups needs. We can see how the users think about the web page as it is today which could help when developing a new website. We can also see the most common information that a visitor looks for on today’s web page and from that we understand what is needed to preserved to the next new website.
Figure 18: Google analytics data is shown in order to understand the target groups like what type of unit they use etc.

Figure 19: Google analytics data is shown in order to understand the target groups like what language they speak.
Figure 20: *A web survey is shown in order for understanding the target groups needs even more.*

Figure 21: *In the web survey section we can see the most common information that a visitor looks for.*
5.6 Results of the pilot study

During the development of the test, there were multiple smaller evaluations and discussions about the test itself with the supervisor at Knowit. When the design of the test started to feel good there was a pilot study in order to evaluate the design even more. The pilot study was performed on four test persons, where two did the test with the original report version of the effect mapping and two participants did the test with the web-prototype. There were 50 percent female and 50 percent male participants that did the pilot tests.

The conclusions from the pilot study showed a couple of faults in the test that had to be fixed. They are listed below:

- In the report, the target groups were listed in order which also was explained in the report. This was not the case in the web-prototype and it was not clear that the target groups were listed in order of importance. This was a problem that had to be fixed since the question in the test was "which target group is the most important?".

- In the web-prototype, the risk-analysis showed the risks in a list divided in two columns. The first risk in the left column and the second in the right with a dividing vertical line between them. This made the test participants confused. This design had to change and the risks were to be shown in a more obvious order.

- In the text in both the original report and web it said "maintain the visual standard" but in the question it said "keep the visual standard". This was then changed so the questions would correspond to the text.

5.7 Result from the main test

The main test consisted, as mentioned, of a comparison between two test groups with five individuals in each group. The first group did a test by answering questions and searching for information using the original report of an effect mapping. The other group did the exact same test with the same questions, but instead they searched for the information in the web-prototype of the effect mapping.

When measuring efficiency, time is often a used tool. The results of the main test is divided in three different parts:

1. Efficiency in time
2. Points in correct/incorrect answers
3. Remembering processed information
4. Experience of the participant

The first measurement is efficiency which was measured by time. The second part contained the errors that the participants had in the test, and the third section was the result of the participants’ comments and answers to the final questions about the way they received the information.

As mentioned the second part of the result is measured how the participants did on the test in the form of points. The points is measured in the amount of correct answers the test participants had on the test. In the cases of multiple correct answers to a question the scoring was different. In these cases the respondents got one point for a correct answer and one minus point for an incorrect
Web prototype

<table>
<thead>
<tr>
<th>Testperson</th>
<th>Time it took (seconds)</th>
<th>Points (max 40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24 min (1440 sec)</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>22 min 15 sec (1335 sec)</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>20 min 3 sec (1203 sec)</td>
<td>33</td>
</tr>
<tr>
<td>4</td>
<td>18 min 51 sec (1131 sec)</td>
<td>33</td>
</tr>
<tr>
<td>5</td>
<td>19 min 39 sec (1179 sec)</td>
<td>29</td>
</tr>
<tr>
<td>Average</td>
<td>20 min 57,6 sec (1257,6 sec)</td>
<td>28,2</td>
</tr>
</tbody>
</table>

Figure 22: A table with the results from the test and the time it took for every participant to complete answering all the questions in the form with the help of the effect mapping as a web prototype.

Original report version

<table>
<thead>
<tr>
<th>Testperson</th>
<th>Time it took (seconds)</th>
<th>Points (max 40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>26 min 20 sec (1440 sec)</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>26 min (1335 sec)</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>24 min 14 sec (1203 sec)</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>25 min 31 sec (1131 sec)</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>22 min 58 sec (1179 sec)</td>
<td>20</td>
</tr>
<tr>
<td>Average</td>
<td>25 min 0,6 sec (1257,6 sec)</td>
<td>22,2</td>
</tr>
</tbody>
</table>

Figure 23: A table with the results from the test and the time it took for every participant to complete answering all the questions in the form with the help of the original effect mapping report.

answer. We can see the results of the time recorded and the points the participants had in the figures 22 and 23.

In figure 24 we can see the calculated points without the questions of remembering the processed information, without the questions 14 and 15 (1 and 2 in section 3, see appendix A).

<table>
<thead>
<tr>
<th>Max 24 poäng</th>
<th>Web-prototyp</th>
<th>Original</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Medel:</td>
<td>22,2</td>
<td>18,2</td>
</tr>
</tbody>
</table>

Figure 24: The amount of points with the memory questions excluded.
The test persons were chosen in order to mirror a wide range of users. In the figures below, we can see that there were 50 percent women and the same number of men in the test groups. There were also a wide range of occupation and a mean age of 32.2 years.

