Integrating Usability Work in the Development Process at a Consulting Firm

by

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Abstract

When needing software, using the services of an IT consulting firm is today a common solution for companies nowadays. To make a system suited for the intended users it is important to focus on usability.

There are many different approaches possible to use when developing a usable system. The purpose of this study was to study if any of the approaches, goal-directed design, could be used when a customer orders a solution from a consulting firm. This was to be studied through a case study which was conducted at the IT consulting firm Sigma. One of Sigma’s customers is Toyota Material Handling Group which is a supplier of forklifts and additional services like the online fleet management platform Toyota I_Site. The platform is about to be further developed by connecting it to a mobile application with the purpose of making the platform more accessible and efficient. The assignment in the case study was to develop a prototype for this mobile application. This was done using the goal-centered design approach. Further, in order to understand the work at Sigma today, interviews were conducted with developers at the company.

The data collected led to an analysis about how Sigma and other similar IT consulting firms could use the goal-centered design approach when developing software. The conclusion drawn was that parts of the method could be motivated to the customer and thereby be used in future projects, while some parts would be harder to motivate for the customer. The included steps were user research, context scenarios, requirements and high-fidelity prototyping. These conclusions can be used to integrate usability work in the development process in the context of an IT consulting firm delivering a system to a customer.
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Chapter 1

Introduction

Today, a common solution for companies needing software is to use the services of an IT consulting firm. To make a system suited for the intended users it is important to focus on usability. Usability can be defined as:

"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.” (ISO 9241-11, 1998)

A lot of approaches and methods used for developing a usable system is available in previous research (e.g Gould and Lewis, 1985; Wei and Xing, 2010 or Goodwin, 2009). The question is however if those techniques really work in practice. Is it possible for a consulting firm to fulfill both the users’ and the customers’ needs and requests by using those techniques given the resources available? In order to answer that question, a case study at the IT consulting firm Sigma has been conducted. The case study consisted of two parts; the development of a prototype, hereafter referred to as the project, and interviews with developers at Sigma.

In the project, one of the well-known approaches, goal-directed design (explained in section 2.2.2), has been used when developing a mobile application prototype for Toyota, one of Sigma’s customers. The project focused primarily on the users and their needs while having the satisfaction of the customer in mind.

The case study was complemented with interviews with developers at Sigma, in order to get an understanding of the company’s current competences and work processes. The case study resulted in a recommended framework for Sigma and other IT consulting companies to use to integrate usability work in the development process.
1.1 Background of study

The study is conducted at the Östergötland department of IT consulting firm Sigma IT & Management. Sigma has a variety of assignments and customers, making each work case unique.

One of Sigma’s customers is Toyota Material Handling Group which is the largest supplier of forklifts in the world. The company also provides additional services like the online fleet management platform Toyota I,Site which is used by managers of the forklift purchasers. The platform is about to be further developed by connecting it to a mobile application. The purpose of the application is to make the platform more accessible and efficient.

1.2 Aim of Study

The aim of the study is to develop a framework for consulting firms to be used to make usability possible, given their prerequisites. A method is tested out to see if it can be used in these matters. Using the answering on the question of research as a basis, found in section 1.3, a framework is to be developed. Through this the thesis strives to reach its goal.

1.3 Problem Definition

The study will be based on the following question in order to reach the aim of the study:

*How can a consulting firm work with usability to fulfill the customer’s and the users’ requests and needs?*

1.4 Demarcation

One of the demarcations of the study is that only one approach for usability work, goal-directed design, has been tested out. This means that there may be other approaches more suitable to use for a consulting firm.

Another demarcation is that the customers views about usability have not been taken into consideration, information about this have only been gathered from the interviewed developers and studied theory.

The time limit of 20 weeks and problems for Toyota to get in contact with their customers led to that fewer users than desirable was involved.

The developed prototype is not a final product, which means that all functionality may not be technically feasible to implement.

The goal of the study is to develop the framework, hence no testing of it will be included.
1.5 Disposition of the Report

The report is divided into six chapters: Introduction, Theoretical Background, Method, Case Study, Result & Analysis and Discussion.

Chapter 1 - Introduction presents the background and purpose of the study as well as the question of research and the demarcation.

Chapter 2 - Theoretical Background presents relevant theory from related work such as theory about usability, techniques for achieving usability and earlier studies of how companies can integrate usability work in their development process. Further analysis will be based on this knowledge.

Chapter 3 - Method first describes the case study method including data collection, data analysis and validity. It then presents the chosen approach for usability design including theory behind it and the reason for the choice.

Chapter 4 - Case Study presents the process of the conducted case study.

Chapter 5 - Result & Analysis presents the results categorized in customers, users and consulting firms, while focusing on the subjects from the question of research: requests, needs and usability.

Chapter 6 - Discussion presents the discussion about what the results mean for Sigma, the industry and the field of research. It also includes method critics and the conclusion.
Chapter 2

Theoretical Background

This chapter presents the theoretical background necessary for understanding the topic of the thesis.

2.1 Usability

According to ISO 9241-11 (1998), usability is defined as:

"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use."

Nielsen (1993) uses five attributes to describe additional aspects of the term usability:

- **Learnability** - That the system is easy to learn, which allows the user to rapidly understand and start using the system.

- **Efficiency** - That a high level of productivity is possible once the user has learned to use the system.

- **Memorability** - That a user can return to the system after a period of absence and still be able to use it.

- **Errors** - That the user makes few errors and that he is able to easily recover from the errors he do make.

- **Satisfaction** - That the system is pleasant to use.

According to Mayhew (1999) the design of the user interface must be based on a number of factors to achieve usability. These are; capabilities and constraints of people in general, characteristics of the potential users, characteristics of the users’ work environment and tasks together with the
technical constraints and capabilities in the software and hardware. This can be done by using Gould and Lewis’s (1985) three principles of design. The first principle is to focus on users and tasks at an early stage of the development, the second one is to use empirical measurements by doing user tests using simulations and prototypes. Finally, the third principle is to do iterative design, which means fixing problems as they come up in user tests, and then test again.

2.2 Methods for Usability

There are several approaches that can be used when designing a usable system, for example user-centered design, goal-directed design and activity-centered design.

2.2.1 User-Centered Design

User-centered design has its focus on the users and their needs and feelings during the design process (Wei and Xing, 2010). It has the philosophy that the user knows best, that they know what they need and want, and thus; the designers have to find out what those needs are and design a product that fulfills them. Users are involved in every step of the design process and are in some cases even seen as co-creators, meaning that they are seen as being part of the development team as much as the actual software developers. The user always needs to determine how things should be done, even in really specific cases like placement of buttons etcetera. The high focus on the user needs allows the designers to not use their own experiences and preferences in the design (Saffer, 2010).

User-centered design has however been criticized for relying too much on the users. According to Wei and Xing (2010), users can be blind for new ideas and not be open for changes. This can hinder new innovations from being developed. For example, when striving to develop a product for increasing efficiency, basing the design only on the basic needs of users will not be enough (Wei and Xing, 2010).

2.2.2 Goal-Directed Design

The goal-directed design process can be divided into the following seven steps: project planning, research, modeling, requirements definition, framework definition, detailed design and implementation support. It has a set of tools like personas and context scenarios to be used in the process. As the name says, the focus in the goal-directed design process is to fulfill the users’ goals, but the approach also involves fulfilling goals of the customers (when they are not the same ones as the users) and the business developing the product (Goodwin, 2009). The primary objective is to achieve the users’ final goal by fulfilling the user experience goal, the ultimate goal and
if possible, the goal in life for the user (Wei and Xing, 2010). Although the steps in goal-directed design are clear, it takes a lot of experience, in fact several years, of using the method to fully understand it and to gain the benefits (Goodwin, 2009). When compared, goal-directed design is more of an overall design method while user-centered design can be used as a guiding principle in the research phase. Through goal-directed design, a clear path of the process is laid while using some parts of the user-centered design.

2.2.3 Activity-Centered Design

The activities performed by users are the main objective in activity-centered design. Activities can be defined as a number of decisions and actions that are performed for a specific purpose and can vary from brief and simple to really complex and time consuming. The focus is on what people do and it is these activities, not necessarily the people performing the activity, that the design is based upon (Saffer, 2010).

Activity-centered design has a more short-time focus than goal-directed design. The activities can be part of a goal and the focus on single activities can lead to designers not looking for solutions for the whole problem. Activity-centered design nor have the same amount of user focus as the methods previously mentioned, maybe leading to a lower level of usability (Saffer, 2010).

2.3 Usability in the Work Process

Historically, a gap has existed between users and developers. To bridge this gap, usability methods are often added to the existing development processes (Borgholm and Halskov Madsen, 1999). The two disciplines software development and usability have developed separately, therefore they are seldom integrated, but rather seen as two different areas. One group of people, the software developers, focuses on the inner workings of the system and the other group of people, the usability experts or designers, focuses on the users (Bygstad, Ghinea and Brevik, 2008).

Bygstad, Ghinea and Brevik (2008) explains that although a majority of companies consider usability being important and as a factor of competitive advantage, many companies are not willing to use resources for it. This is especially true for projects with strong time and cost limitations (Bygstad, Ghinea and Brevik, 2008). According to Høegh (2007) this is due to that key persons and managers do not understand the potential value in a usability investment or that a hostility towards having a usability focus exist in the company. The time assigned for usability issues may then be limited making a clear indication for the software developers what to prioritize (Høegh, 2007).

According to Bygstad, Ghinea and Brevik (2008) the majority of companies always includes usability in their requirements. These are based on
either best practices from earlier projects or user interviews. Usability requirements is further perceived as far more important than usability testing. Usability testing means that the product is tested on potential end users and is explained more in chapter 4. Many companies do not use this method, but the ones that do often only perform tests on a small amount of users (Bygstad, Ghinea and Brevik, 2008).

Seffah and Metzker (2004) recommends that usability experts get involved in the software development teams in order to integrate the usability methods with the software development process. This can be done through one of the following ways:

• By involving a third-party company specialized in usability.
• By involving an external consultant with expertise in usability issues.
• By forming a usability department or group.
• By educating some members of the development team in order for them to act as usability experts.

Which one to use depends on the project characteristics, time and cost constraints and on the size of the company.

To succeed in this process, the communication between developers and usability experts have to work well. If the communication between these parties does not work, problems can arise in the subject of them using different notations and tools as well as that the parties perceives the importance of the software in usability differently. This can lead to that usability matters will be incorrectly implemented, with the result of a lower grade of usability in the final product. In a worst case scenario, this would lead to the product having as little user focus as if the usability issues was not considered at all. An understanding for each others work and practices through education in each others areas is a good way to start in order to enhance the communication between the parties (Seffah and Metzker, 2004).
Chapter 3

Method

In this chapter the methods used in the study is described.

3.1 Case Study Method

A case study is defined by Yin (2003, p. 18) as:

"...an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."

In other words, case studies are great tools when it is important to understand the contextual conditions in order to get a full understanding of a real-life phenomenon. This in contrast to an experiment, which separates the phenomenon from the context. In real-life situations, context and phenomenon are not always distinguishable. Because of that a case study is not a data collection method alone but an all-encompassing method using multiple sources in the gathering of information (Yin, 2003).

Due to the importance of keeping the subject in their normal context during this study, a case study was deemed as a suitable method when studying how consulting firms can enable usability in their work. It was vital to use multiple sources in order to get a thorough understanding of the matter. This to not only get the theory behind it, but to also see how the integration between usability and development works in reality.

3.1.1 Data Collection

Data collection in a study can be quantitative or qualitative. Quantitative means that the data studied are numerical or highly categorized and are analyzed using statistical methods (Runeson and Höst, 2009). Qualitative means that the data analyzed is rather unstructured as a result of interviews
or observations (Jakobsson, 2011). It has the goal of creating an understanding of the thoughts, feelings and experiences of the people studied (Jacobsen, 1993). In case studies it is most common to use qualitative data in order to gain this understanding (Runeson and Höst, 2009).

According to Runeson and Höst (2009), it is recommended to use different data sources as well as different techniques to collect data when conducting a case study. In this way, the data can be compared and lead to more valid results than if only using one source or technique. Runesson and Höst (2009) further presents three levels of data collection techniques, where the result will be more thorough and valid if using more than one of them. The first one includes direct methods, where the researcher has a direct contact with the subjects collecting data in real time. The second level includes indirect methods, which means that a collection of raw data is made by the researcher while not interacting with the subject. The third level includes independent analysis of data already available and compiled. Suitable techniques for data collection in a case study are for example interviews, observations and document analysis (Runesson and Höst, 2009).

3.1.1.1 Interview

An interview is a type of conversation between two parties with the goal of mediating the knowledge, opinions, experiences and perceptions from the interviewee to the interviewer (Jacobsen, 1993). Interviews can be structured, semi-structured or unstructured. In a structured interview the interviewer are in control over the form of both the questions and the answers. This type of interview is like a questionnaire with a list of response options for each question, and every interviewee gets the exact same questions. In a semi-structured interview the questions that should be answered and the relevant topics are decided in advance as well, but the interview is more flexible and the questions do not have to come in a specific order. The answers are open and the focus is at the explication of the interviewee’s views and perceptions. Finally, the unstructured interview is about allowing the interviewee to speak as freely as possible without questions prepared in advance. Here the interviewer interferes as little as possible (Denscombe, 2009).

Interviews can be seen as the first level of data collection techniques, where the researcher collects data in real time through direct interaction with the subjects (Runeson and Höst, 2009).

