Improving Customer Value Through Increased Co-Operation Between the Customer and Supplier During the Requirements Engineering Process

A Case Study
Improving Customer Value Through Increased Co-Operation Between the Customer and Supplier During the Requirements Engineering Process A Case Study

Understanding the customer enables suppliers to create software that solves the needs of the customer. Requirements engineering (RE) is the process responsible for finding these needs and defining the requirements of the software. Solving a need makes the software beneficial for the customer and thus creates customer value.

The goal of this thesis is to understand how the case company can increase customer value by utilizing an improved customer understanding in the RE process. Action research was chosen to generate managerial relevance and data was gathered through interviews with 4 customers and 7 interviews with staff at the case company.

The research showed that improving customer understanding is tightly coupled to the quality of the interactions between supplier and customer. The better the supplier co-operate with the customer the better understanding there is. The usage of prototypes, informal communication and co-created models such as process flow charts are great ways for achieving this. This co-operation enables a deep understanding of the customer where the customer processes, goals and environment truly is understood.

Having a deep understanding is a precondition for creating customer value, as only then the product can really support the tasks of the customer. High quality co-operation is a key to gaining deep understanding of the customer and thus co-operation enables the creation of customer value. When customer value is created through co-operation it can be classified as value co-creation as it builds on interaction. Therefore, RE done co-operatively actually enables value co-creation.

Keywords: Requirements Engineering, co-operation, customer value, customer value co-creation, involving customers, understanding customers

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Nyckelord: kravhantering, samarbete, kundvärde, samskapande av värde, inblandning av kunder, förståelse av kunden

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Espoo, February 17, 2019

Oskar Aspelin
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Chapter 1

Introduction

1.1 Motivation

As with any product, software have to cater the needs of the user. A software which is not feasible provides less value for the user. Therefore, when designing a software the user needs has to be taken into account. In other words, the requirements of the software needs to be mapped and defined based on the needs. Taken from this perspective, the success of the software relies heavily on how well the Software Requirements are fulfilled (Nuseibeh and Easterbrook, 2000; Cheng and Atlee, 2007).

Requirements engineering (RE) is the process of finding the Software requirements (Nuseibeh and Easterbrook, 2000; Cheng and Atlee, 2007). Requirements engineering involves finding the stakeholders, understanding their environment and defining their needs. RE builds on the “real world” goals of the software (Zave, 1995), those goals make up the rationale behind the system and the role of RE is to see them made through. A concept widely used in marketing and increasingly adopted in other field is the concept of Customer Value. A software solving the needs of a user creates customer value as the software provides value-in-use for the user. (Grönroos and Voima, 2013) Therefore, RE plays a critical role in the creation of Customer Value (Kauppinen et al., 2009).

Requirements are not only limited to functionality it also encompasses aspects such as usability, security and business goals. The diverse and sometimes complex nature of the requirements creates challenges in communication and various stakeholders might have different views on the requirements of a software. (Nuseibeh and Easterbrook, 2000) This creates a demand for non-technical skills such as social skills and domain knowledge for conducting requirements engineering successfully (Hofmann and Lehner, 2001). The
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process of requirements engineering requires a deep understanding of the user (Kauppinen et al., 2009). In the case of the case company in this thesis the systems are specifically tailored according to the customer needs. As each system is unique the process of creating an understanding of the customer is a core prerequisite for a successful project. Misunderstandings might be costly both in terms of time and money for both the customer and the case company.

Apart from system specific preferences customers also differ vastly based on their background, knowledge and perhaps previous systems. Some customers might have a clear view of what they desire whereas others expect the case company to offer this expertise. Also, in terms of involvement in the development process customers behave differently. Some are very much involved and actively participate in activities such as testing, requirements definition and software design. In other projects customers might have a more passive role and the case company needs to engage the customer to receive input. Needless to say, each project and each customer is unique. This creates a demand for requirements engineering that also takes the customer preferences into account.

It all comes down to understanding the customer and there is a problem for the case company to understand the customer and sometimes for the customer to understand the case company.

In this first chapter of the Master Thesis the research problem will be defined as well as the research questions used to solve the problem. The structure of the thesis will also be explained in section 1.4. The master thesis is done for and in co-operation with a company providing IT-solutions for laboratories. The case company will be introduced in section 2.2.1.1.

1.2 Research Problem and Questions

Understanding the customer is crucial for the success of any project at the case company. By understanding the customer the Software Requirements can be defined through the process of Requirements Engineering.