Figure 25: There were 50 percent women and 50 percent men in the different test groups.

Figure 26: This figure shows the percentage of the test persons occupations

5.7.1 Efficiency

When measuring the efficiency, this study recorded the time it took for every participant to answer all the questions and find the answers in the effect mapping. First, the time consumed when taking the test will be presented. This does not take into account if the participant answered right or wrong on the questions.

When measuring and comparing two groups statistics is used, and more specifically, the T-test\[2\]. The T-test is often used when to determine if the means of two groups differ from each other. An assumption that is made in a T test is that there are random sample populations where the data is collected from a randomly selected but representative portion of the population.\[2\] This means that we would have to answer and prove that the samples are completely random which we can not since it is really hard to fulfill the requirements of completely random populations. The test participants were randomly selected in a local area and chosen to be representative to the whole
The user population. The test groups were chosen to be 50 percent women and 50 percent males and divided between students, working with IT or working with other than IT. This was not completely random so this T-test is therefore used as an indicator and illustrator of the results of the study more than a proof of it. In order to do the T-test which will indicate a result, we assume that the groups are independent and the null hypothesis is:

- $H_0 : \mu_1 - \mu_2 = 0$ There is no difference in means between the two populations.
- $H_1 : \mu_1 - \mu_2 \neq 0$ There is a difference in means between the two populations.

The test was computed and calculated with the program Minitab which is a tool used to analyze data and calculate statistics. In this program, the results were put in. The results consisted of ten different values of time it took to complete the test with five in each group. In the figure below there is a table which shows the results from the study and the amount of time it took for the participants to complete the test and find all the requested information. Remember that at this point the correctness of the answers is not taken into account.

**Two-Sample T-Test and CI: Web; Report**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web</td>
<td>5</td>
<td>1259</td>
<td>127</td>
<td>57</td>
</tr>
<tr>
<td>Report</td>
<td>5</td>
<td>1500.6</td>
<td>83.6</td>
<td>37</td>
</tr>
</tbody>
</table>

Difference $= \mu \text{ (Web)} - \mu \text{ (Report)}$

Estimate for difference: -243.0
95% CI for difference: (-409.3; -76.7)
T-Test of difference $= 0 \ (vs \ neq) : T$-Value $= -3.57$ P-Value $= 0.012$ DF $= 6$

Figure 27: This figure shows the calculations made in the T-test of the two groups.

In figure 26 the calculations of the T-test are shown. The null hypothesis is that there is no difference in means between the two populations (test-groups), and in these calculations we can see that the P-value is 0.012. This means that the probability of this being true is 0.012 which equals 1.2% and is very low. This means that we can discard or reject the null hypothesis and therefore assume and prove the opposite. The foundation behind any test with hypothesis is that the statistics from a test is possible to put in the context of a probability distribution. In this study, the T-test is used and therefore placed our T-value in the context of the T-distribution and this way we get a result from the study and the test. As seen in figure 26, the T-value says -3.57 but the absolute value of it is 3.57. This value is compared to the T distribution and the t-table where the value, that the resulted T-value is compared with, depends on the degrees of freedom (df). Since equal variances can not be assume, because of the large difference in variances between the two test groups, Minitab is used without that assumption and gets 6 degrees of freedom.

Web: Variance $= 16112$ seconds with a standard deviation of 127 seconds.
Original report: Variance $= 6990$ seconds with a standard deviation of 83.6.
\[
T\text{-}value = 3.57 \\
\text{Degrees of freedom, } df = 6 \\
P\text{-}value = 0.012
\]

Figure 28: This figure shows the t-table to which we compare our T value.