3.1.1.2 Observation

The purpose of an observation is to study how certain tasks are performed by the people being observed. The observation can be a first or second level data collection technique, where an observation where the researcher observes the subjects without interfering or interacting with them belongs to the second level. An observation where the researcher asks questions about what happens and what the observants are thinking or where the researcher
is part of the observed environment, as in a participatory observation, belongs to level one. In this method there is interaction between subjects and researcher. (Runeson and Höst, 2009).

In this study, a participatory observation has been conducted through the process of developing the prototype. The researcher has a role of being both the observer and the observed subject and has through that gained personal experiences. Because of that it will be hard to stay totally subjective, as would be easier for an outside observer (Iacono, Brown and Holtman, 2009). Further, the data from the participatory observation is based on only one person’s perception, making it less valid than when involving multiple sources (Runeson and Höst, 2009).

3.1.1.3 Document Analysis

To perform a document analysis means to study already available documents that serves a specific purpose. This can be viewed as an implementation of the third level of data collection techniques (Runeson and Höst, 2009). This technique was used in the development process.

3.1.2 Data Analysis

Different types of data analysis is conducted depending on if the data is quantitative or qualitative. Analysis on quantitative data can include analyzing statistics, correlation analysis and hypothesis testing. Qualitative data analysis has the basic objective of deriving conclusions from the data through a chain of evidence from the results and conclusions. It is also recommended to have an analysis carried out during the data collection process in order to be able to use the gained insights in the further collection of data (Runeson and Höst, 2009).

The analysis of the data collected during the project was processed according to Goodwin’s (2009) method, presented in 3.2. The data from the interviews at Sigma was, after being written down, compared in order to find patterns and similarities. Based on the results from the project and the interviews at Sigma, a final analysis was made. This was done through the use of an affinity diagram by starting to search for relevant and interesting parts in the results and writing them down on post-its. Thereafter, the post-its were mapped and categorized and patterns were found, leading to conclusions which answered the research question.

3.1.3 Validity

The validity of a study signifies the credibility of the results and how trustworthy the results are. Validity should be considered throughout the case study but is finally evaluated in the analysis phase (Runeson and Höst, 2009).
Runeson and Höst (2009) mention different aspects of validity; internal validity, external validity and reliability. Internal validity involves the aspects of whether the results reflect reality and if the casual relationships are true. External validity describes to what extent the results are generalizable and how interesting the findings are to people outside the studied case. Finally, reliability concerns the impact the researcher has on the result (Runeson and Höst, 2009).

Since qualitative data often are used in case studies and not have a high degree of precision, triangulation is used to increase it. Triangulation creates a broader picture of the studied object through looking at it from different angles. This can be made for example by using more than one data source, as is the case for this research (Runeson and Höst, 2009).

### 3.2 Design Method for the Case Study

Among the existing techniques for designing usable systems, goal-directed design was chosen. This due to that it is more suitable than user-centered design in development of new inventions where the goal is to be more efficient and to change existing ways of working, as mentioned before. Goal-directed design also involves the goals of stakeholders. Because the importance for Sigma to satisfy their customer Toyota’s requests and needs, this seemed to be an important aspect to include. It also was perceived long-term goals being more important to solve than single tasks, as in activity-centered design. The clear steps used in goal-centered design was another matter that made it suitable to use for a person with a smaller amount of experience in usability work, as for the author. Goodwin (2009) presents a detailed way of following these steps, and because of earlier successful work for the researcher with it in previous courses, this source was used.

Goodwin’s (2009) process begins with the research phase, including both stakeholder and user studies. The next phase is the modeling phase where personas (described in 3.2.3.1) are created based on earlier research. Further, context scenarios are created based on the personas. The next phase includes the development of requirements. This is followed by low-fidelity prototyping and testing. Finally, a redesign is made and followed by high-fidelity prototyping and testing. The steps are illustrated in figure 3.1 and described in detail in the following sections.

#### 3.2.1 Stakeholder Research

To get a good start in the user research, interviews with stakeholders should be conducted initially. This gives the interviewer an overview of the objectives and goals for the product before studying the actual user behavior (Goodwin, 2009).
3.2. DESIGN METHOD FOR THE CASE STUDY

3.2.2 User Research

Because users are different, the ultimate user interface style varies between users. To develop the best user interface for a product, user research is required. Through this the designer can understand the user and get to know their characteristics and thereby design the best fitted interface for the specific group of users (Mayhew, 1999).

The user research can either be quantitative or qualitative. According to Goodwin (2009) it is recommended to use a qualitative approach through user interviews and observations when conducting user research, in order to gain this understanding of the user.

3.2.2.1 Interview

In the user research, Goodwin (2009) recommends a minimum of four interviews per role if the role is specialized, like it usually is in business environments. Further, the number should be adjusted depending on factors that can diverse the roles, like industry and culture. Goodwin (2009) also recommends that the user interviews are conducted in the context in which the product is intended to be used. The context and the items in it will help the interviewee to remember correctly and to be more specified and detailed when answering questions.

Figure 3.1: The process of developing the prototype.
To be able to really understand the interviewee and to not only get answers on the questions asked, Goodwin (2009) presents some principles for an interview. First, it is important to ask open questions to make the interview a conversation and not an interrogation. It is furthermore vital to be considerate and a receptive listener, taking into account nonverbal cues. The interviewer should also preferably not ask leading questions or ask about solutions if this is not found to be absolutely necessary. In such a case, the recommendations are to ask these questions last, in order to enable for the subjects to naturally come up earlier during the interview (Goodwin, 2009). Furthermore Saffer (2010) presents the technique ”Directed storytelling”, which means that the interviewee is asked to tell stories about a specific experience or action. This can be about the first time they performed an action or the latest time they performed it. In a business environment it also works well to ask the interviewee what a typical workday is like by asking for a description of what happened yesterday (Goodwin, 2009).

3.2.2.2 Observation

To understand the work process and the user needs, observation can be used (Goodwin, 2009). Saffer (2010) presents the technique ”Fly on the wall” which means that the observer goes to a location and observes what happens there and what actions are taken, in obscurity without disturbing the process. It is important to blend into the environment so the subject being observed notice the observation as little as possible, and thus behave as normal. This can be done by for example using clothes and props that fits the environment and by using a camera phone instead of a system camera (Saffer, 2010).

3.2.3 Modeling

After the research is finished, the next step is to analyze the results to model it into a description or a visualization to facilitate an understanding about the observed behavior. First, the stakeholder findings should be analyzed to later on enable a use of this information to see the overlap between this and the user data. It is also useful in order to get knowledge about constraints that needs to be taken into account (Goodwin, 2009).

Further on, the user data should be analyzed. Goodwin (2009) presents a way to do this:

1. The first step is to perform a single-case analysis (Goodwin, 2009) to understand the data by looking at the gathered information from one individual at a time. The important question to be answered here is why the interviewees behave and think like they do, not only what explicitly has been said during the interviews. This question can be answered through organizing the data by adding code words for each
comment and sort it into categories such as goals, skills, frustration, priority, demographics etcetera.

2. Next, a cross-case analysis (Goodwin, 2009) is performed which has the goal of identifying behavior patterns from the user data. This can be done either by comparing the answers of each interview question with each other or by finding out what is similar between different interviewee’s behaviors.

3. In the final step meaning is drawn from the data by finding out what relationships exists between different behaviors. This step also includes comparing the interviewee answers with the observation, to ensure the correctness in the statements (Goodwin, 2009).

### 3.2.3.1 Personas

A persona is an archetype that uses storytelling to describe the goals and behavior patterns observed among the users. This way the involved designers, stakeholders and programmers can be engaged socially and emotionally. Through this they can be able to develop a suitable design and verify that it fits the user needs. Each persona represents a user type and the description of the persona includes a name and a photo, goals, attitudes, skills and other factors that affect the persona’s behavior pattern. Some fictitious details are recommended to be added as well to make the persona seem like a human (Goodwin, 2009).

The number of personas needed depends on the data. Adlin and Pruitt (2006) present three general guidelines in deciding an appropriate set of personas. First, the set of personas should be relevant to the product as well as to the business goals. Further, the personas should be based on the collected data and finally the personas should be engaging and enlightening throughout the product development (Adlin and Pruitt, 2006).

Goodwin (2009) presents a process of nine steps for developing the set of personas:

1. In the first step different user roles are defined based on what tasks the interviewees perform as well as on their business roles. Each interviewee is then assigned one of these roles.

2. The second step includes identifying what behavioral variables distinguishing the interviewees from each other, for example goals and task frequency. Further, demographic variables like environment, gender and age are identified as well. Often the variables can be presented as a continuum, but the ones that are difficult to express in that way can instead be presented as a multiple-choice. The number of variables recommended by Goodwin (2009) is around 20. The scales should be drawn on for example a big white-board in order to easily be able to make changes when they further are used in the following two steps.
3. In the third step the interviewees is placed on the variable scales from step two. Based on the interviewee data, the respondents are placed relative to the others on each continuum scale and on the most suitable choice on the multiple-choice scales.

4. In the fourth step, behavior patterns among the respondents should be identified. This is done by circling the two or more interviewees that most frequently show up together in the variables. They can be considered a pattern if they occur together or close to each other in at least one third of the scales. Further, the relationships between the different variables should be tried to be explained. This should be repeated until the majority of the interviewees are circled. Then a temporary description of each group of interviewees should be written to define a set of prototype personas.

5. The fifth step includes defining goals for the prototype personas. At least one goal per prototype persona should be clear based on the third step. It is recommended by Goodwin (2009) to have three or four goals total per persona and the rest of the goals can be retrieved from the interview notes. The goals should be expressed in the way the persona would phrase it and be short and memorable.

6. The sixth step in the process is to add details to the prototype personas as well as sharpening the descriptions to make them more real and memorable. This includes information like behavior, demographics, skills, feelings and frustrations.

7. The seventh step is in the best case not needed, but may be necessary in order to satisfy the stakeholders’ assumptions and requests. In that case this step includes adding additional personas to convince the stakeholders in different ways.

Figure 3.2: The nine steps in persona development.
8. In the eight step one persona is set as primary and the others as secondary in order to know which persona’s needs to prioritize over the other’s. The primary persona should be chosen based on that if a product is designed for this persona, the rest of the personas would be partially or mostly satisfied.

9. In the ninth and final step a story for each persona should be developed based on the earlier defined information. This is to make the persona seem as human as possible and to invoke empathy in the designers. The goals are recommended to both be included in the story and to be clearly defined in the end of the persona description. Everything in the persona should be described in a way the persona would describe it. A photo of the persona should be attached as well in order of making the persona even more real. This is preferably a photo of a person’s face and it is important that it fits well with the persona description.

3.2.4 Requirements

To be able to know what the product must do to fulfill the user needs, Goodwin (2009) recommends that requirements should be developed. Requirements specifies what the system must be able to perform and can be later on be used to prove whether the product does what it should or not (Torkar et al., 2012). Most of the requirements are based on scenarios, but other information about the personas like environment, skills and goals can also be used in order to develop a proper requirement list. The requirements regarding time and money spent on the project as well as what value the product should bring to the business can be derived from the stakeholders (Goodwin, 2009).

3.2.4.1 Scenarios

A scenario is a story created to understand an aspect of the use of the product. It is usually presented either in plain text or in a storyboard. The story is based on the research data but contains assumptions as well. It is recommended to create the scenario around a persona to make the scenario authentic (Stickdorn and Schneider, 2011). In the requirements definition process context scenarios are used. Context scenarios are a specific type of scenarios that are optimistic with a low level of detail presenting situations that can happen and the ideal system behavior for it, without including explicit solutions. The interaction between the system and the persona in one or more tasks is described from beginning to end. The parts of the system visible for the persona are described along with the persona’s actions and behaviors and their motivations for them. It also shows which persona goals that are fulfilled by the system (Goodwin, 2009).

The development of the context scenarios are based on the situations and tasks the personas can experience. The scenarios should further de-
scribe the process the persona is going through when completing the task without specifying which specific tools are being used. When the scenarios are developed, requirements can be extracted by dividing the story into smaller parts and looking for each thing the system must be able to do in order for the scenario to work (Goodwin, 2009).

3.2.5 Prototyping

The next step in the developing process is to visualize the solutions. The focus should initially be on structure, not on details. A good way to start is by sketching proposals for the logic and the basic design, based on previous research (Goodwin, 2009).

According to Pfleeger (2001) a prototype can be used to demonstrate a design and approach as well as the feasibility of it. The prototype development is often iterative using both user and stakeholder feedback to alter the prototype versions. Prototypes in software engineering are built before the design is decided and are used in further development (Pfleeger, 2001).

Goodwin (2009) recommends the use of either low-fidelity or high-fidelity prototyping which is followed by performing user tests with the developed prototype.

3.2.6 Usability Testing

Barnum (2011, p. 6) defines usability testing as:

"The process of learning about users from users by observing them using a product to accomplish specific goals of interest to them”.

The focus of a usability test should not be on the product but on the user, emphasizing that it is the product that is under test, not the user (Rettig, 1994). This leads to an understanding of what the user needs and if the prototype tested works for the user. It clarifies whether the design fulfills the users’ needs and expectations as well as if it supports the user goals or not (Barnum, 2011).

Rettig (1994) recommends that the tests are based on test scenarios, where the user taking the test is told to solve a typical work situation using the prototype. The prototype should be designed to support the scenarios and does not have to be fully completed with all possible functions included (Rettig, 1994).