The objective of this thesis is to find means to streamline the RE-process by increasing the understanding between the case company and the customer. Are there ways in the different steps of the requirements engineering process to promote this customer understanding in order to better define the requirements? The aim is to come up with new ideas of how the case company could conduct RE more efficiently and yield better results. This can be acquired by finding ways to better interact with the customer and would result in creating superior customer value.
CHAPTER 1. INTRODUCTION

The main research question of this thesis is *What are the means for the case company to better understand the customer during the RE process in order to increase customer value?*. The topic is relevant to the case company as the customers are their most valuable asset and by increasing the customer value it will further strengthen their position as market leader in the Nordics. By better involving the customer and understanding them, the RE-process will be smoother and lead to better results which in the end yields an increased customer value.

In order to further illustrate the aim of this research, three research questions are constructed to answer the research problem.

**Research Question 1:** What are the strengths and challenges with the current RE practices at the case company?

**Research Question 2:** Which are the ways for the case company to involve customers in the RE process?

**Research Question 3:** How can the case company improve the understanding of the customer requirements?

The first research question maps what works well and what could work better regarding the current RE practices at the case company. Answering this question requires understanding the current situation. By finding the practices that currently work and what could work better, the literature of the thesis can be targeted even better. Clear issues identified here can then also be given improvement suggestions later on. This question is answered by interviewing the case company’s staff and their customer. In order to gain a clear picture of the current practices existing documents such as Standard Operation Procedures (SOPs) will also be examined.

The aim with the second research question is to draw on ideas from existing literature and interviews how customers can be used as an asset in the RE process. As customer involvement is important for RE especially in the case of the case company, a prerequisite for answering the research problem is to understand how the case company best involves their customers. The sources for data for this answer primarily comes from literature but also from interviews with the staff at the case company and their customers.

The third research question is related to the second but focuses on understanding the customer and rather uses the answers from the first and second research question. The goal with the research question is to find tools and processes for the case company to guide them in their work so that they better understand the customers in the RE-process. Hence, the answers will take a very practical form. The question is answered mainly using data from
interviews but ideas will also be taken from theory. Special attention will be given to solving issues identified in the answer of RQ1.

In order to illustrate how the research questions are answered, table 1.1 explains their relation to the empirical and the theoretical part of this thesis. The main data sources are also included in the table.

### 1.3 Scope of the Thesis

Operations at the case company can be divided into two main business areas: healthcare solutions and “industrial” laboratory information management systems. This thesis will be limited to the latter mentioned. A thorough description of the solution will be given in section 2.2.1.2. The research will also be limited to new customer projects, i.e. delivery projects where the customer acquires a new system. Therefore RE activities in after-sales or software improvements later on will not be taken into account.

The results of the thesis will provide ways for improving customer value through finding means of better understanding the customer during the RE process. The aim of the thesis is not to update the whole RE process. The goals are to provide tools to facilitate customer understanding but a complete work flow falls out of the scope.

### 1.4 Structure of the Thesis

The first chapter of this thesis will be concluded by explaining the structure of the thesis. In this chapter the research problem and research questions have
been introduced. These guide the research as the research is built around them.

In the following chapter (chapter 2) the methods used for conducting the research are explained. After that, the thesis proceeds to the literature review starting from basic theory regarding requirements engineering (section 3.1). The rest of chapter 3 will concern more in-depth theory required for answering RQ2 & RQ3 and the main research problem.

The empirical part of the report will be processed in chapter 4. The empirical part starts by reviewing the current RE practices and the answer of RQ1. The empirical part then proceeds to answer RQ2 and RQ3. In the empirical chapter under section 4.4 the suggestions to the case company will be formulated. The empirical chapter is concluded by summarizing the main gains and lessons learned in section 4.5.

After the empirical part of the thesis follows chapter 5 (Discussion) and chapter 6 (Conclusion). The structure of the thesis and its parts are illustrated in figure 1.1. The figure also explains the relationships between the research problem and the research questions with the different parts of the thesis.
Figure 1.1: Structure of the thesis
Chapter 2

Methods

2.1 Literature Review

The theoretical part of this thesis is taken up in chapter 3. The chapter begins with explaining the concept of Requirements Engineering. For a good overview of the research around Requirements Engineering basic textbooks both in requirements engineering and software engineering in general were used. Apart from this other sources used were central articles regarding the subject (such as Nuseibeh and Easterbrook (2000)) also called “the roadmap paper” (Cheng and Atlee, 2007).

The more in depth part of the literature review concerns theory used for answering research question 2 & 3. They follow the same pattern as with the “basic theory” by first establishing what researchers agree on and then dive into more specifics. The more in depth articles will also be selected based on the findings in the empirical part so that a theoretical understanding of the results can be created.