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.000</td>
<td>0.816</td>
<td>1.061</td>
<td>1.386</td>
<td>1.886</td>
<td>2.920</td>
<td>3.030</td>
<td>3.253</td>
<td>3.355</td>
<td>3.440</td>
<td>3.520</td>
<td>3.592</td>
<td>3.653</td>
<td>3.707</td>
<td>3.752</td>
</tr>
<tr>
<td>3</td>
<td>0.000</td>
<td>0.765</td>
<td>0.978</td>
<td>1.250</td>
<td>1.638</td>
<td>2.353</td>
<td>2.887</td>
<td>3.355</td>
<td>3.653</td>
<td>3.920</td>
<td>4.167</td>
<td>4.341</td>
<td>4.511</td>
<td>4.673</td>
<td>4.821</td>
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<tr>
<td>4</td>
<td>0.000</td>
<td>0.741</td>
<td>0.941</td>
<td>1.190</td>
<td>1.533</td>
<td>2.132</td>
<td>2.776</td>
<td>3.374</td>
<td>3.747</td>
<td>4.054</td>
<td>4.341</td>
<td>4.620</td>
<td>4.902</td>
<td>5.173</td>
<td>5.431</td>
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<tr>
<td>5</td>
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<td>0.727</td>
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<td>3.865</td>
<td>4.255</td>
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<td>1.812</td>
<td>2.228</td>
<td>2.864</td>
<td>3.465</td>
<td>4.167</td>
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<td>5.694</td>
<td>6.021</td>
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<td>0.876</td>
<td>1.088</td>
<td>1.363</td>
<td>1.796</td>
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<td>2.819</td>
<td>3.409</td>
<td>4.167</td>
<td>4.620</td>
<td>5.001</td>
<td>5.355</td>
<td>5.694</td>
<td>6.021</td>
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<td>0.873</td>
<td>1.083</td>
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<td>2.761</td>
<td>3.355</td>
<td>4.167</td>
<td>4.620</td>
<td>5.001</td>
<td>5.355</td>
<td>5.694</td>
<td>6.021</td>
</tr>
</tbody>
</table>

Figure 29: This is a boxplot of the results from the efficiency test with respect to time.

Since the p-value = 0.012 < 0.05 and the T value 3.57 > 2.447 (in the table, figure 27), a result can be concluded. With this result and data from Minitab the conclusion is that the null hypothesis can be discarded and therefore the opposite \( H_1 : \mu_1 - \mu_2 \neq 0 \) hypothesis is true; that
there is a difference in means between the two populations. Figure 28, as well as the data, clearly shows that the participants that took part of the information with the web prototype took less time to answering the questions and finding the answers.

5.7.2 Points

If the same t-test is done, but now with the difference that we only focus on the points the participants got on the test. Now only the performance is evaluated, without respect to time and efficiency.

The same hypothesis is set as when measuring the efficiency in time, but not only with the focus on points.

- $H_0 : \mu_1 - \mu_2 = 0$ There is no difference in means between the two populations.
- $H_1 : \mu_1 - \mu_2 \neq 0$ There is a difference in means between the two populations.

Figure 30: This is a boxplot of the results from the measurement of points in the test

Based on the boxplot (Figure 29), it is possible to guess that there might be a difference between the two test groups with the respect to points and solving the test. But it can not be known without looking at the calculations. Figure 30 shows these calculations further.

In figure 30 we can see the follow calculations:

- $T - value = 2.38$
- Degrees of freedom, $df = 5$
- $P - value = 0.064$
Figure 31: This figure shows the calculations done in Minitab when calculating if there is a difference between the two test groups with respect to points.

When taking these numbers and analyzing the result we can see that the p-value is 0.064 which is not below the significance level of 0.05. This means that we can not discard the null hypothesis.

If we look at the T-value 2.38 and then compares it in the table, which we can see in figure 27, we can see that the T value in the table is 2.571. This means that our T value is smaller than the t value in the table which in return concludes the same result when just looking at the p-value: we can not discard the null hypothesis.

5.7.3 Memory: Remembering processed information

As mentioned there were two questions where the test participants did not get to search for the correct answers but remembering the answers from the information they had just processed.

In figures 31 and 32 we can see the result from the questions were the participants had to remember the answer without looking up the information. In the first question there were no difference between the group that had the web prototype and the group that used the original report version. In the second question we can see a difference in the result which indicated that the users of the web prototype had it easier remembering the information they just had processed.

5.7.4 Experience

This section presents the results from the final questions the participants answer to orally after doing the main test. To see all the questions please see Appendix C.

In the first question: "1. How did you experience using the web-prototype / report?" there were a lot of different answers depending on what group the participants belonged to. The group that used the original report tended to answer with words and sentences like: Awkward, Way too much information, too long report, "I want more pictures" etc.

The users that did the test with the web-prototype as a tool answered with words and sentences like "Overall good", "Interactive which felt right", "beautiful", "It was good", "clear", "gave a good overview" and more.