3.2.6.1 System Usability Scale

The System Usability Scale (SUS) is a scale for measuring usability when a user test has been performed. It was developed in order for the industry to have a quick and simple way of getting a subjective assessment of usability on the tested product. It has ten statements which are graded by the test
person in a form on the scale one to five between “Strongly disagree” to “Strongly agree” (Brooke, 1996):

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I think that I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most people would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

(Brooke, 1996, p. 4)

Based on the answers, the SUS score is calculated. The score can be from 0 to 100 where 100 is the best result. The scores are calculated as following:

- For items with odd numbers, the score is the scale position subtracted with one.
- For items with even numbers, the score is five subtracted with the scale position.
- The scores for each item are then added together and the sum is multiplied with 2.5. This result is the total SUS score.

(Brooke, 1996)

In order to analyze how positive or negative a SUS score is, Bangor, Kortum and Miller (2009) presents a scale of adjectives with their counterpart in SUS score:
### Adjective SUS Score

<table>
<thead>
<tr>
<th>Adjective</th>
<th>SUS Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worst imaginable</td>
<td>12.5</td>
</tr>
<tr>
<td>Awful</td>
<td>20.3</td>
</tr>
<tr>
<td>Poor</td>
<td>35.7</td>
</tr>
<tr>
<td>OK</td>
<td>50.9</td>
</tr>
<tr>
<td>Good</td>
<td>71.4</td>
</tr>
<tr>
<td>Excellent</td>
<td>85.5</td>
</tr>
<tr>
<td>Best imaginable</td>
<td>90.0</td>
</tr>
</tbody>
</table>

(Bangor, Kortum and Miller, 2009, p. 118)

To further clarify the meaning of the scores, Bangor, Kortum and Miller (2009) also have a grading scale based on the SUS scores:

<table>
<thead>
<tr>
<th>Grade</th>
<th>SUS score</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>0-59</td>
</tr>
<tr>
<td>D</td>
<td>60-69</td>
</tr>
<tr>
<td>C</td>
<td>70-79</td>
</tr>
<tr>
<td>B</td>
<td>80-89</td>
</tr>
<tr>
<td>A</td>
<td>90-100</td>
</tr>
</tbody>
</table>

(Bangor, Kortum and Miller, 2009, p. 121)

Finstad (2006) recommends that the questions are translated to the user’s native language to facilitate the user in filling out the form and to avoid misunderstandings.

### 3.2.7 Low-Fidelity Prototyping

A low-fidelity prototype is a simple, incomplete and sketchy prototype which is easy to construct and modify in order to test different broad concepts (Usability First, 2013).

It is recommended by Rettig (1994) to begin prototyping with a low-fidelity model in paper and test this instead of coding a real application directly. Using this approach the behavior of the interface can be demonstrated and tested early in the development process, which is both money saving and effective. It also allows more ideas to be tested.

Rettig (1994) recommends that the construction of the low-fidelity prototype starts with collecting material that inspires the creative process like different kinds of paper, colored pens and pencils, tape and scissors. Further a relatively tight deadline should be set in order to be forced to quick imaginative solutions instead of having the ability to be too detailed in the work. The prototype should not be an illustration but an interactive model, with the focus of being able to move around the different screens, menus and text boxes during the user tests (Retting, 1994).
3.2. DESIGN METHOD FOR THE CASE STUDY

3.2.7.1 Low-Fidelity Prototype Testing

According to Rettig (1994) four roles in addition to the user are involved in testing a low-fidelity prototype: greeter, facilitator, ”computer” and observer. The greeter role is responsible for welcoming the user and making sure forms are filled out. The facilitator is in charge of over the test, giving instructions to the user and making sure the user express what he or she thinks during the test. The ”computer” has expertise about the system’s logic and acts like a computer by acting out the choices the user is making. The observer observes the test and takes notes (Rettig, 1994).

3.2.8 High-Fidelity Prototyping

A high-fidelity prototype is a prototype constructed like a preliminary version of the final product interface, with the design close to the final one (Montero and López-Jaquero, 2006). It should be more realistic than a low-fidelity prototype, but can still be produced without having to make a large investment. It still allows for changes to make but makes the designer having to think through the product more than when using a low-fidelity prototype. The high-fidelity prototype is an interactive description the functionality and design of the product well suited for demonstration of the system for stakeholders as well as for user testing. It further reduces the time going from prototype to final product compared to if using a low-fidelity prototype. This because of that the high-fidelity prototype is more clearly defined than the low-fidelity prototype and that many problems have already been mandatory to solve during the implementation (Cagan, 2008). There are a number of tools available for fast development of prototypes available. It is recommended that these tools have an adequate abstract level so that the focus is not too much on the look and feel but primarily on the functions (Montero and López-Jaquero, 2006).

3.2.8.1 High-Fidelity Prototype Testing

According to Barnum (2011) the same roles are involved in the high-fidelity testing as in the low-fidelity testing, except for the ”computer” role that may not be needed depending on what tool is used.
Chapter 4

Case Study

This chapter presents the conducted case study. This includes case background, the prototype development process and additional interviews. Chapter four also presents the final design delivered to Toyota.

4.1 Case Background

Sigma AB is an IT consulting firm that is divided into two business areas; IT & Management and Information Logistics. The company has about 1600 employees in eight countries with the base in Scandinavia (Sigma, 2013). The study is conducted at Sigma IT & Management Östergötland, which have about 30 employees (Ståhl, 2013).

Toyota Material Handling Group and specifically the part of the company located in Mjölby is one of Sigma’s customers and is the largest supplier of forklifts in the world. The company also provides additional services like technical support, spare parts supply, driver training, rentals and an online platform, Toyota I_Site, for fleet management (Toyota, 2013).

In order to make I_Site more accessible and efficient, a mobile application connected to it is about to be developed (Manager Concept Development Toyota, 2013). This project has been examined in the conducted study.

4.1.1 Toyota I_Site

Toyota I_Site can be used by fleet and logistic managers in order to support management at one or multiple sites. It is available online for the forklift purchasers for a monthly fee. An overview dashboard shows user customized real-time information placed in up to nine tiles. By clicking on the tiles more detailed information can be reached (Toyota I_Site brochure, 2013). The tiles can contain information from one or multiple sites about:

- *Contract monitoring* - How much a forklift has been driven compared to the contracted time. This can result in an improved control of
costs through having contracts matching the actual utilization (Toyota I_Site brochure, 2013).

- **Utilization** - The utilization rate for drivers or forklifts. This can support managers in planning and optimize schedule and fleet size (Toyota I_Site brochure, 2013).

- **Battery status** - Shows status of the forklift batteries and thereby support the charging cycles. This leads to an increased life length of batteries and machines (Toyota I_Site brochure, 2013).

- **Shocks** - Presents the number of shocks (forklift collisions with other forklifts or something in the environment) that have occurred at different severity levels as numbers or a graph. This gives guidance about which drivers need more training and which machines need a control as well as giving an indication about problems in the environment. The levels used to define the severity of the occurred shocks are green (low), yellow (medium) and red (high) (Toyota I_Site brochure, 2013).

- **Pre-operational check** - In some countries, certain security controls are mandatory to perform before operating a forklift. In these cases and otherwise when management finds it necessary, a checklist with things to control can be established, containing critical and less critical points (Product Manager Toyota, 2013).

Figure 4.1: Example of the overview dashboard.
4.2 Prototype Development Process

This section presents the conducted prototype development process, using Goodwin’s (2009) method.

4.2.1 Stakeholder Research

The stakeholder research was conducted in two rather informal meetings early in the study. Attending the meetings were the Concept Development Manager and the Product Manager at the Logistic Solutions & Development department and the Department Manager for IT Products at the Information Systems department at Toyota. These meetings were primarily about the basic premises such as that the product should be a mobile application used as a complement to the existing implementation on computers and to set deadlines. The stakeholders emphasized further that usability and to fulfill the users’ needs was important for them and that the product should have a high level of quality and appearance. A global focus was seen as important in the development as well.

4.2.2 User Research

In order to understand the potential users’ work situation as well as their thoughts and experiences of the existing platform, a qualitative user research has been conducted. The research methods used was primary interviews but also observations to some extent.

4.2.2.1 Interview

The interviews conducted were semi-structured with a number of open questions prepared in advance. A semi-structured interview was considered suitable for the purpose of getting a deep understanding of the user’s situation and thoughts, through having a dialog but at the same time focusing on specific topics. The English version of the questions can be found in Appendix A.

Five interviews were held at five different companies using I_Site today. Because of the difference between the companies, a higher number of interviews would have been desirable, but due to time constraints and Toyota not being able to get in contact with more users, the number was limited to five.

Two interviews were held in Sweden in person at the site were the interviewee was working, thus following Goodwin’s (2009) recommendations. The remaining three interviews were conducted by phone. One of them was held in Swedish and two of them in English with users in Denmark and Spain. These three users were seen as important for Toyota and their location was the reason for not conducting the interviews in person. Their importance to the customer and their experience with the existing platform
4.2. PROTOTYPE DEVELOPMENT PROCESS

was seen as more important than the possibility to perform the interviews in person at the site. Since the stakeholders emphasized the importance of thinking globally when developing the product, it was further important to interview not only Swedish users.

The main question in the interviews were ”Tell me about yesterday, what did you do?” based on the ”Directed storytelling” technique. The interviews also centered on personal and company background, tasks, the usage of the platform and potential areas of improvement through the application. The interviews took half an hour to an hour to complete, depending on the answers and possible following questions. They were documented using notes and recording equipment, which made it possible to listen through the recording afterwards and summarize it for future analysis. The questions used can be found in Appendix A.

4.2.2.2 Observation

Since the users interviewed at the sites did not use the platform more than a couple of hours a week at a maximum, an observation of the usage was not considered useful or feasible. Instead, the observation consisted of studying the site environment in order to understand the business generally and was held after each personal interview was finished. The method ”Fly on the wall” was used, in combination with some explanations about the work from the person earlier interviewed.

4.2.3 Modeling

In the modeling process, the first step was to sort the summarized interview data for each interview by a number of headlines based on the questions asked. This because of the fact that the answers given were overlapping each other. Each interview was then analyzed using a single-case analysis by coding the answers with important code words. The coding was then summarized in categories like goals, frustrations, interaction with others and frequency. In the cross-case analysis between all interview data, the data of each headline was compared to each other instead of basing the comparison on the actual questions. Behavior patterns and relationships between behaviors was identified and in the relevant cases compared to the performed observation.

4.2.3.1 Personas

In the creation of personas, the nine steps in Goodwin’s (2009) process was followed. Step seven; if necessary add additional personas, was not considered necessary and was therefore not performed.

Two user roles were defined. One role were responsible for only one site, which he was located on. The other role had the overall responsibility for multiple sites. Further, 18 behavioral variables was identified:
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Behavioral Variable

<table>
<thead>
<tr>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency for using the platform:</td>
</tr>
<tr>
<td>Daily - Once/month</td>
</tr>
<tr>
<td>Number of machines connected to the platform:</td>
</tr>
<tr>
<td>5 - 300</td>
</tr>
<tr>
<td>Importance of safety:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Importance of cost reduction:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Importance of control of drivers:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Importance of where to put the machines:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Importance of managing the fleet/utilization:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Importance of efficiency:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Importance of direct communication with drivers:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Importance of control overall:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Importance of control/structure for drivers:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Using shock function:</td>
</tr>
<tr>
<td>Not at all - A lot</td>
</tr>
<tr>
<td>Using the platform outside the office:</td>
</tr>
<tr>
<td>Not at all - A lot</td>
</tr>
<tr>
<td>Prevention safety work:</td>
</tr>
<tr>
<td>Not at all - A lot</td>
</tr>
<tr>
<td>Views work perceived unnecessary:</td>
</tr>
<tr>
<td>Does not matter - Avoid totally</td>
</tr>
<tr>
<td>Comfortable with technology:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Open for new inventions:</td>
</tr>
<tr>
<td>Low - High</td>
</tr>
<tr>
<td>Age:</td>
</tr>
<tr>
<td>20 - 60</td>
</tr>
</tbody>
</table>

The placement of the interviewees on the scales and the following circling of answers in patterns led to an identification of three groups. One group was connected to the overall responsible user and the remaining two to the user responsible for one site. The first group resulted in the persona Christoph Amsel and the other two in Anders Fors and Simon Sjövall. The persona descriptions can be found in Appendix B. Based on the interviewee data, three personas was considered the right amount in order to cover the different user goals. The primary difference between the personas responsible for one site was if he had his focus on safety issues or not. This seemed to have a significant importance in order of what his focus was and which tasks were performed.

According to the stakeholders the application should be a complement to the existing implementation used on a computer. Therefore the primary user group for the application should be users who spend or want to spend a majority of their time out of the office, thus the Anders Fors or Simon Sjövall persona. Since a fulfillment of Anders Fors’ goals would lead to the other personas becoming mostly satisfied, Anders Fors was chosen as the primary persona. Because of the minimum benefit that Christoph would gain from using the platform in an application instead of on the computer, his goals will be seen as the least important in the development process.
4.2.4 Requirements

Based on the persona descriptions, four scenarios where developed in which the persona was performing a commonly occurring task. The scenarios covers four of the most commonly performed tasks where the application could be useful. The scenarios can be found in Appendix C. This together with the interview data and the stakeholder research resulted in a list of 22 requirements. These can be found in Appendix D.

4.2.5 Prototyping

In Goodwin’s (2009) method, a gap between the requirements and the visualization of the product using prototyping exists. Therefore the step between them was improvised. This step included studying the requirements and analyzing how they could be satisfied in the application through as few functions as possible. This led to the concept of having four major functions reachable from the start screen, including presentation of level red shocks, pre-operational check fails, latest drives and driver PIN codes. Also a settings function was included in the concept, which enables the possibility to chose which sites and functions to show in the application along with the possibility to change notification settings.