This master thesis is selective regarding the literature which makes it possible to focus on those phenomena relevant to the study. Rather than trying to review all articles regarding involving customers and understanding customers the focus was on those considered applicable for the situation based on the interviews. This to some extents limits the generalizability of the results in the literature review but on the other adds relevancy to this case.

The primary source for information retrieval was the electronic sources offered by the Aalto University library. The search engines used were Scopus, Web of Science and Google scholar. The main search words were “Requirements Engineering”, “Requirements elicitation”, “customer involvement in requirements engineering”, “understanding customers in software projects”,
“value creation” and various combinations of these. The articles included in this thesis were chosen based on their relevancy to the research. When using older articles, attention was paid to how many times they have been cited in order to establish an understanding whether or not the article is central in the research. For newer publications attention was also paid to where they have been published. For example proceedings to requirements engineering conferences where deemed relevant as they clearly had been made a part of the broader discussion.

2.2 Empirical Study

2.2.1 Case Description

In this section the case will be elaborated and the case company as well as their product will be introduced.

As already stated the case company offers bespoke IT-systems to their customers. This creates a demand for understanding the customer in order to provide the solution a customer needs.

2.2.1.1 Case company

The case company is a Finnish IT-company providing Laboratory Information Management Systems (LIMS). Founded in 1992, the case company has during its 25 year old lifespan grown both organically and through acquisitions to become the leading LIMS provider in the Nordic markets. The case company now employs over 100 people and has offices in Finland, Sweden and Norway.

Customers ranges from governmental to the private sector and are not only limited to the Nordic countries. Apart from traditional laboratory informatics solutions the case company also offers healthcare-, biobanking- and laboratory intelligence solutions. The common denominator of all solutions is that they are highly customized to serve the customers needs. This makes a deep understanding of the customer a critical part of any new or existing project.

The business areas at the case company can be divided into two larger groups, Healthcare and LIMS. The main difference is that the healthcare business area is completely focused on healthcare solutions, such as those used in big hospital districts. In this thesis the healthcare business area will fall out of the scope and the focus will be on the LIMS business area.

The customers in the LIMS business can be divided into three groups.
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*Quality Control (QC) laboratories* - used for testing the quality of the products, e.g. oil company testing that their oil reach the standards. *Service laboratories* - offers laboratory analyses to internal or external customers, compared to QC labs they are therefore more ad hoc. *R&D laboratories* - which develops products and thus their needs are more from a scientific perspective.

### 2.2.1.2 Solution

There are four different products in the LIMS business area, two of which are old legacy products that only are maintained. Therefore, when selling a new LIMS it can be of two types, “enterprise” LIMS and the “express” version. As this master thesis is only concerned with new projects the two latter mentioned are the only relevant for this thesis. These versions are built on a browser based system called LabVantage\(^1\) that contains a preconfigured set of functionalities which then are customized according to the customer preferences.

The main difference between the “enterprise” version and the express version is simply that the express is less customizable and contains more standardized features. The express version has been developed and preconfigured internally inside the case company and can therefore be shipped significantly faster. With the “enterprise” version each project starts from a clean slate where all customer specific functionality has to be configured from scratch. Rather than going into details regarding the differences between these two products the main idea behind a LIMS will be explained.

A LIMS (Laboratory Information Management System) is used by the laboratory staff and takes care of activities such as sample management and laboratory workflow. To put it very simply a LIMS keeps track on which samples have been taken, the types of samples, what tests have been made to them, the results of the tests etc. and stores all this data. One could say it is sort of an ERP to a laboratory as it is a tool for managing lab operations. Modern systems automate much of the work in laboratories and are typically interfacing to other systems such as SAPs and instrument used in the laboratory.

The “out-of-the-box” LabVantage system contains many functionalities that are not needed for all laboratories. As it is highly generic the case company then builds on the system with customer specific functionality. In practice this configuration concerns the appearance, content and functionality of the system. It holds true in a product sense that the case company sells

\(^{1}\)http://www.labvantage.com/lims/
LIMS to customers. However, the value emerges from a configured version of LabVantage that caters the needs of the customer. In that sense, apart from license fees, the customer actually pays for the expertise of the case company in configuring laboratory solutions according to their needs.

### 2.2.2 Research Method & Research Process

As the aim of this research is to provide real world relevance the main criteria for the method was its ability to create change and offer tangible improvement suggestions. Therefore, the method chosen for this thesis was *Action Research*.