In the second question "Was it easy to use the web-prototype / report?" the difference between the groups marked itself when the group with the original report answered: "NO, it was really
It became clear that the majority of the participants that used the original report version of the effect mapping thought it was hard to find the information they wanted and it was difficult to use the report in general. They were also expressing that they became less interested in the project than the group that used the web-prototype. None of the test participants that did the original report version thought that the report was attractive, instead they thought the other way around and that they would not willingly open and read the report. When showing this group the web-prototype after the test, all participants said with distinction that they would definitely rather use the web version than the report.

In Figures 33 and 34 the answers to some of the questions are illustrated.

Figure 32: This figure shows the results from the first question: "10 target groups were identified during this impact mapping, do you remember any of them?".

<table>
<thead>
<tr>
<th>Poäng</th>
<th>Web</th>
<th>Original</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>3</td>
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<td>4</td>
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</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>17</td>
</tr>
</tbody>
</table>

"I think it depends on if you are involved with the project for real or not", "No I don not think so except for certain parts that was good".
Figure 33: This figure shows the results from the second question: "The impact mapping resulted in some recommendations for the development of the future webpage. Do you remember any of them?".

<table>
<thead>
<tr>
<th>Poäng</th>
<th>Web</th>
<th>Original</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
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<tr>
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<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>Medel</td>
<td>2</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Figure 34: This figure illustrates some of the answers to the first question.

<table>
<thead>
<tr>
<th><strong>Web prototype</strong></th>
<th><strong>Original report version</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>- I did not really know what to expect but I really liked the map and the pictures on the phone and computer</td>
<td>- Messy, there was a lot of information I did not care about at all.</td>
</tr>
<tr>
<td>- A bit static, mostly scrolled through</td>
<td>- I think it was okey but to long texts, I would wish more pictures.</td>
</tr>
<tr>
<td>- Overall good, I like the concept, interactive.</td>
<td>- Booring, kind of gave me anxiety.</td>
</tr>
<tr>
<td>- Clean and uncluttered even though a one-page is not my thing</td>
<td></td>
</tr>
</tbody>
</table>
How was your experience in finding the information you wanted?

**Web prototype**

- Clear sections
- The pictures and diagrams helped
- I would like a search function
- After I had the possibility to acclimatize it went really well.

**Original report version**

- I had to read through really thoroughly
- Way to much information
- Hard!

Figure 35: *This figure illustrates some of the answers to the third question.*
6 Discussion

The goal with this study was to see if a digital web-prototype would improve efficiency, in the regard of taking part and comprehend information form an effect mapping, in comparison to how the effect mapping is presented today with a report and an effect map itself. When collecting the results and analyzing it statistically, it was clear that there was a significant difference in the efficiency in the regard of finding information and answering questions. There was also a large difference in the amount of points received by the participants when answering the questions in the test correctly. The mean point of the group using the web prototype was 28.2 points, while the group that used the original report version of the effect mapping had a mean of 22.2 points. This is an obvious difference between the two means, but there is no significant difference which means that the difference could possibly be just a coincidence at this time. An explanation of this might be because of the first test person that did the test with the web prototype, seemed to have difficulties with the language (English) which would effect the outcome of that individual’s result in a negative way. Errors like these could be minimized by doing more tests on different people in their own native language. The test was done in English since the original report was in the same language, so in order to avoid having to translate the whole report to Swedish, the prototype was done in the corresponding language as the original report.

The purpose of the questions that were answered orally after the main test was to collect the thoughts, ideas and experience from the test-participants. In this section, there were a lot of different answers but they all concluded the same thing. The experience with the web prototype were a lot more positive than the original effect mapping report which both reflected in the answers from the participants and the observations from the test leader. In the observations the test-leader (researcher) recorded different reactions from the test participants, and a common observation was that the participants seemed more likely to show frustration when using the original report version of the effect mapping.

The test was made on many people in different ages, genders and occupations as seen in Figures 24 and 25. The wide distribution of the participants was visible in the results, since their thought and ideas on the design varied. Some thought the design was perfect while some, especially if they worked with IT, thought that it had flaws. This is not something the author of this report would argue with, since he feels that the design could be a lot better with more functions like the search opportunity and a menu that could visualize and illustrate where in the navigation the user is. But even if the design is not perfect, it obviously is good enough in order to increase the efficiency in perceiving the information from an effect mapping.

To summarize the conclusions from this study, the study showed that the efficiency of the perception of information could significantly improve by developing a web version of the effect mapping. The users were also able to find the right information quicker and had obvious tendency to get more points on the test. Besides being more efficient and correct, the web prototype was also perceived as more attractive, beautiful and easy to use. There was not a single test person that would rather use the report version instead of the web prototype. This is a clear and obvious signal to the IT companies that there is no longer a need to deliver these effect mappings in the old fashion way as a report. Today, it is more efficient, attractive and involving to present the effect mappings on the web, with an easy way of presenting graphs, animations and much more.