When the needed functions were identified the visualization of the solutions was done through a phase of sketching of the possible screens and the logic behind it, as Goodwin (2009) recommends. The goal was to fulfill the requirements as well as use the existing platform for inspiration.

Since the work was done alone without much feedback on the design, the choice was made to first make a low-fidelity prototype in order to get feedback from colleagues about the structure and basic layout. Then, after a redesigning phase, a high-fidelity prototype was developed, which was a suitable deliverable to Toyota.

4.2.6 Usability Testing

In the usability tests, five test scenarios were used. The scenarios were developed based on the four context scenarios and the low-fidelity prototype. These were typical work assignments with clear goals and were used in both the low-fidelity and the high-fidelity tests. The test scenarios can be found in Appendix E.

4.2.6.1 System Usability Scale

After each test, the test person was to fill out the system usability scale form. The reason for using it in this project was to be able to evaluate the prototypes based on the existing scales as well as enable a comparison between the low-fidelity and high-fidelity prototypes.
All the test persons had Swedish as their native language, therefore the questions in the SUS form were translated to Swedish, as recommended by Finstad (2006).

### 4.2.7 Low-fidelity Prototyping

Based on the sketches made the final prototype was crafted using printed frames on paper, colored pens and pencils, tape, scissors and plastic foam. The prototype layout was similar to the existing platform, especially regarding colors, shapes and symbols. The low-fidelity prototype and reasons for specific design choices are presented in the figures below (the requirements referred to can be found in Appendix D):

- **Figure 4.2:**
  - *Requirement 6* - Looks similar to the existing L.Site design. The prototype has the same colors and the same icons when possible as L.Site. The square shapes and the application head is also similar to L.Site.
  - *Requirement 23* - Have only a few functions, the most important ones to have on the warehouse floor.
  - *Requirement 22* - The icons can be removed or added through settings.
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- Red icon → Fig. 4.3 (a)
- Blue icon → Fig. 4.5 (a)
- Grey icon → Fig. 4.6 (a)
- Yellow icon → Fig. 4.7 (a)

![Figure 4.3](image)

(a) Red Shock Alert  (b) Pre-operational Check Fail Alert

**Figure 4.3**

- **Figure 4.3 (a):**
  - *Requirement 9, 10* - Alarm when a red shock has occurred. Use standard alarm function in the phone, showing this box not only in the application.
  - Easily get more information by clicking on ”View” (→ Fig. 4.4 (b)).
  - *Requirement 11* - Show which machine and driver are involved in the shock in order to quickly find the location.

- **Figure 4.3 (b):**
  - *Requirement 12, 13* - Alarm when a pre-operational check has failed. Use standard alarm function in the phone, showing this box not only in the application.
  - Easily get more information by clicking on ”View” (→ Fig. 4.5 (b)).
  - *Requirement 14* - Show which machine and driver are involved in the pre-operational fail in order to quickly find the location.
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(a) Shocks Screen 1

(b) Shocks Screen 2

Figure 4.4

- **Figure 4.4 (a):**
  - *Requirement 6* - List looks similar to the existing I_Site design.
  - Easily get more information by clicking in the list (→ Fig. 4.4 (b)).
  - Be able to view the five latest level red shocks in retrospect.

- **Figure 4.4 (b):**
  - Display detailed info valuable on the warehouse floor about shocks.
4.2. PROTOTYPE DEVELOPMENT PROCESS

(a) Pre-operational Check Fail Screen 1

(b) Pre-operational Check Fail Screen 2

Figure 4.5

- **Figure 4.5 (a):**
  - Requirement 6 - List looks similar to the existing I.Site design.
  - Easily get more information by clicking in the list (→ Fig. 4.5 (b)).
  - Be able to view the five latest pre-operational check fails in retrospect.

- **Figure 4.5 (b):**
  - Display detailed info valuable on the warehouse floor about the pre-operational check fail.
(a) Latest Drives Screen 1  (b) Latest Drives Machine

Figure 4.6

- **Figure 4.6 (a):**
  - *Requirement 15* - Offer the ability to search for a specific driver.
  - *Requirement 17* - Offer the ability to search for a specific machine.

- **Figure 4.6 (b):**
  - *Requirement 18* - Display which driver was the last one to login on the machine.
  - *Requirement 21* - Display the latest drivers of the machine in order.
  - *Requirement 20* - A similar screen fulfills this requirement by showing the latest machines driven by a specific driver.
4.2. PROTOTYPE DEVELOPMENT PROCESS

4.2.7.1 Low-fidelity Prototype Testing

The next step to perform was to test the low-fidelity prototype. The first idea was to test it on end-users but because of the difficulty of getting in contact with them the plan was changed. The prototype was instead tested on three colleagues at Sigma, primarily to test the logic and the new icons as well as getting an input from experienced developers. All the roles except for the user were taken by the researcher. To support the analyzing process after the test, a recording device was used and the users were told to clearly explain what they did. The test was then analyzed directly afterwards to combine the recording and the memorized observations.

All of the three participants solved all test scenarios. A few times the scenarios however were misinterpreted and a clarification was needed. About half of the test time the test persons took the shortest way to the goal, and

- **Figure 4.7 (a):**
  - Requirement 15 - Offer the ability to search for a specific driver.

- **Figure 4.7 (b):**
  - Requirement 16 - Display PIN code for a specific driver.
  - Requirement 19 - Offer the ability to change PIN codes.
the other half of the time they took a detour, often a short one. The biggest problem was the icons on the start screen that were not taken from the existing platform, due to that those functions now connected to them did not exist there. They were not clear and precise enough making the test persons unable of understanding the meaning of them. However, none of the test participants had a problem with the logic and one of them said "After having gotten over the learning threshold the application is really simple".

The calculated SUS-score based on the participants’ answers were 72.5, 77.5 and 92.5. In average that gives a score of 81 which can be translated to a strong "Good" or the grade B.

4.2.8 Stakeholder Feedback

Half-time through the project, a meeting was held with the stakeholders. The participants were the Concept Development Manager and the Product Manager at the Logistic Solutions & Development department at Toyota along with one of the developers responsible for the further development of the application at Toyota. This meeting was held to check that the stakeholders accepted the design and to make sure that the planned functions were able to be developed technically. During this meeting the user research along with the low-fidelity prototype was presented. The stakeholders accepted the solution with only one minor change, to expand the amount of driver information in the application. This change did not interfere with the personas’ needs and was therefore applied on the high-fidelity prototype.

4.2.9 Redesign

Based on the low-fidelity prototype tests and stakeholder feedback, some redesign was made before the creation of the high-fidelity prototype. This was in line with Goodwin’s (2009) recommendation of iterating during the prototype development phase. The main redesign concerned a supplementation of the PIN-code function to instead be a driver info function, where it besides viewing and changing PIN was possible to view which forklift each driver had the permission to drive. This to satisfy stakeholder requests which was possible to do without affecting the personas’ experience negatively. Therefore, a requirement about that the product should be able to show which machines each driver is allowed to drive was added.

Further, because of the test results a redesign of the icons for the latest drives and PIN-code functions were considered needed. Since the PIN-code function were altered, that icon were changed to represent driver info instead. The icon of the latest driver function were clarified through adding a picture of a list to the existing clock image. Complementary information text on all of the start menu icons were also added for clarification of there meaning.

To be able to try out the alert messages, two preliminary buttons for open the alert dialogs were added. Finally, title information about each
page were put in the header along with a change of header color depending on which start menu button were pushed. This was in order to know were in the application the user is located and also to save space.

4.2.10 High-fidelity Prototyping

The high-fidelity prototype was created as a web page suited for iPhone 4s. It was implemented using Jquery, JavaScript, HTML5 and CSS in the JQuery Mobile Framework. The high-fidelity prototype is presented below. Also a few screen-shots of the existing platform are presented, in order to enabling comparison and show the similarities between I_Site and the prototype.

![Start Screen in the high-fidelity prototype compared to the Start Screen in I_Site.](image)

Figure 4.8: Start Screen in the high-fidelity prototype compared to the Start Screen in I_Site.
Figure 4.9: Latest Level Red Shocks screen in the high-fidelity prototype compared to Shocks Screen in I_Site
4.2. PROTOTYPE DEVELOPMENT PROCESS

Figure 4.10: Info about a shock in the high-fidelity prototype compared to the info in I_Site.

Figure 4.11: Latest Drives screen 1
Figure 4.12: Latest Drives screen 2

Figure 4.13: Driver Info screen 1 (Showing the possibility to search for names)
4.2.10.1 High-fidelity Prototype Testing

The high-fidelity prototype user tests were conducted in the same way as the low-fidelity prototype tests except that the user did not need to have assistance from the ”computer” role here. Instead the prototype were tested on an iPhone 4s mobile device. Three tests were performed, one on a potential end user and two on employees at Toyota. All of the test scenarios were solved quickly by all test persons. Four out of five scenarios were solved without any detours but the remaining one involved a few more clicks than necessary. This scenario however regarded the settings, a function not so frequently used, and therefore it was found to not be a major problem.

The result from the SUS answers were 77.5, 92.5 and 92.5 which in average is a score of 87.5. This is an improvement from the low-fidelity prototype test result and the new score can be translated into ”Excellent” or a strong grade B.

4.3 Additional Interviews

In order to understand how a consulting firm works with usability and to get the developer’s views on the subject, four interviews were conducted with developers at Sigma. These four interviewees all have the role of software developers and are not specialized in usability work. This data was an important part of the case study to enable triangulation and to get a broader understanding of how usability could be integrated in the development process. The interviews were semi-structured to facilitate the analysis and comparison between the collected data while obtaining the deeper un-
derstanding. The interviews were held in Swedish but the questions have been translated to English and can be found in Appendix F.

According to the interviews, the level of focus on usability matters varies a lot between projects. It is most common that the customers are not willing to pay anything extra for usability matters, leading to only general requirements like "The system should be usable". According to one interviewee, customers often request a usability focus because of that they think it is a modern word or a seal of quality, but that this would not have any true significance if it is not decided how to work to accomplish usability. In addition, time and money are needed in order to develop a system with a real usability focus.

In contrast to some of the theory about usability in companies, all the interviewed developers considered usability to be a really important matter when developing a system. This to such an extent that they often when possible added a user focus in the system on their own, mainly based on best practice and previous experiences. The developers seemed interested in how to make the systems more usable although none of the developers had actually worked with any explicit methods like personas or context scenarios in the projects. Methods used for getting to know what the customer wants could instead be for example workshops with experts from the customers or by getting a complete requirement list from the customer. The actual potential end users are rarely involved in this process, but if they are, they are involved really early in the development process, before anything is implemented. Then they are not involved during the implementation, but can be involved after the release in the tests of bug fixes and other minor issues. These tests of the final product is quite common, but in most cases the tests of the final product is only an acceptance test where the customer tests the product in order to see if the requirements are fulfilled. In these cases the end users are not involved.

Two of the interviewees had worked in a project were an external consulting firm specialized on usability issues were involved. That company was responsible for conducting user studies and for designing the interface. Sigma’s role was thereafter to implement the designed interface. The customer were responsible for this distribution of responsibilities and once the design of the interface was handed to Sigma, the external firm had finished their task and the contact between them and Sigma was limited. Instead Sigma went directly to the customer when needing clarification etcetera.

Overall, different projects have varying levels of usability focus, mainly dependent on the customers attitude to such issues. The developers interviewed emphasizes that Sigma in general seems to have a high focus on those matters, within the limits set by the money the customers wants to spend on this. Finally, Sigma has not that much contact with the end users but the more with representatives from the customer, making it especially important that the customer representatives know what the end users want and need.
Chapter 5

Result & Analysis

This chapter presents the result and analysis of the study. It is divided into three main themes: customers, users and consulting firm, which are the three parties involved when a consulting firm develops a usable system ordered by a customer. Further, each theme presents a discussion about specific topics discovered in the study together with relevant examples from the results. Finally, the synergy between the results and the analysis is presented, followed by the recommended framework.

5.1 Customers

This theme presents the results and analysis connected to the customers.

5.1.1 Usability in the Projects

As an answer to the question "How much priority does usability have in the development processes at Sigma?”, one of the interviewees at Sigma said: "Not much, not much at all".

According to the interviewees, the customer decides whether there should be a focus on usability issues or not. As one of the interviewees at Sigma explained it: "The customer decides how much focus there should be on usability". As presented earlier, the theory says that most companies perceives usability being an important matter, but that refers to software developing companies in general, not their customers (Bygstad, Ghinea and Brevik, 2008). Further, Høegh (2007) explains that the lack of focus on usability is due to that key persons do not understand the potential value in a usability investment. In the case of a customer ordering a product from a consulting firm, such a key person could be the customer. This lack of understanding was confirmed by one of the interviewees at Sigma: "Most customers do not understand the value of it [usability]. More focus ought to be put on usability
since the users only see the graphic parts and think that the graphics, and not what is underneath, is the application”.

Since the customer orders and pays for a service from the consulting firm, the aspect of money is vital. As previously mentioned in the theoretical framework, companies are often not willing to spend money on usability, especially not if they do not know the possible revenue of such an investment. This is particularly true for projects with strong time and cost limitations (Bygstad, Ghinea and Brevik, 2008), which is the case for most of Sigma’s projects. According to one of the interviewees at Sigma: ”Most of the time the schedule is so tight that usability is not prioritized”.