*Action research* is a combination of research and practice and has grown to become a valid research method in Information Systems research (Avison et al., 1999; Baskerville, 1999). *Action research* provides managerial relevance as it is built on practical action with the aim to solve a problem. *Action research* is rooted in a positivist or neopositivist approach (Baskerville, 1999), which also is the approach many requirements engineers tend to take (Nuseibeh and Easterbrook, 2000). A positivist adaptation takes a materialistic ontology with “reality” considered to be observable things (Blaikie, 2004). *Action research* builds on the belief that the social context cannot be reduced to smaller parts, it should rather be analysed as a whole and it is the “action” (intervention) that brings the understanding. Researchers not only observe the phenomena under study, they also participate and play an active role in the setting. (Baskerville, 1999). The aim for the action researcher is to try out a theory in a real world setting together with practitioners, get feedback, and possibly modify the theory based on the feedback. (Avison et al., 1999)

The method for this master thesis was chosen to be action research based on the following criteria:

1. The aim with action research is to create an increased understanding of a real world situation
2. The answers to the research questions can be considered to be “out there” and observable, not socially constructed
3. The author of the thesis works with tasks related to the topic of this thesis and can without difficulty assume the role of both practitioner and researcher.
4. The research is done by collaborating with the personnel at the case company
5. The success can be measured by evaluating the impact of proposed change in the case company’s RE-processes. This also increases the understanding of the problem and the underlying theory.

These criteria are characteristics of action research and in line with the purpose of this master thesis.

Action research is typically iterative and as findings can re-define the understanding of the problem, inductive reasoning was applied in this research. As there were no hypotheses the analysis was based on data instead of theory. The theory functioned as a supplement for understanding the data. The absence of hypotheses also minimized the risk for limiting the perception of the phenomenon and influencing the data gathering to a certain direction. Due to time constraints the research was cross-sectional.

The prerequisite for the empirical research was a sufficient understanding of the theory related to the phenomena. Literature was revisited throughout the research process but the greater part of the literature review was done in the early phases when basic understanding of requirements engineering was established in (section 3.1). When empirical data had been gathered and analysed, theory was revisited and key aspects found in interviews were added to the literature review. The theoretical part of this thesis is to its full extent found in (chapter 3).

The research process followed a basic three phase pattern of an action research process. Starting by diagnosing the problem, then intervention and finally evaluation which here will be referred to as “Lessons Learned”. In the first step (problem diagnosis) the nature of the problem was defined. The aim with this step was to gather as much data as possible regarding the RE-processes at the case company as well as the preferences of customers. With this deep understanding of the current situation the suggestions were formulated which was done in step 2 (intervention). The intervention phase consisted of formulating suggestions for the case company of how they could improve their RE practices. The relevance for the case company also came in form in materials such as documents which can be used in the RE-process. The last phase consisted of evaluating the interventions proposed in step 2. This was done together with a key stakeholder at the case company. This measured the success of the intervention and shed more light on the improvement areas. This will be further explained in section 2.3. The research process is illustrated in Figure 2.1.
2.2.3 Data Collection and Analysis

The data used for the empirical part of the thesis were of two types; interviews and written documentation. Interviews were held with both the case company staff and its customers. The written documentation included documents such as SOP’s (Standard Operating Procedures), templates used for RE and specification documents used in customer projects.

The “in house” data (interviews and material) served as a basis for answering the first research question (see section 1.2). This also provided the opportunity to better target the literature later on in the process. The customer interviews gave an understanding about the customer perspective of the problem.

2.2.3.1 Sampling Strategy

In order to gather the “in house” data a news article was published in the case company intra net where the research was briefly introduced and the needs for data explained. An information oriented selection strategy (Flyvbjerg, 2006) was used and those persons working a lot with requirements engineering or having recently worked with defining requirements were asked to take contact. However, the purpose with the news article was also to inform the company about the research and give any employee the possibility
CHAPTER 2. METHODS

to contribute in forms of interviews or by sending material. As this was not a very efficient strategy for finding interviewees, key persons identified by the researcher and the advisor of this thesis were also contacted separately. Interviews were held until a saturation point was reached and no new information was gained.

The customers were contacted through the responsible persons at the case company and the sampling strategy was again information oriented (Flyvbjerg, 2006). The aim was to find different kind of customers and possibly projects that had been implemented differently.

2.2.3.2 Data description

In total seven interviews were held inside the case company. The interviewees had all managed customer projects and all of them had at least 5 years of experience of working at the case company. The data from the employees of the case company can be seen as all comprehensive. Some of the interviewees typically worked with large organizations requiring more documentation and bureaucracy. Others drew on experiences from somewhat smaller and perhaps more agile projects. During the last few interviews not much new information was gained and a saturation point was considered to have been reached. All of the interviews held within the case company were conducted face-to-face and recorded with the permission of the interviewee.