All test participants claimed that they would rather use the web prototype over the original report version of the effect mapping. The participants that used the web prototype were also more willing to recommend their colleagues to take part of the information within the effect mapping.
This indicates that the participation and willingness to read the effect mapping information increases when the information is presented digitally as an interactive web version.

Search functions can be described as a graphical control element where the user is able to search for words or content. The search functions did not work in the web prototype since the prototype was built on pictures. That is why the test persons did not get access to the PDF file digitally but instead a printed version of it in order not to be able to search after words. This was done in order to make the two ways of giving the information as equal as possible.

The participants in the test was aimed to be random, but what is random? The idea was to test participants from a broad perspective which means that there were suppose to include both women, men, different ages, different occupations and students. Since the test facilitator (the author) chose the participants in order of these factors the participants no longer became random test persons. This makes the T-test not as valid as a proof since an assumption of the T-test is that the test populations is random. The T-test is therefore used as a indicator and illustrator of the results from the study more than a proof.

6.1 Limitations

This study had limitations in the number of tests done. The goal was to conduct at least 25 tests, but because of the limitations of time, the number of tests ended up at four pre-studies and ten regular. The tests took about 30 minutes to perform, which was a bit too long time for some of the persons that were asked to participate. It was a problem for the author to find participants for the study since many of the asked persons thought that they did not have enough time to do the test and that they were occupied with other tasks.

Finding completely random participants for the test groups was a problem, both with the definition of randomness and to find completely random test persons. In this study the participants were chosen at random at a specific company, a specific university and 3 more random participants. This might not be completely random since the participants were chosen in a local area, which makes the T-test not as valid. Therefore the T-test is used to show and visualise the result and to indicate if there are any differences in the results between the two test populations.

The web prototype could have been more interactive, but the time restraint of the study created a limitation for the author in making the prototypes. The tool for making the prototype was Atomic, which was a new tool for the author and it could have been used in a better way to create a more interactive prototype.

Another limitation with this study is that the design of the web prototype is not fully tested. The design is based on guidelines, but they are not tested as a real design project. The test in this study was more focused on deciding if a web prototype is more efficient than the original effect mapping. The design is therefore based on the author’s earlier design education, skills and other guidelines regarding designing for user experience. The design can be improved further developed in order to reach the full potential of the digital effect mapping.

Considering these limitations the results of this study are not generalizable to all firms and all effect mappings.

6.2 Future work

In future research and work, it would be a necessity to do a re-design of a deeper research about what will be the most efficient and at the same time appealing design. The future of visualizing
an effect mapping like in this study might depend on how much work it will demand in order to process and develop an effect mapping. To help and minimize that work, there would be a positive opportunity if there was a CMS developed. A CMS for example is Wordpress, Joomla and programs like that. It could work as a template for the developers of the effect mapping, with sections ready to fill in, instead of having the cost of developing a new website for every effect mapping. That would never work since it would take too much time, money and unnecessary work. If this were to be fully implemented, there is a need of a template that could fit all effect mappings and for every project the developers could just change the content and information. This study can be used for further research by applying it to other reports and firms.
7 Conclusion

The purpose of this study was to evaluate if a visualized web version of the effect mapping is more efficient than the original paper report version. A prototype was worked out and tested in comparison to the original paper report version of the effect mapping. The study shows that it is a significant difference in favor of the web prototype. When presenting the information of an effect mapping in an interactive web version, the likelihood of participation and perception is higher. The time to perceive the information is significantly shorter, and the correctness of the perceived information is higher if the developed prototype is used. These conclusions show that firms working with effect mappings benefit from the use of a digitalized presentation of the effect mapping results.

Even though only one effect mapping report was transformed to a digital web version, the results showed such significant improvements that it is most likely applicable to other firms and effect mappings as well.
8 Acknowledgements

The author of this master thesis study would like to thank Knowit Experience in Linköping and all the colleagues that helped with input, thoughts and feedback. The author would like to give a special thanks to supervisor Niclas Aström from Knowit, who helped a lot in discussions, idea sessions and the general problems with developing this thesis.

The author would also like to give a special thanks to the supervisor from Umeå University Thomas Mejtoft who has been an invaluable asset when developing this master thesis.
References

[1] Understanding t-tests: t-values and t-distributions — minitab. 