The project conducted at Toyota did not demand any monetary investments from Toyota. When comparing this project to other projects conducted by Sigma at other customers at the same time, it is assumed that the amount of time the development of the prototype required was about more than half the time that normally would be available for the whole project. In a normal case, a final product would have been delivered using not much more time than the time spent on the conducted project. The approach used in the conducted project would thus not be possible to use to its full extent in a real project where a monetary investment is required.

The tight money and time limitations together with the customer’s lack of knowledge about the value of usability leads to unwillingness to invest in such issues. Because the customer is in charge of deciding what to focus on in a project, these issues will not be prioritized. In order to enable usability to be integrated in the development an investment in usability issues from the customer is needed. For this to happen, the customer needs to know the revenue usability work can result in.

5.1.2 Requests

The customer’s requests are the primary ones for the consulting company to fulfill in order to satisfy the customer. One of the interviewees at Sigma explained it: “In general, Sigma as a consulting firm aims to satisfy the unique requests of their customers as much as possible”. The important thing is not to explicitly fulfill all the explicit requests but to make the customers feel that their requests have been fulfilled. At Sigma, the requests are forwarded from the customer through, for example, a complete list of requirements, workshops, discussions between the customer and the consulting firm or interviews.

The procedure of clarifying the customer’s requests in the project was conducted through discussions at the informal meetings in the initial development process. The identified requests were later added to the list of requirements. Further, just over halfway through the process, a presentation of the concept and the low-fidelity prototype for the stakeholders were performed. They were mostly satisfied with the solution but also wanted to add the possibility to view which forklift each driver was allowed to drive.
This request was not seen as interfering with the users’ needs, therefore it was added to the requirements list. Finally, the final prototype was delivered to Toyota, where the customer were able to give their feedback about the work performed. The customer found the prototype satisfying and they felt that all of their requests had been fulfilled. They decided to show the prototype in its current condition at a forklift exhibition a few weeks later, which can be seen as a proof of their satisfaction with the prototype. In this project, the initial meetings together with the meeting half-time through was enough contact between Sigma and Toyota in order for the customer to be satisfied.

At the time of the delivery, the customer showed particularly strong interest and satisfaction about the specific parts they were involved in altering. This shows that because of the possibility of giving feedback half-way through and the resulting alteration of the prototype, the customer likely felt that they were involved during the process instead of just order an already finished product. The alteration was likely of more importance to the customer in perceiving they were involved than it was for the product as a whole. The importance of the customers’ or stakeholders’ sense of participation is also mentioned in Goodwin’s (2009) method when developing personas. In both cases, their perception of being involved is more important than the actual involvement in order to make them satisfied. This is important to take into consideration in order to achieve customer satisfaction. This can be done through performing a presentation of a prototype to the customer, as it was done in the performed project. This way, the customer are able to give feedback and thereby perceive that they are involved in the project and have the ability to influence the development process. However, it is important that this participation do not result in any negative impact for the users, making it important to compare the different solutions against each other.

According to one of the Sigma employee interviews: "In projects I have worked in, it have often been said that the project should focus on usability - but it has not been more specified than that. It is like it is a buzzword for the customer, they have heard that it is a seal of quality. But if the work with usability is not clear, it usually does not lead to any real results". In the project conducted, Toyota emphasized the importance of usability and of having a user focus. This was mentioned along with the fact that the application should have a high level of quality and appearance. This combination together with the interviewed developer’s experiences about usability being a only a buzzword, leads to the conclusion that their experiences are accurate here as well. However, the study did not include studying the customer’s views on usability nor demanding any monetary investments by Toyota. Therefore it is difficult to know how valuable usability really is perceived at Toyota.

Further one interviewee explains that general requirements is something used in every project and gives an example of how the requirements re-
garding usability could look: "We should develop a system. It should be developed from the users’ perspective and it should be usable". This together with earlier presented results implies that the customer usually do not have an understanding for what the word usability really means. Without a clear definition of what it means in the specified context, no results will come from it. Therefore, proper and detailed requirements about usability have to be developed in order to accomplish the wanted results. Because of the customer’s lack of knowledge about usability matters, these would preferably be developed in collaboration between the customer and the consulting firm.

Since requirements are something well known for the customer, it may be easier to motivate a further development of the requirements than to introduce a completely new method for increasing the level of usability. The introduction of more detailed requirements can also be motivated through the possibilities of being a basis for the consulting firm to prove that they actually have done their job right and lived up to the expectations. The detailed requirements could both include more general requirements such as the ability for the system to work for specific users in specific contexts, where it is clearly specified which users and which contexts the requirements refers to, but also - and maybe primarily - be derived from the user research if such a study has been made.

The recommendation for Sigma is to use the same approach as they do today when understanding the customer’s requests. During the development of the product, it is important to take the customer’s requests into consideration to make the customer satisfied but at the same time not letting it result in any negative impact for the users. Further, the recommended way to include their requests is to use requirements, as is already the case. The requirements about usability issues however have to be further developed to facilitate for the possibility of implementing them.

5.2 Users

In this theme the results and analysis connected to the users is presented.

5.2.1 User Requests

In the conducted project, the user research was primarily done through semi-structured interviews together with observations. However, the questions asked in the end of the interviews were leading ones in order to derive the users’ requests. Here the interviewees were asked to answer explicitly what they wanted in a portable solution. To ask leading questions about details or solutions is however not recommended in the theory, if not seen as absolutely necessary. In that case, those questions should be asked at the end of the interview so that it is possible for those subjects to occur earlier. This recommendation was followed in the conducted project. Since
Toyota already had told the interviewees about the reason for the study being researching for the development of a mobile application, the interviewees already had thought about this. It seemed necessary to ask the leading questions in order to not miss out on any ideas that the interviewees might have had. Another reason for asking leading questions was that the user research was not especially thorough whereas these questions was seen to be a simple and fast way to get additional data. An example of an explicit request from one of the interviewees was to be able to see and change the driver’s PIN codes down at the warehouse floor instead of having to go to an office computer.

In Goodwin’s (2009) method, leading questions are not recommended to be used. However, Goodwin’s (2009) approach contains more and deeper user research than what probably is possible to do in an environment of strict monetary and time limitations as in the case of a consulting firm’s work. Using leading questions can be a way to derive requests that could be overseen if the user study is not performed more thoroughly.

Since the users’ requests normally are not included to a larger extent in the goal-directed design approach, the conclusion drawn is that the user needs should be the main focus in the development process. The user requests should be included only when they do not interfere with the needs of the users. This was also the assumption used in the conducted project. As an example, the request of an alarm sounding when a level red shock had occurred was included since it was in line with the observed needs. The request of having the opportunity to add new drivers to the system through the application was not included due to the need for the application to be really simple, with only a few functions. The function of adding new users would have been far to complicated, demanding more than ten fields of information to be filled in for every new user.

In the project, it was further clear that not all users had the same explicit requests while the discovered needs were more generic between the users. The users’ requests can however be important to include in order to achieve user satisfaction. The explicit requests and expectations for a product can affect the satisfaction positively or negatively. Satisfaction is one of Nielsen’s (1993) five attributes for defining usability and is therefore important in order to achieve usability. Thus, the recommendation about requests versus needs is that the users’ needs are to be prioritized over their requests, but that the requests should be taken into consideration.

When performing user research, the recommendation is to, if needed, add some leading questions to the interviews, in order to derive the users’ request. These will later on be compared to the users’ needs. The requests will be included if they are relevant and not are interfering with the users’ needs. This to achieve satisfaction and to not miss out on any relevant data because of the depthless user research. It is however important to ask the leading questions at the end of the interview, to allow the subjects to arise naturally earlier in the interview.
5.2.2 User Needs

In Sigma’s projects today, the knowledge about what the users need usually only is derived from experts at the customer through, for example, workshops or a complete list of requirements. If the experts do not know what the users need, information about the users’ needs will not be brought to Sigma and the development team. This information will therefore not be implemented in the product. A recommended approach for Sigma is instead to have a direct contact with the users in order to know that the users’ needs are taken into consideration. How this can be done is presented below.

5.2.2.1 User Research

Besides being an important step in Goodwin’s (2009) method, user research can be seen as Gould and Lewis’s (1985) first principle of designing a usable system, which focuses on users and tasks in an early stage. In the project the user research consisted primarily of interviews and observations which mostly centered around getting an understanding of the users’ existing work processes. This corresponds to one of Mayhew’s (1999) factors to achieve usability, the characteristics of the users’ work environment and tasks. The interviews and observations were found to be a good way, since it revealed user needs not obvious from the beginning. It enabled the creation of a product solving the users’ problems and not only relying on the users’ requests or on what the customer thought the users needed. According to Goodwin (2009) the researchers can not only rely on what the user explicitly requests in order to know what the user needs. As mentioned earlier, it is possible to miss out on vital user needs if only focusing on what the users explicitly state they want and need. Therefore it is important to study the users’ needs on a deeper level than just asking them about what they want and need. An example from one of the interviews is the derived feeling and need to not do anything unnecessary, like going out at the warehouse floor from the office when it is not needed. This was probably nothing he would explicitly say, but nevertheless very important for him.

Another example is when one of the potential users interviewed at the site where he worked explained how he found it problematic to always be reachable by phone. He phrased it as: “Let me be a human sometimes”. Later on in the interview, the interviewee’s phone rang because a serious incident had occurred at the site. Because he was responsible for incidents at the site he had to run out immediately to check that no damage was done and that no one had been hurt. From this example the conclusion was drawn that although he did not want any extra devices and thought it was a problem to carry a phone with him all the time, he needed an alarm when an incident occurred. This discovery would not have been made if the interview was not conducted on the site, indicating the previous mentioned recommendation for conducting the interview at the right context being accurate.
Conducting interviews in the context where the product is intended to be used can however be time consuming and thus come with an extra cost. Even though the decision of conducting three of the interviews by phone was not a voluntary choice, those interviews was a good complement to the one conducted in the right context. They gave an expanded view in a fast and simple way. The phone interviews would however not have been especially useful without the initial interviews held at the sites, since the first ones gave more understanding of the users’ work and needs than the phone interviews. Therefore, if the project’s budget are tight or if the consulting firm finds it hard to give grounds for the extra investment user research entails, the recommendations are to combine interviews in the right context with interviews by phone.

The technique ”Directed storytelling”, explained before, was used in the interviews. This is an effective and simple method to use when wanting to understand the users’ work. This question resulted in for example information about a common problem at one of the sites which had occurred the day before; that many drivers left the forklifts at the wrong places. Based on that information and some follow-up questions, the need for knowing who had driven the machine last was derived. The ”Directed storytelling” technique is recommended to use because of its simplicity and of the results derived in the conducted project.

Observation was only used at the sites to get information about the work processes. They did not result in much information that the interviews could not deliver. If they had not been conducted in conjunction with the interviews, they would have been perceived as unnecessary and time consuming. However, since already being at the location, a small amount of extra time was needed, and therefore they were relatively valuable. If conducting observations in other projects, it is recommended to do so in conjunction with the interviews, otherwise it may not give enough value compared to the time set aside for it.

The recommended way to derive the users’ needs is to perform interviews in the right context and supplement it with interviews by phone. The main technique to use should be ”Directed Storytelling”, a simple and rewarding technique to collect data about the users’ needs. When on location, the interviews can be complemented with observation.

The user research is recommended to be rather depthless involving only a few users. This because it then can be motivated to the customer as a relatively cheap but rewarding method, giving valuable data to use in further work. Doing a depthless user research will however come with the risk of the research being uncertain and that vital user needs and requests will be missed out. It is also possible that a certain type of users are left out, leading to even more needs and requests being missed out on. Further, a depthless user research can not be generalized, leading to the product suiting the specific users studied, not the potential users in general. However, it is found to be better that it is ensured that the product suits specific users
than that it can not be ensured that it does not suit any users at all.

5.2.2.2 Modeling

In the project the modeling process started with analyzing the user study data in order to further understand the users’ needs and the reasons for their behaviors, goals and frustrations. During this phase, patterns where found in the data. One example of such a pattern is that the interviewees located at the companies’ headquarters had the main goal of decreasing costs. Another example is that interviewees lacking technical skills saw a direct contact with the drivers as important. Next, personas were developed in order to present the users’ needs properly. The analyze done and the personas developed was found to be a good way to present the needs and requests of the users. By performing such an analysis, a more general picture of the users was created than if only directly using the data from the user research. This leads to the product suiting the general potential user and not only those specific users involved in the research, increasing the level of usability.

Even though these steps were assessed to be a good way to go, it could be hard to give grounds for using it to a customer because of the amount of time needed for it. As mentioned before, the customer is usually not willing to spend any extra time or money on usability issues, especially not if they do not explicitly see the reward of it. The modeling phase does not result in a distinct visible outcome that is clear regarding how to use it in further work. Therefore it might be hard to motivate an investment of time and money in it to someone lacking knowledge in usability issues, as often the case for the customer.

The next step in the conducted process was to develop context scenarios. These clearly showed what was needed in order to satisfy the user and thereby achieve high usability. It was further easy to use the context scenarios as a base to ensure that the product fulfills all the identified user needs when the requirements were developed in the next step. Because of the distinct purpose of the scenarios it is assumed that the customer can see the value of using them. However, if the first steps in the modeling process, analyzing the user data and creating personas, are not used, a new way to go from the user research directly to the context scenarios has to be developed. This can maybe be done by using the potential users participating in the user research as personas and developing scenarios directly for them. However, it would likely not be such a thorough work when not taking all perspectives into account. This might lead to the product being developed for the explicit persons involved in the user research, not for users in general. Some types of users might be left out and the system could be designed for a too narrow group of users and only be suitable for them. Not using personas could also lead to less understanding and engagement for the users for designers, stakeholders and programmers, making them focusing less on the users. However, taking the limitations of time and money into consideration, excluding the modeling phase might be an acceptable approach. To
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base the scenarios directly on the user data, and thereby fit those specific users, is better than to not take the users into consideration at all.