In total 4 interviews with customers were held. Three out of four customer interviews were held remotely using phone and not recorded. During these interviews more detailed notes were taken for compensation. The projects in question were quite recent and actually one of them was still in the implementation phase. Thus the interviewees had the projects in fresh memory. Both from the customer’s point of view and the case company’s point of view the projects had been quite successful. Therefore, good insights in what works well from a customer point of view was gained. However, from a generalization point of view, the disadvantage was that they had been quite homogeneous, implemented in quite an agile manner.

The interview template for the “in-house” interviews can be found in appendix A.1 and for the customers in appendix A.2.

2.2.3.3 Data processing

All of the “in house” interviews were transcribed. The interviews were transcribed word-for-word but metadata such as pauses or bodily signs were left out. The transcribed interviews were processed using the qualitative analysis
CHAPTER 2. METHODS

Figure 2.2: The taxonomy used for when processing the transcribed interviews

tool Atlas.ti\(^2\). For coding a taxonomy was created so that the text could be grouped into analysable parts that answered the research questions. This taxonomy is illustrated in Figure 2.1.

Each transcribed interview was processed twice. In the first iteration text was coded according to the groups described in the figure above. EG. when a part of the text concerned the role of the customer it was coded to belong to the group “Customer Role”. Overlapping was permitted, meaning that parts of the text could belong to two groups, ie. parts about challenges with communication could be given both the “Challenges” code and the “Communication” code. This allowed analysing code co-concurrences.

During the second iteration each code group was further divided into subgroups. This allowed detailed analysis of specific areas of interests. For example the group “Challenges” was divided into internal and external challenges, meaning that during analysis a list of all external challenges could be easily compiled and vice versa. The amount of subgroups was not limited but were kept on a fairly broad level so results would not be too specific for analysis.

As the customer interviews had not all been recorded a similar approach could not be used. The notes from the interviews where coded using Atlas.ti but as they could not be coded as specifically as the “in house” interviews, text parts were grouped into more broader themes. Each theme represented the customer viewpoint in a certain matter, together creating the stance of the customer. The themes are described in Figure

\(^2\)https://atlasti.com/
Figure 2.3: The themes of the interviews with the customers

2.3 Evaluation

A session together with the advisor of the thesis was held after the improvement suggestions had been formulated. During the session the results were presented to a key stakeholder at the case company and the improvement suggestions were reviewed.

This enabled gaining insight in the feasibility of the initial improvement suggestions. As a result, some of them were elaborated and slightly changed. The biggest gain with the session was that it aided making the suggestions more concrete. As an official of the highest level on the company, the stakeholder helped finding practical ways of fulfilling the suggestions. After the session, the improvement suggestions were updated. This is described in section 4.5.
Chapter 3

Literature review

3.1 Requirements Engineering

The purpose with this first chapter of the theoretical part of this thesis is to cover key concepts and generate a basic understanding about requirements engineering.

The requirements of a system can be seen as the definition of what the system should consist of and what it should do (Sommerville, 2011). The process of finding those needs is called Requirements Engineering (RE) (Nuseibeh and Easterbrook, 2000; Cheng and Atlee, 2007). In simplicity, it involves identifying stakeholders, defining their needs, analysing and communicating the findings. (Nuseibeh and Easterbrook, 2000). Conducting RE relies on multidisciplinary skills (Cheng and Atlee, 2007) and requires domain knowledge, IT skills and knowledge about the RE process itself. Well conducted RE is one of the most important factors leading to the success of a software project (Hofmann and Lehner, 2001; Sillitti, A. and Succi, 2006; Nuseibeh and Easterbrook, 2000).

3.1.1 Software Requirements

Before diving into the requirements engineering process and how RE is conducted, the concept of software requirements will be explained. A common misconception of a software requirement is that a requirement = feature. While it holds through that many requirements are descriptions of a desired feature there are also other types of requirements.
CHAPTER 3. LITERATURE REVIEW

The IEEE consortium defines a software requirement as (*Systems and software engineering – Vocabulary*, 2010):

1. a software capability needed by a user to solve a problem to achieve an objective

2. a software capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed document