9 Appendix A

9.1 Test questions

The following is the questions the test participants got when doing the test, either with the original report version or the web prototype of the effect map. There are also the alternatives to the questions displayed, if there are non the participants were asked to answer in free text. They all got the same questions.

9.1.1 Section 1

Questions:

1. What is your age?
2. Gender?
   - Man
   - Woman
   - Other/prefer not to answer
3. What is your occupation?
   - Working in IT
   - Student
   - Working with something else than IT
   - Other ........

9.1.2 Section 2

*During this part you may search for the information at the same time*

1. What is the purpose of Väderstads new website?
2. Which target group is the most important?
   - The mixed farmer
   - The interested buyer
   - The demo booker
   - The media junky
   - The future employee
3. What is the target groups determined by?
   - Demographics (like age, gender, interests and education etc)
   - Title
   - Organization
• Patterns that they are expected to act upon
• I do not know / I can not find the answer

4. Which one of the following alternatives is a recommendation of action in order to fulfill the final purpose?

• Show less information about the machines
• Maintain the visual standard
• Make the site responsive
• I do not know/I can not find the answer

5. In order to reach the main purpose there were 8 measurable goals formulated. Which of the following are included in those 8 goals?

• Increased amount of returning customers
• Increased amount of sold products
• Increased download of the product brochures
• Increased amount of pictures on the website
• I do not know / I can not find the answer

6. Which of the following alternatives does the mixed farmer want?

• Find info on products for smaller farms
• Wants to browse information
• Understand the product
• Historic information about the company
• Wants to download brochures

7. Which of the following alternatives does the media junky want?

• Understand the product
• To be able to interact with the site in a playful manner
• To find the newest stuff
• Get tech data to be able to compare machines
• I do not know/I can not find the answer

8. List the four biggest risks with this upcoming website implementation project.

9. In a competitor vernissage there were an analysis made on competitors websites. How many websites were examined?

• 19
• 23
• 27
10. In the competitor vernissage there were an amount of conclusions that were judged to be important to keep in mind and bring into this project of the new website. Which of the alternatives below are presented in those conclusions?

- Large texts
- Use images
- More products
- Easy to navigate between the different countries and languages
- I do not know / I can not find the answer

11. What percentage of the visitors are using a desktop today?

- 27
- 54
- 66
- 72
- 82
- 97
- I do not know / I can not find the answer

12. Which of the following languages are the five most used languages by the visitors?

- Swedish
- German
- Chinese
- English
- Italian
- Russian
- Spanish
- Polish
- Norwegian
- French
- Japanese
- I do not know / I can not find the answer

13. Which one of the following alternatives is the information which the majority of the visitors are looking for first today?

- Jobs
• News
• Demo booking
• Dealers
• The actual products
• Service and parts
• I do not know / I can not find the answer

9.1.3 Section 3

1. 10 target groups were identified during this impact mapping, do you remember any of them? Name the target groups that you remember

2. The impact mapping resulted in some recommendations for the development of the future webpage. Do you remember any of them? List the recommendations that you remember

9.1.4 Section 4

1. The test person got the information from:
   • Report
   • Web prototyp

2. How many minutes did the test take? Answered by test facilitator
# Appendix B

The form the test leader filled out when observing the test person did the main test.

<table>
<thead>
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<th>Question number</th>
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<th>3</th>
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<th>5</th>
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<th>9</th>
<th>10</th>
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<th>12</th>
<th>13</th>
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<tbody>
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<td>Frustration</td>
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<tr>
<td>Hesitation</td>
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<tr>
<td>Easy with the task</td>
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<tr>
<td>Hard with the task</td>
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</tbody>
</table>

Comments and reflections from testleader:
11 Appendix C

This is the questions all the test participants got after doing the test. This was done in order to collect information about the participants thoughts, opinions and ideas. The only difference in question between the two groups is that the user was only asked about the tool they used to find the information, in this case the web-prototype or the report. This was changed depending on which group the test participant belonged to.

1. How did you experience using the web-prototype / report?
2. Was it easy to use the web-prototype / report?
3. How was your experience in finding the information you wanted?
4. Did you become interested in the project?
5. Did you experience the web-prototype / report attractive?
6. If you were working at Väderstad, would you be willing to recommend others to take note of the information?
7. How did was it to be included in this study?

After answering these questions the test participant got introduced to the opposite way of finding the information. The participants that did the test with the use of the web-prototype was introduced to the original report, and the other way around. They when got one more question:

1. Had you rather used this web-prototype / report?