The recommended way to go after performing user research is to directly develop context scenarios. Doing this it is easier to motivate it for the customer than if using modeling too, while keeping the clear way from the context scenarios to the development of requirements. However, it is important to keep in mind that this way might result in that the scenarios are developed for the specific users involved in the user research, not for the general potential user.

5.2.2.3 Prototyping and Tests

One of the interviewees at Sigma said: "It is not very common to develop prototypes, but they are useful for getting feedback so I think they ought to be used more". As mentioned before, according to Pfleeger (2001), prototypes can be used to get feedback on the product before the actual implementation. This is both money and time saving and also allows for more ideas to be tested out (Rettig, 1994). To know if the users’ needs and requests are fulfilled and if the product is usable it can be evaluated on users through tests of a prototype or of the finished product. This can be seen as Gould and Lewis’s (1985) second principle of design, which emphasizes the importance of prototypes and simulations when developing a usable system.

The phase of prototyping and testing was conducted in the project initially through developing a low-fidelity prototype and testing it on a number of colleagues at Sigma. Since testing was performed on colleagues rather than potential end users, the question of whether the system worked for the intended user group or not was not answered. Because of the possible differences between the potential end users’ and the test persons’ technical skills and earlier experiences, it is possible that the test results are not applicable on the intended user group. Therefore, the test results might not be suitable to use when defining if the system is usable for real users.

However, the test results can instead be used as an indication of the quality of the system logic and structure in general. The tests can be seen as a substitute for discussions and collaboration with colleagues in the project, which otherwise is recommended by Goodwin (2009) to use. Since the developers at Sigma according to the interviewees usually work in teams, discussion and collaboration between colleagues in a normal case would come natural. This leads to the recommendation to use discussions instead of using a low-fidelity prototype. Since collaborating is already an existing part of the process, adding the element of discussing usability would require none or little additional time. Seen to the strict time limitation present in most projects, the discussion approach renders itself the most suitable of the two.

After the low-fidelity prototype was tested, some redesign was made according to the recommendation in Gould and Lewis’s (1985) third principle of design, to do iterative design based on the user tests. The iterative design based on the feedback was successful, since the problems appearing
in the low-fidelity prototype tests did not appear again in the high-fidelity prototype tests. To further measure the progress made during the second iteration the System Usability Scale was used in both tests, which also showed an improvement between the prototypes. Because of that the same questions are used in both tests it is a good way of comparing the usability between iterations. Allowing feedback and using it in further development is a recommended approach to use because of the improvement of the product indicated in the project. Since it is not recommended to develop both a low- and a high-fidelity prototype, the iterative development will occur further on in the project.

The tests can further be evaluated according to the level of usability based on Nielsen’s (1993) aspects of design. Because of the test persons’ increased confidence and efficiency throughout the tests, it was clear that the subjects quickly learned how to use the system. This demonstrates that the aspects of learnability as well as of efficiency are being met. Since none of the users tested the system more than once, the aspect of memorability was not tested. When focusing on errors, the tests showed that quite few errors were made, could all easily be recovered from. The high-fidelity prototype was developed and tested with the purpose of being a more realistic version than the low-fidelity prototype. Thus, primarily the aspect of satisfaction (Nielsen, 1993) could be tested in a more truthful way than in the first set of tests. The satisfaction seemed to be high, both because of the high SUS result but also because of the expressed feelings during the tests, like: ”This looks really good, I think I will use I_Site more often now”. These five aspects can be used when evaluating the performed user tests, in order to include all parts of the usability concept.

The definition of usability includes that specified users should be able to achieve specified goals in a specified context of use. To be able to test if the prototypes were suited for achieving specified goals, test scenarios including those exact goals were used. To test the aspect with specified users, the potential users of the system, such persons should preferably have conducted the tests. However, only one of the tests were conducted by a potential end user, leaving this part of the usability definition basically untested. The specified context of use would preferably have been at the warehouse floor on a site with potential end users. However, since the tests were only performed using prototypes, it was not possible to use real data, which would have been needed in order to properly test this aspect. This can instead be tested when the product is further developed and close to release in order to be able to use it in the real context.

Using prototypes and user tests in the development processes is a good way to try out different ideas and to get feedback to use further in the development. Doing this, users will be involved not only in the beginning and at the end of the process (right before releasing the product) a commonly used approach today as stated by one of the interviewees at Sigma. He explains the problem with this approach being that the users are involved
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in the project too late for any real changes to be made. If using prototypes and testing them on users, as was done in the conducted project, it will lead to usability being tested out while it is still possible to do changes, both major and minor. Therefore, using prototypes and prototype testing is recommended. However, based on the required time needed for prototype development, it could be hard to convince the customer of the need for it. It is not commonly used in today’s projects, as mentioned before. However, the part of the development represented by the low-fidelity prototype and the following redesign in the conducted project could instead be replaced by collaboration between colleagues. Using this approach will lead to the ability of taking best practices and earlier experiences into consideration. The user feedback is however vital to include. This can be done through testing a high-fidelity prototype, developed based on the collaboration between colleagues. Developing only one prototype makes it less time consuming then if making multiple ones.

To motivate the use of prototypes to the customer, the previously mentioned arguments, about how involving the users in the development process leads to increased usability, can be used. The smaller amount of extra time needed for just making one prototype compared to what would have been needed to make two prototypes might make it possible to convince the customer of the value of usability.

Some theory recommends to use low-fidelity prototyping (e.g. Rettig, 1994) while others recommend using high-fidelity prototyping (e.g. Montero and López-Jaquero, 2006). According to Cagan (2008) a high-fidelity prototype reduces the time going from prototype to final product compared to if using a low-fidelity prototype. This is another reason for using high-fidelity prototyping in a context where time and money are limited, as in the case for consulting firms. A high-fidelity prototype may also be easier to convince a customer with lower technical skills about, since it do not require the imagination of future technical possibilities as much as when using a low-fidelity prototype. A disadvantage with not developing a low-fidelity prototype and instead only developing a high-fidelity prototype is that the possibility of testing a lot of different ideas as when using a low-fidelity prototype (Rettig, 1994) is missed out on. Testing only a few ideas can lead to that a ”good-enough” solution, where the customer is satisfied but not more, is found, but that the optimum solution is not. Using a high-fidelity prototype instead of a low-fidelity one further leads to that the structure and basic design is not tested as thoroughly as when using the latter, instead a lot of focus is on the feel and look of the prototype. This can also interfere in the search for an optimum solution. However, when facing strict time an money limitations, as in Sigma’s case, a ”good-enough” solution regarding usability on the system being developed is considered being enough. Based on this, together with the previously mentioned arguments, this leads to the recommendation of using only a high-fidelity prototype.

The risk with only developing one prototype (hence not iterating between
CHAPTER 5. RESULT & ANALYSIS

prototype development) is that only one iteration comes from the prototype development, the one leading to the initial development of the real product. Further iterations have to come during the phase of developing the real product. This hinders changes to be made, compared to if multiple iterations had been performed during the prototype development. However, compared to today’s approach at Sigma only developing the real product, it is better to get one set of feedback and possibility to change the product before starting implementing the real product, than to not have that possibility at all.

Further, based on the study, test scenarios are recommended to use. This is an easy and clear way of checking if the prototype satisfies the needs and requests. The test scenarios can be used to show whether or not the product works in reality and are simple to develop if context scenarios already exists. Those reasons can be used when convincing the customer to include it in the development process.

At Sigma, tests are used, but they are mainly acceptance tests, which means that the customer checks if the requirements are fulfilled or not. This is usually done when the product is already finished. As one of the interviewees at Sigma said: “We do not perform user test but acceptance tests, where the customer can test the system in a test environment”. The test persons performing these tests are usually the person responsible for the project at the customer company, often making them experts at the system developed. Thus, the system is not tested from the users’ perspective in those cases. However, the interviewees at Sigma explained that in some rare cases a test environment is set up where users are able to test the system. These tests are not held by Sigma but by the customer and therefore the importance of the result from these tests can vary. These tests are though always performed right before or even after the release of a system, when only minor changes can be done. If the system does not suit all the users then, the alternatives may be either that they have to use it anyway or that a major investment are needed in order to make the changes after the delivery. These arguments can be used as a motivation to convince the customer about the importance of using tests earlier in the development process.

The recommendation for Sigma is to develop a high-fidelity prototype based on previous data, such as user data, context scenarios and requirements. Before the actual implementation of the prototype, discussions and collaboration with colleagues should be conducted. This in order to facilitate development of a usable product through taken all available data as well as earlier experiences into consideration. The high-fidelity prototype will then be tested on potential end users and the stakeholders using test scenarios to evaluate if the prototype works to solve real potential tasks. The results and feedback from the tests should further be used when developing the final product.
5.3 Consulting Firm

This theme presents the results and analysis connected to the consulting firm.

Sigma does not seem to have any strategy for working with usability, explained by one of the interviewees: "I do not think there are a strategy for working with it [usability] at Sigma, I have looked for it and have not found anything". Even though the overall perception was that all of the interviewed developers realized how important usability is when developing systems, not much of any real work with it was conducted.

As mentioned in the theoretical background, there are ways recommended for companies to increase the possibility of integrating usability work in the developing process. Depending on the size and structure of the company, different approaches can be taken. According to the interviews at Sigma, in some of Sigma’s earlier projects an external consulting firm specialized in usability has been involved. This is one of the ways to go recommended by Seffah and Metzker (2004). However, this approach demands the customer to be willing the extra cost of involving external usability experts. It may also be hard to integrate the usability work and the developing process because the different parties do not understand each others work (Seffah and Metzker, 2004).

A more suitable way for consulting firms where a few consults are involved in each assignment, like in Sigma’s case, could be to educate some members in the developing team in usability matters. In that way they can work as experts in the field at the same time as working as developers. This can be possible to do without adding a large cost to the project and thus it will be easier to convince the customer that it is worth the cost. These experts can also be responsible for educating the customer about the importance of usability. According to one of the interviewees at Sigma: "The reason for Sigma not working with usability is because we do not have the right skills". This further shows the importance of educating some of Sigma’s employees about this matters.

By defining a clear strategy through a framework for usability, usability work could be integrated in the development at Sigma. It could both be useful throughout the development process and also when pitching the recommended practices to the customer. The study shows that the developers understand the value of usability, even to that extent that they add a user focus on their own when possible, as stated by the interviewees. This indicates that it likely would not be too hard to introduce a strategy through a recommended framework to be used in the development processes at Sigma.

The recommendation for Sigma is thus to educate some members of the development team to act as experts in usability issues in the development process as well as working as a resource when informing the customers about the subject. Further, a clear strategy based on a framework for integrating usability in the development process is recommended to be used. The
recommended framework is presented in the next section.

5.4 Synergy

This section presents the synergy between the different results and discussion presented above.

The customers in general lack the knowledge about usability and its value. This together with the strict time and money limitations in the projects and that the customer is in charge of setting the direction of the projects leads to the fact that usability usually is not prioritized. Because of this, the time available is not enough to implement the goal-directed method as it is, as done in the project conducted by the researcher. Therefore, a new framework, customized to be used by consulting firms, is needed.

In order to satisfy the customer, the customer’s requests are the primary ones to fulfill. Today, Sigma derives the customer’s requests through for example a requirement list, interviews or workshops. This way is still recommended to use. Along with the specific requests the customer have for the product, it is important that the customer perceive that they are involved in the development process. Therefore, it is recommended to enable feedback to be given by the customer about the product throughout the development. This feedback should be taken into consideration in the further development, but at the same time it is important that it does not interfere with the users’ needs.

As mentioned earlier, the customer generally lack in knowledge about usability issues. Instead, it is common that the customer perceive usability being a buzzword without knowing the importance or the possible revenue of the concept. Today at Sigma, requirement lists are used, but usability is often only mentioned in the terms of “the system should be usable” with no further details of what it means for the product. According to one of the interviewees at Sigma, this leads to no real work with usability being done. The recommendation is therefore to specify the requirements regarding usability more and since requirement lists already are commonly used, it likely would not be too difficult to motivate the use of it to the customer.

The specified requirements however needs to be based on what the users need in order to achieve a high level of usability. In order to understand the users’ needs, a user research is recommended to conduct. The main reason for performing a user research is to understand the potential end users and their needs. This is recommended to do through using the technique ”Directed storytelling” in interviews, as was done in the conducted project at Toyota. This technique seeks to get information about the users’ work through stories told by the interviewee about specific tasks or actions. It is recommended to perform interviews in the right context combined with complementary ones by phone. The former in order to derive information less obvious when merely talking and the latter to minimize monetary cost, as would be the case if only performing interviews in their right context.
The interviews in context can be complemented with observations of the environment to get further information. Because of the strictly limited time and money available, it is recommended to perform a rather depthless user research. It is however important to know that this might lead to that vital user needs are left out and that the research can not be seen as applying generally on all potential users. However, it is better that the product suits some users than none at all, as could be the case if not performing any user research at all.