This defines software requirements as software capabilities needed by users or required in order to satisfy a certain criteria imposed by some documentation. These software capabilities or software requirements are commonly divided into two types, *functional and non-functional requirements* (*Systems and software engineering – Vocabulary*, 2010). Non-functional requirements are also often called quality requirements (Nuseibeh and Easterbrook, 2000). Functional requirements are as the name states concerned with the functionality of the system, what it should do or not do (Wiegers, 2003; Sommerville, 2011). A functional requirement can be seen as a feature (Wiegers, 2003). Non-functional, on the other hand are generally on a more higher level and usually specifies the system as a whole (Nuseibeh and Easterbrook, 2000; Sommerville, 2011). Examples on non-functional requirements are: security requirements, performance requirements (*Systems and software engineering – Vocabulary*, 2010), usability requirements, dependability requirements (Sommerville, 2011), reliability requirements (Nuseibeh and Easterbrook, 2000).

### 3.1.2 The Requirements Engineering Process

The process itself can be broken down to a set of activities starting from understanding the environment to managing requirements. Table 3.1 shows an overview of the key activities in the RE process according to a set of scholars in the field. In the table, the number after each activity indicates in which order the authors presented them. However, most of the authors see the activities as intertwined and part of an iterative process. Therefore, the table cannot in most cases be interpreted as the exact sequential order of the activities. To be noted is that different authors also essentially alludes on the same activity, they just have named them differently.
### Table 3.1: Requirements Engineering Activities

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<td>Unspecified</td>
<td>Interleaved/iterative</td>
<td>Iterative</td>
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<td><strong>Activities</strong></td>
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<td>Evaluation (5)</td>
<td>Requirements management (4)</td>
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<td>Requirements Management (5)</td>
<td>Requirements Management (5)</td>
<td>Requirements Change Management (5)</td>
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</table>
CHAPTER 3. LITERATURE REVIEW

Depending on how the author sees the scope of RE the process, it either begins with some sort of situation exploration; Feasibility Study (Sommerville, 2011), Domain Analysis (Van Lamsweerde, 2000) or elicitation. All authors identify *elicitation* as a main RE activity which is the process of discovering (eliciting) the requirements (Nuseibeh and Easterbrook, 2000; Cheng and Atlee, 2007; Hofmann and Lehner, 2001). The absence of domain analysis does not mean that the other authors disregard it, domain analysis is generally a part of the elicitation process (Zowghi and Coulin, 2005).

There seems to be disagreements between the authors concerning which activity generally is done after elicitation. Some of the authors see *analysis* (analysing the elicited requirements) as the next activity (Paetsch et al., 2003; Kauppinen, Marjo; Kujala, Sari; Töhönen, 2016) whereas others consider *modelling* (representing the requirements) to be the next step (Cheng and Atlee, 2007; Hofmann and Lehner, 2001). Nuseibeh and Easterbrook (2000) considers modelling and analysis as simultaneous activities. Nevertheless, there is a consensus that modelling (representation (Kauppinen, Marjo; Kujala, Sari; Töhönen, 2016), documentation (Paetsch et al., 2003)) and analysis are two of the main activities in the RE process.

There is also unity between the authors that after analysis and modelling, the requirements need to be *validated* by the stakeholders. Nuseibeh and Easterbrook (2000) even identifies communicating requirements as a separate activity. Some of the authors considers the RE process to be complete after validation (Sommerville, 2011; Hofmann and Lehner, 2001), whereas others sees *Requirements management* to be a main activity (Nuseibeh and Easterbrook, 2000; Cheng and Atlee, 2007; Paetsch et al., 2003; Kauppinen, Marjo; Kujala, Sari; Töhönen, 2016).

Based on this at least five different main requirements engineering activities can be identified which here will be called; Elicitation, Modelling, Analysis, Validation & Communication and Requirements Management. In the following sub chapters the activities will be introduced and defined. This classification is aligned with a classification done by Dermeval et al. (2016) reviewing 67 papers related to RE and according to *(Systems and software engineering – Vocabulary, 2010)*. A high level iterative RE process is illustrated in Figure 3.1

**Elicitation**

Roughly defined, the elicitation stage of a RE process involves working with various stakeholders to discover what the service should provide. (Sommerville, 2011; Zowghi and Coulin, 2005). To put it even more simply, it is about understanding the users and the customer (Zowghi and Coulin, 2005).
The term *elicitation* is used to emphasize that the task is not simply about asking the right questions (Nuseibeh and Easterbrook, 2000) as it is comprised of a multitude of techniques requiring multidisciplinary skills (Zowghi and Coulin, 2005). As this lies in the core of understanding the customer, elicitation will also be further discussed in section 3.4.

Zowghi and Coulin (2005) breaks down the elicitation process into 5 parts:

- Understanding the application domain
- Identifying the sources of requirements
- Analysing the stakeholders
- Selecting the techniques, approaches and tools to use
- Eliciting the requirements from stakeholders and other sources
As stated in section 3.1.2, some scholars consider domain analysis to be separated from the process of requirements elicitation. Either way, it is an important part of the whole RE process as it is a prerequisite for understanding the application domain i.e. the setting where the service is to operate. This involves social and organizational aspect as well as key problems and business objectives Zowghi and Coulin (2005).

The second activity Zowghi and Coulin (2005) distinguishes is identifying the sources of requirements. Sources for the requirements are not simply the future users. It might be existing systems and processes, reports, manuals and other existing documentation. Especially if a current system is replaced these sources can be very valuable. (Zowghi and Coulin, 2005)

Stakeholders are naturally sources of requirements. A stakeholder is anyone with an interest in the system or someone who is affected by the system. Therefore, stakeholders are not to be confused with a user, a stakeholder might for example be the customer of the customer, or the owner of a current system the new one needs to be integrated to. Thus identifying stakeholders and analysing them is a critical activity in elicitation. Typically it is also a good idea to identify key users of a certain group of users that can be used as representatives. (Zowghi and Coulin, 2005)

There are a vast amount of different elicitation techniques and approaches and the best results tend to come using a combination of different techniques (Zowghi and Coulin, 2005). Apart from very straightforward methods such as interviews and questionnaires, techniques include observations, ethnography and task analysis. Tools such as prototypes, storyboards and models can be especially useful in later stages of an RE process (Cheng and Atlee, 2007).

The final activity in requirements elicitation according to Zowghi and Coulin (2005) is the elicitation itself using the techniques and tools chosen. This is possible only when the sources of requirements and the stakeholders have been identified and analysed.

**Modelling**

As the name says this activity involves creating graspable representations of the requirements. The models created can be used later on in the RE process to elicit further requirements or validate them (Nuseibeh and Easterbrook, 2000). The strength of models is that they can be understood by various stakeholders (Hofmann and Lehner, 2001) including less technical. The notations used varies, and ranges from use cases to prototypes. Typically they are informal and maybe incomplete in the early phases of RE and evolves when requirements are more precise. Other typical types of models are scenarios, enterprise models and paper prototypes (Cheng and Atlee, 2007).
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Analysis

Analysis is the assessment of the models or documentation created (Cheng and Atlee, 2007). In this phase it is also feasible to take into account multiple requirements and check for potential conflicts as well as prioritize them (Paetsch et al., 2003). This activity is tightly coupled to modelling and for example Nuseibeh and Easterbrook (2000) sees it appropriate for the two of them to be done simultaneously. Paetsch et al. (2003) and Wiegers (2003) considers modelling to be a part of analysis. Therefore, modelling and analysis depend heavily on each other and are the two phases in requirements engineering that perhaps are the most intertwined.

Validation & Communication

This phase of the RE process essentially provides an answer to the question “are we specifying the right requirements?” (Hofmann and Lehner, 2001). In this thesis communication has been included since many of the researchers highlight communication and negotiation (Nuseibeh and Easterbrook, 2000; Van Lamsweerde, 2000). In order for validation to happen, the requirements also needs to be communicated to the stakeholders accordingly. Although, many of the phases require collaboration with customers. In this phase involvement is crucial as the future users or customer are the ones that knows whether or not the requirements engineer has understood the requirements correctly (Cheng and Atlee, 2007). It is important to note that in terms of communication it is not limited to the communication between the supplier and the customer organisation. The requirements engineer must also be able to communicate requirements to internal resources such as developers.

Requirements Management

As the requirements evolve and change during the process the requirements also need to be managed. In practice, requirements are refined, prioritized, deleted or added. (Nuseibeh and Easterbrook, 2000) Requirements management is also linked to other managerial activities in the project such as cost estimation, risk management and traceability (Cheng and Atlee, 2007).

3.1.3 Comparison Between “Traditional” and Agile RE

It is commonly known that software development processes have transformed to become more agile due to their efficiency and flexibility. Requirements engineering is not an exception, and new ways how to conduct RE more
agile have emerged. The name itself requirements *engineering* suggests a more formal “engineering” process. Nowadays service design can be seen somewhat as a synonym to RE. However, RE is still a relevant discipline in the field and one can make a distinction between “traditional” engineering processes and agile RE processes.