Further, the users might have requests about the product. These are recommended to be derived through asking leading questions about what the interviewee requests in the end of the interview. This can lead to a higher user satisfaction but it is at the same time important to not let the user requests interfere with the discovered user needs.

To develop requirements from the user research, an intermediate step is required. The recommended way here is to develop context scenarios, which are scenarios solving tasks through the use of the future system. These are recommended to be based on the potential users involved in the user research. The method used in the project, goal-directed design, instead bases the context scenarios on personas developed from an analysis of the user research. This was a good way to go but is perceived as difficult to motivate for the customer, since it is time consuming and do not have a clear meaning for people lacking knowledge about usability issues. Therefore these steps are removed in the recommendations, even though it will lead to the context scenarios suiting only the specific users involved in the user research, not potential users in general. The context scenarios can directly be translated to detailed requirements regarding usability.

Based on the requirements it is recommended to develop a high-fidelity prototype through collaboration and discussions in the development team. In the conducted project a low-fidelity prototype was developed instead of the colleague collaboration. Removing the low-fidelity prototype part leads to fewer ideas being able to be tested out, but because of the time saved by developing only one prototype it is however perceived as a good way to go. The reason for developing a high-fidelity prototype instead of a low-fidelity prototype is that the high-fidelity type facilitates the transition from prototype to real product and that it is perceived to be easier to demonstrate a high-fidelity prototype to customers lacking technical knowledge.

As mentioned before, it is important that the customer perceives that they are involved in the development process through enabling them giving feedback on the product. This is recommended to do on the high-fidelity prototype due to that changes are still able to easily be made but at the same time there is a product looking rather real to give feedback on. The prototype should also be tested on potential end users, in order to enable feedback leading to changes from the users as well. This is recommended to do through using test scenarios based on the context scenarios which will lead to testing if the product works for the tasks it was designed for.
According to the interviewees at Sigma, the company lacks both a strategy about how to work with usability as well as knowledge about the subject. The recommendations regarding this are for Sigma to use the framework recommended in the next section as a clear strategy to integrate usability in their development processes. Further, it is recommended to educate some developers in order for them to work as usability experts both in the development teams at Sigma but also to educate the customer about usability issues. This way the experts can provide the customer with information about the possible revenue of usability and explaining and motivating what each part of the framework can result in and thus integrate usability work in the development process.

5.5 How to Implement Usability

By analyzing the results from the study, recommendations for IT consulting firms to enable integration of usability in the development process have been developed. Initially it is important that some people in the development team have knowledge about usability issues and the approach used in the company and thus are able to support the process in the development team as well as educating the customer in these issues. The significance of this for Sigma and the industry in general is explained further in the next chapter.

Collecting and analyzing the customers requests are recommended to do in the same way as today, through workshops and meetings. It is important to take into consideration that while it is vital to fulfill the customers requests in order to satisfy them, the customer requests must not have a negative impact on the users’ needs. After deriving the customer’s requests, the following framework is recommended to use:

The framework recommended is based on goal-directed design through Goodwin’s (2009) method and the project conducted in the study. A direct contact with the users instead of forwarding the user data via the customer is recommended in order to know that the data is accurate.

The first step in the framework is to do a user research, in line with Goodwin’s (2009) recommendations. Depending on how large the project is, the number of involved users can vary. It is however recommended to do a quite depthless research, because of the difficulties of motivating the extra costs to the customers. The risk taken with not performing a thorough research is though that the results can be rather uncertain and that it is possible to miss out on vital user needs and requests. It is also possible to miss out on including a whole type of potential users, which leads to even more needs and requests left out. It is however better to do a depthless user research than none at all, which could otherwise be the case because of the limitations in time and money. The user research could consist of a number of interviews conducted in the right context, complemented with some interviews by phone. In the interviews, preferably the technique ”Directed storytelling” recommended by Saffer (2010) could be used. This since it is
an easy yet rewarding method when wanting to understand the users, giving a clear picture of the users’ work and tasks thus facilitating an understanding of the users’ needs. To gather the requests the users might have, using leading questions to explicitly ask what they want in the specific product in the end of the interviews is recommended. The users’ needs are however to be prioritized over their requests, but the requests can be included if not interfering with the needs discovered. Further, the interviews conducted on location can be complemented with observations in order to further understand the users’ work.

The second step in the recommended framework is to develop context scenarios (Goodwin, 2009). Since the user data has not been modeled into personas, as recommended in Goodwin’s (2009) method, context scenarios are to be developed for the users participating in the user research. The absence of the user data analysis and the personas might lead to inaccurate scenarios fitting the specific users involved in the user research rather than the general potential user. However, due to the extra time needed for the modeling phase may be hard to justify to the customer, this can be a tolerable solution. It will lead to that even if the scenarios do not fit all kinds of users, it will suit the users involved in the user research and thereby be usable for this specific user group. The context scenarios are perceived to have enough clear value for the customer to understand it through the way
it facilitates further development of the requirements. In the third step the scenarios are used to create detailed requirements, as it is in Goodwin’s (2009) method. Due to the fact that requirements are something already well known for the customer, it would likely be rather easy to motivate the development of more detailed requirements to them. The requirements can also be used by the customer at the end of the product when checking if the consulting firm has done their job right (Torkar et al., 2012).

The fourth recommended step is to develop a high-fidelity prototype. Using a high-fidelity prototype has been recommended over using a low-fidelity prototype. This due to the high-fidelity prototype being perceived as a more suitable deliverable to the customer together with that it reduces the time going from prototype to final product compared to using a low-fidelity prototype (Cagan, 2008).

In the fifth step the prototype is shown to the customer in order for them to give feedback and thereby make them feel involved in the development process.

Finally, the prototype should be used in tests with potential users. These tests should be based on test scenarios, as Goodwin (2009) recommends, which are derived from the context scenarios. In that way it can be tested if real specified users could achieve real specified goals through the prototype, as says the definition of usability (ISO 9241-11, 1998). The results and feedback from the tests should be used as a base for further development.

Using these recommendations, consulting firms can integrate usability in their development processes. This can lead to a higher level of usability in their products and thereby satisfying both their customers and the end users of the product.
Chapter 6

Discussion

This chapter presents a discussion of the significance of the results derived from the study followed by the method critics. It also presents the final conclusions drawn.

6.1 Significance of the Results

This section presents what significance the results have for the studied company Sigma, the IT consulting firm industry and the field of research in the subject.

6.1.1 Sigma

In order for Sigma to enable usability to be integrated in their development process, it is recommended that they follow two recommendations from the study, mentioned in the previous chapter.

The first one is to educate some members of the development team in order for the company to get the skills needed for working with usability. This in line with Seffah and Metzker’s (2004) recommendations. These developers can then work as experts on usability, both in the team and towards the customer. The newly fledged usability experts will already be in the development team, knowing the existing practices and having a personal relationship with the other developers. This will facilitate the communication in the group which is important according to Seffah and Metzker (2004). The communication will likely work better with this solution than if some external usability expert was to be involved as is another recommendation of Seffah and Metzker (2004). This due to the personal relationships with the colleagues and the knowledge of the existing practices as well as the vocabulary used. Further, because of the educated developer’s expertise on the subject through education from the management, they will likely have a higher authority and have more to say about how the work should be
done, than if they were to be self-appointed experts. Through this education of developers, the usability matters can be integrated in the existing development process, solving the problem of the separation between software development and usability mentioned by Bygstad, Ghinea and Brevik (2008).

The second recommendation is for Sigma to develop a strategy based on the framework recommended in the previous chapter. The framework is developed to suit Sigma’s prerequisites. These prerequisites include that there are strict time and money limitations and that the projects are rather small with only a few consultants involved. Further, the focus in the company is to deliver what the customer requests and orders. Both Sigma and their customers consider usability being a non critical factor. The customers usually are not willing to spend extra time and money on usability work to achieve the optimum solution, but are instead satisfied by getting a “good-enough” solution. Since these prerequisites applies throughout nearly all of Sigma’s projects, the framework is considered working generally in the company.

Using the recommended framework will lead to that the employees will have a clear path and a strategy to follow when dealing with usability issues. It will also result in that the customers will know that Sigma is a consulting firm where usability is included in the products. They will be aware of the techniques and methods used which makes it easier to know what to expect. It is important that the customer understands the potential revenue of a usability investment in order for them to approve a focus on usability.

Using these two recommendations will enable usability work to be integrated in the development process at Sigma. Using this clear way, Sigma can explain to their customers how usability is achieved in their products. This can be useful both when showing that the product match the order from the customer and also as a sales pitch, ensuring a high level of usability in the products.

A higher level of usability can lead to more satisfied users, increased ease of use of the product and improved productivity through reduced errors and higher efficiency. If Sigma develops products achieving this, it likely will lead to satisfied customers wanting to continuing working with Sigma as well as recommend it to others. The quality of a usable product delivered can thus constitute a competitive advantage against other IT consulting firms.

6.1.2 The Industry

As for the industry of IT consulting firms, the same basic recommendations regarding educating developers in usability matters are given as for Sigma. Though with alterations depending on the size of the company. In Sigma’s case there are often only a few consultants involved in each development but many consulting firms take on larger assignments than this. In such cases, it may be suitable to follow the recommendations of Seffah and Metzker (2004) to form a usability group. This group could consist of developers
educated in usability matters together with other usability experts, in order to get the benefits of facilitating communication as previously mentioned.

The slimmed framework is recommended to use in IT consulting firms with similar prerequisites as Sigma, for example when having strict time and money limitations as well as a small size on projects. When the limitations are not that strict, it might not be necessary to remove as many parts from Goodwin’s (2009) method as done in the recommendations for Sigma. This could be the case for larger projects where more developers are involved and the developing time is longer. Further, the recommended framework has the risk of missing out on the optimum solution and only result in a “good-enough” solution, as mentioned in previous section. Therefore it is not recommended to use the slimmed framework when usability is the main focus, for example when usability is used as a major sales argument. To sum it up, since the prerequisites can vary a lot between IT consulting firms, it is important to take each company’s unique conditions into consideration when deciding how to work with usability. This in order to find the best suiting solution for each company.

6.1.3 The Field of Research

The main significance of the study for the field of research is that Goodwin’s (2009) method does not work as it is for an IT consulting firm. This when the customer’s requests are very vital and the time and money available and the customer’s knowledge about usability issues are strictly limited. Although some of the steps in the process could be motivated even for a customer without knowledge about usability issues, all of the steps may not be realizable in that context. A recommended framework has been developed but gaps in it exists. For example is there not clear how to go from the user research to the context scenarios without loosing to much information about the users. This is something for the field of research to work on further. Since the recommended framework has not been tested out in a real context, this is also something that could be done in the future.

6.2 Method Critics

This section presents the method critics for the conducted study.

6.2.1 Validity

According to Runesson and Höst (2008), three aspects of validity can be used when analysing the results of a case study; internal validity, external validity and reliability.
6.2.1.1 Internal Validity

The internal validity involves to what extent the results reflects reality (Runesson and Höst, 2008). This has primarily been handled in the study through triangulation of data.

However, because of time limitations and Toyota having trouble getting in contact with end users, the number of potential end users involved was not enough in the conducted project. In the user research, because of the variety between the companies, a few more interviewees would have been preferable to follow Goodwin’s (2009) recommendations and get a broader picture of the potential users. In this way, it is not sure that the result really reflects reality. Further, it would have been useful to test both of the prototypes on potential end users, instead for on primarily employees at Sigma and Toyota. The fact that only one end user was involved makes the test results rather unsubstantiated.

Further, only Goodwin’s (2009) method have been tested out, meaning there may be some other method better to base a recommended framework on. Also, only one project has been conducted, which could be too insufficient to base a recommendation of a framework on. The framework has not either been tested as it is in reality.

When collecting data from Sigma triangulation was used in order to gain internal validity. The four interviewees all had varying backgrounds and had been involved in different projects, making them a suitable set for obtaining extensive information. However, the data about how the customer perceives the value of usability has only been gained from the employees at Sigma. The demarcation to not study the customers’ views on it was made before the study started out. Based on the other results, their views might have been relevant to include in order to get a thorough understanding of their views through a wider triangulation of the data.

6.2.1.2 External Validity

According to Runesson and Höst (2008), external validity involves to what extent the results in the study are generalizable and if they are interesting to people outside the case or not.

The results are likely generalizable in other cases with a customer and an IT consulting firm, but since only one consulting firm and one customer have been studied, that is not sure. The results can though be interesting for other IT consulting firms wanting to integrate usability work in their development processes.

6.2.1.3 Reliability

Reliability concerns the impact the researcher has on the result (Runesson and Höst, 2008).
Since the observation made in the case study was a participatory one a subjective view has been had during the study (Iacono, Brown and Holtman, 2009). Therefore, the results of the project conducted can not be certain and this subjectivity has to be taken into concern when using the results. The earlier experience the researcher had of using the goal-directed design could further have affected the study. If a person with no previous experience in the method, like a developer at Sigma, would have been using it, the result might have been different. The time to learn each step would have taken a longer time and more mistakes might have been made. Because of this, it could have led to other results and conclusions.

The additional interviews were more objective than the conducted project, leading to it being less influenced by the author.

6.3 Conclusion

The conclusion drawn from the study is threefold.

First, it involves the recommendation of educating developers in consulting firms in usability issues. Through this they can educate the customer in usability matters in order for them to see the importance and value of it. Further, they can also work as experts in the developing team, enabling usability work to be integrated in the development process through good communication and collaboration together with their knowledge in the matters.

Secondly, the result shows that Goodwin’s (2009) method do not work as it is in an IT consulting firm where the customer’s requests have to be highly prioritized in order to make them feel satisfied and where the time and money are strictly limited. However, some of the steps are useful and can be justified to the customer, making goal-centered design a suitable approach if it is somewhat remade.

Thirdly and finally, a recommended framework to be used by IT consulting firms in order to enable usability work in their assignments has been developed. The steps included are:

1. Perform user research through interviews both in context and by phone.
2. Develop context scenarios for the studied users.
3. Generate a detailed list of requirements from the context scenarios, specifying usability issues.
4. Implement a high-fidelity prototype.
5. Demonstrate the prototype to the customer, allowing them to give feedback on it which may be taken into consideration if it does not affect the product negatively.
6. Test the high-fidelity prototype on potential end users using test scenarios developed from the context scenarios. In this way it is tested if specified users could achieve specified goals through using the prototype.

In the context of an IT consulting firm delivering a system to a customer, these three conclusions can be used to integrate usability work in the development process.
Bibliography


**Personal Contact:**

[34] Manager Concept Development Toyota. Personal communication August 16, 2013.


**Pictures:**

Figure 4.1 - Printscreen https://www.toyota-isite.eu/

**Persona Pictures:**

Christoph Amsel - http://www.freedigitalphotos.net/images/Computing_g368-Businessman_Working_with_Laptop_p89756.html

Anders Fors - http://www.freedigitalphotos.net/images/Mature_Men_g217-Senior_Man_smiling_p88795.html

Simon Sjövall - http://www.freedigitalphotos.net/images/On_The_Phone_g371-Young_male_reading_sms_p93687.html
Appendix A

User Research Interview Questions

A.1 Presentation

- My name is Mikaela Bergenbrant and I am writing my master thesis for Toyota. The study is about I_Site and I am interested in how you use it. I will use this information in the further development of I_Site.

- Is it OK if I record the interview? I am the only one that will listen to it and you will be anonymous in the report.

A.2 Background

1. Personal information
   (a) What is your role in your company?
   (b) What does this mean? What are you responsible for?
   (c) How long have you been working here? In your role?

2. Company information
   (a) Tell me about your company.
   (b) How many people are using I_Site in your company?

A.3 Roles and tasks

1. I would like to know what tasks you are performing a normal day, for example yesterday?
   (a) Why?
(b) Explain?
(c) How do you do that?
(d) How do you use I_Site for that? Which menu choices?
(e) Are any other people or systems involved in this?

2. What else happens a normal day of work that did not happen yesterday?

3. What are the problems you are facing?

4. How much of your time do you spend by your computer and how much time do you spend out at the site?

A.4 I_Site

1. How often do you use I_Site?

2. What functions in I_Site do you use the most?
   (a) Why?
   (b) How often?

3. What information do you have on your I_Site tiles?
   (a) How often do you use them?
   (b) What information do you get from them? What do you use that information for?

4. How do you think I_Site works?
   (a) Good or bad?
   (b) Why?

5. Do you use I_Site on a desktop, laptop or a tablet?

6. Changes
   (a) Would you like for something to work differently in I_Site? What?
   (b) What information do you miss in I_Site?

A.5 Other questions

1. What in I_Site could you have usage for out at the site in a mobile application and not only in your computer?

2. What information in I_Site would you like to have a signal, like an SMS alert, about when it happens?
A.6 Closure

1. Is there something you would like to add?

2. Thank you so much for participating!
Appendix B

Persona Descriptions

B.1 Christoph Amsel

36 years.
Support Coordinator.
Sachen Logistics, Germany.

"My most important challenge is to continuously reduce the costs."

Christoph Amsel is working in the Operation Department as a support coordinator for the use of I_Site on Sachen Logistics’ 15 sites. He supervises the use of it and together with his colleagues he plans the use of the forklifts in all the warehouses. Sachen Logistics is a large logistics company with services in transportation, warehousing, re-packing and distribution. The company is located in the Sachen district in Germany. The total amount of forklifts in the company connected to I_Site is 200. The platform was introduced in the company three years ago and Christoph has been responsible ever since.

Christoph is a strict businessman often having a fully booked calendar. At home he uses his computer daily mainly to surf on the Internet. He also owns a smartphone which he mostly uses for traditional communication like calls and SMS:s but he also uses applications for Internet banking and stock information. He is comfortable using technology and is always up to date with the latest devices.

The main focus as a support coordinator is to use I_Site in order to reduce costs and increase the level of productivity. This is done through statistical studies of data where the utilization level both for the machines and the drivers is emphasized. Further, security is important, partly because of
the connection to cost reduction through decreasing damages on goods and machines. Christoph is mainly located in his office at the headquarter, but about once every other week he visits different sites along with his colleagues at the Operation Department. These visits mostly include meetings with site managers in order to discuss management issues. Christoph brings I_Site on his laptop to this meetings and uses it to visualize the results from the previous period.

Each day Christoph starts his work day by logging on to I_Site to check if any shocks of level red occurred yesterday. The number of shocks is then compared to the number of shock reports delivered to the safety group. If there are missing reports, Christoph contacts the manager of the involved site who then is responsible for contacting the driver responsible for the shock. Further Christoph studies the utilization level on the different sites and if needed make plans to increase the utilization level. When not at his office, a lot of Christoph’s time is spent in meetings with other people in the Operation Department or higher level management.

Goals

- Reducing costs is the top priority.
- Security is important as well.
- To have an overall control over all the sites.

### B.2 Anders Fors

52 years.
Forklift Manager.
Gyfa Material, Sweden.

"Forklifts are the most dangerous vehicle in Sweden; therefore the security must be the primary focus."

Anders Fors is the forklift manager at Gyfa Material located in Ljungby in Småland. The company produces construction materials and has 50 employees. Twelve of their forklifts are connected to I_Site. Anders started out in the company 30 years ago as a forklift driver and has made a career in the company since then. He has been the forklift manager for nine years but only used I_Site for one year.

At home Anders only uses the computer for necessary tasks like Internet banking and does not feel very comfortable around computers other than the tasks he has been shown properly. His grownup daughter has however
recently moved abroad, making Anders more curious of how they can keep in touch via Internet. His phone is a simple model and he finds it irritating to always be available for everybody through it, but at the same time he knows it is a necessity that he gets reached in emergency situations at work. Therefore he always carries the phone with him when at work. The most important thing for Anders is to have good relations with all the staff and that they are aware of their importance to the company as well as of their personal responsibility when driving the forklifts. About 40 percent of his working hours are spent out in the production and he is keen to be down to earth and through this build up the trust between the drivers and himself. He rather talks to the employees in person than calling them.

Anders is responsible for the forklifts including operational matters, service and damages. He is also responsible for training programs for both the new drivers as well as for the existing staff. Anders explains his work as: ”safety is the top priority, no doubt”. This is reflected through Anders’ emphasis of the driver authorization and the shock detection in the platform.

Anders discovers the shocks by looking through the shock function in the platform about two times a week. Then he follows up the incident by checking if an incident report has been filed. If not, he personally contacts the driver responsible and finds out why it has not been done. However, if it is a level high shock, the production manager in charge at the time contacts Anders immediately through phone or personal contact, in order to enable damage control directly. Anders is very keen to always leave anything else in order to check what has happened on location, especially if the incident seems critical.

The driver authorization is important in order to get the drivers to realize their own responsibility when driving ”the most dangerous vehicle in Sweden” as Anders puts it. Except always knowing who is driving a specific forklift, Anders finds it vital to emphasis it further through training and by stepping out to the drivers himself when an incident has occurred.

A functionality recently implemented is the pre-operational check function. Anders wants to know immediately if the control has failed, and this is done through a phone call from the production manager. Anders is also using I-Site to control the battery change and to a smaller extent for checking utilization for planning and scheduling reasons.

**Goals**

- Security is the primary focus.
- Personal relationships with the drivers, to always be available for them.
- The drivers should feel that they are responsible for their own work, they need to understand how dangerous the forklifts actually can be.
B.3 Simon Sjövall

25 years.
Foreman responsible for I_Site.
Matberget, Sweden.

"My work has to be efficient, I do not have time for anything unnecessary."

Simon Sjövall works as a foreman at Matberget, a food wholesale located outside of Gothenburg. Matberget has 20 forklifts connected to I_Site.

Three years ago Simon started working as a forklift driver at Matberget and a year ago he became a foreman and responsible for I_Site. At his spare time, Simon uses social networks daily both on his laptop and in his smartphone. Growing up he had an interest in computers and he consider technology being a natural part of life.

Simon is responsible for administrating users and permissions in the platform. Since Matberget often uses labour hire companies, new users with strict permissions are added regularly. Sometimes the not so frequent users forget their PIN codes and this is Simon’s responsibility to solve. The access to the platform is at a desktop computer at his office, which is a problem because of a considerable distance between the warehouse floor and the office. He does not understand why he cannot have the access on a laptop or in a smartphone instead.

Another problem Matberget is facing is that the drivers do not park the forklifts on the right spots at the site when taking a break. Often they just leave the machine where they are at the moment, creating a problem for the other drivers who might need to drive there as well. Simon would want to know who has last driven the misplaced machines to know who is to blame.

The main focus for Simon is his daily tasks as a foreman and he do not want to use I_Site more than necessary. In fact, he does not want to do anything that is not a must, including interacting with drivers or relocate himself to another part of the site. He considers himself being an efficient person which fits well with the money saving actions recently introduced by management.

Goals

- To only do what is absolutely necessary.
- Administrate new and old drivers in the platform.
- Have high efficiency, things should not take longer than they have to.
Appendix C

Scenarios

C.1 Level Red Shock
At the site, a level red shock occurs when the driver Tom is crashing against a warehouse shelf. Anders is taking a coffee break when an alarm sounds from his smartphone that is lying in front of him on the table. He gets information about the shock and quickly goes to the forklift in question.

C.2 Pre-operational Check
At the site, the driver Tom is doing a pre-operational check. He answers “no” on a critical question and therefore the pre-operational check fails. Anders is down on the warehouse floor in another part of the site when an alarm sounds from his pocket. The sound comes from his smartphone, so he takes the phone out to check what has happened. The reason for the alarm is a failed pre-operational check, so he knows it is not an emergency. He takes a minute to finish what he is up to and then he goes to Tom.

C.3 Check PIN code
Anders is down on the warehouse floor when the driver Tom approaches him. Tom asks what his PIN code is, because he has forgotten during his two week vacation. Anders looks it up in his smartphone and because he knows Tom in person, he gives it to him without checking his ID card.

C.4 Last Driver
Anders discovers that a forklift is parked in the way for other machines and the driver is nowhere around. He checks in his smartphone to see who has
left it there. He finds out that it is the driver Tom that is responsible and therefore asks the foreman in charge about where to find him. He finds Tom in the break room and gives him a reprimand about not leaving his forklift on the wrong place again.
Appendix D

Requirements

From stakeholders

1. Should work on optional smartphone device.
2. Should have a high level of quality.
3. Should have a high level of appearance.
4. Should work on a global market.
5. Should be usable.
6. Should look similar to the existing I_Site design.
7. Have the ability to display what machines each driver are allowed to drive.

From scenarios

8. Have the ability to make a noise, to alarm.
9. Have the ability to immediately alarm when a level red shock has occurred.
10. Have the ability to display that a level red shock has occurred.
11. Have the ability to display which machine and driver is involved in a level red shock.
12. Have the ability to immediately alarm when a pre-operational check fails.
13. Have the ability to display that a pre-operational check has failed.
14. Have the ability to display which machine and driver is involved in a pre-operational check fail.
15. Offer the ability for the user to search for a specific driver.

16. Have the ability to display the PIN code for each driver.

17. Offer the ability for the user to search for a specific machine.

18. Have the ability to display who was the last driver logged in on a machine.

19. Only have a few functions.

From interviews

19. Offer the ability for the user to change PIN codes on existing drivers.

20. Have the ability to display which machines were the last ones a driver logged in to.

21. Have the ability to display who were the last drivers (more than one and in order) logged in to a machine.

22. Offer the ability for the user to choose which functionality he/she wants.
Appendix E

Test Scenarios

You are responsible for L_Site at a company. Right now you are down on the warehouse floor and have the L_Site application in your smartphone.

E.1 Scenario 1

The driver Tom approaches you. He has forgotten his PIN code during his vacation last week. Now he is unable to log in, and therefore he is approaching you. Help Tom by giving him his PIN code.

E.2 Scenario 2

You are walking around on the site and suddenly discovers a misplaced forklift. Find out who is responsible for leaving it there.

E.3 Scenario 3

A pre-operational check fails and a message about it appears on the screen. Find out why it failed.

E.4 Scenario 4

Find out which forklift that was involved in the last level red shock and in what direction it occurred.

E.5 Scenario 5

You are about to attend an important meeting and wants to turn of the pre-operational check function notification. Do this.
Appendix F

Additional Interview Questions

1. How much priority does usability have in the development processes at Sigma?
2. Does Sigma have any strategy for usability work?
3. Are there any time and resources available for usability work?
4. Are there any usability experts involved, like external consults or another firm?
   (a) How does the communication and cooperation between them and the developers at Sigma work?
5. How do a standard process for development look like?
6. Are there usually any requirements about usability?
   (a) Examples on such requirements?
   (b) How high are the priority for those compared to other requirements?
   (c) In projects, does Sigma get a complete requirement list delivered or is Sigma creating the list?
7. Are usability tests on end users performed?
   (a) During the development process?
   (b) Just before delivery?
8. Are there any other methods used in order to involve the end users?
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