The difference between the two approaches can perhaps best be understood by first having a glance at the agile manifesto (*Manifesto for Agile Software Development*, 2001) which states:

- **Individuals and interactions** over processes and tools
- **Customer collaboration** over contracts
- **Working software** over documentation
- **Responding to change** over planning

These core principles of agile development are seen in agile RE as more informal processes (Sillitti, A. and Succi, 2006; Cao and Ramesh, 2008), customer involvement (Paetsch et al., 2003), less documentation (Paetsch et al., 2003; Cao and Ramesh, 2008), constantly planning to respond to change and test driven development (Cao and Ramesh, 2008). Sometimes agile methods poorly are simplified to iterative models, and while it holds true that agile models tend to be iterative this also is true for “engineering” type of RE processes (Nuseibeh and Easterbrook, 2000; Sommerville, 2011; Wiegers, 2003). Therefore, the distinction between the two rather is how the activities are handled than the order and iterations. Table 3.1.3 shows the main characteristics of agile RE processes and its counterparts in “traditional” RE.

The flexibility and time-saving aspects of agile RE can be advantageous for the industry. This is due to lighter documentation, prototyping and quicker feedback. (Inayat et al., 2015)
Table 3.2: Characteristics of agile compared to “traditional” RE-processes

<table>
<thead>
<tr>
<th>Agile RE</th>
<th>“Traditional RE”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum written documentation, informal and oral communication (Cao and Ramesh, 2008; Sillitti, A. and Succi, 2006)</td>
<td>Relies on heavy documentation (Paetsch et al., 2003)</td>
</tr>
<tr>
<td>All stakeholders in the development organization involved with customers (Paetsch et al., 2003; Sillitti, A. and Succi, 2006)</td>
<td>Customer involvement but limited to a subgroup (Hofmann and Lehner, 2001)</td>
</tr>
<tr>
<td>Extreme prioritization of requirements (Paetsch et al., 2003; Cao and Ramesh, 2008; Sillitti, A. and Succi, 2006)</td>
<td>Prioritization but less often</td>
</tr>
<tr>
<td>Frequent validation through review meetings (Paetsch et al., 2003; Cao and Ramesh, 2008)</td>
<td>Documented requirements are validated (Paetsch et al., 2003)</td>
</tr>
<tr>
<td>Managing requirements through constant planning (Cao and Ramesh, 2008)</td>
<td>Managing requirements through documentation and agreements (Paetsch et al., 2003)</td>
</tr>
<tr>
<td>Prototyping/modelling smaller parts of the system incrementally (Paetsch et al., 2003)</td>
<td>Documented prototypes/models</td>
</tr>
<tr>
<td>Test driven development (Cao and Ramesh, 2008), iterative deployment (Paetsch et al., 2003)</td>
<td>“Ready” product shipped</td>
</tr>
</tbody>
</table>
3.1.4 Documenting Requirements

Even though RE would be done in a very agile manner there is always a need for some kind of documentation. This last section of the basic theory regarding Requirements Engineering will briefly open up two very typical documents related to requirements engineering.

User requirements specification (URS) or sometimes User requirements document (URD). This is written by the future user and stakeholders and contains high level and thus not specific requirements. Typically the URS is written in natural language without the usage of any modelling language or specific methodology. This document is typically the first contact of the requirements for the supplier. (Soares et al., 2008)

Functional specification on the other hand specifies the functions that the system must perform (System and software engineering – Vocabulary, 2010). Therefore it is concerned with the functional requirements. Typically this already involves technical aspects.

3.2 Value Creation

Value creation has for long been recognized as a key concept in strategy and marketing. It provides a sense-making of the benefits of a product or a service but the term itself tend to remain on a very metaphorical level. Discussion among experts revolves around questions on when value is created, who creates it and how it is created and there seems to be a vast amount of different views. (Grönroos and Voima, 2013)

Previous perceptions that value is embedded in products has been challenged by the idea of value created through usage. This implies that value is not created as an output of the supplier i.e. through a development process. Grönroos eg. (Grönroos and Voima, 2013; Grönroos and Ravald, 2011) offers one of the perhaps most clear definitions of value creation. Value is created by utilizing the resources from a production process and transforming them to value-in-use. (Grönroos and Ravald, 2011) Grönroos and Voima (2013) highlights this by separating value creation into three spheres; provider sphere, customer sphere and joint sphere. The value is created in the customer sphere as there only can be value-in-use there. This division into spheres is illustrated in Figure 3.2.

This definition of value creation emphasizes the separation of production and development from value-creation. The provider or supplier creates resources that eventually can lead to customer value. However, it is inside the customer sphere that value creation happens. The customer uses the re-
Figure 3.2: Value Spheres according to Grönroos and Voima (2013)

sources provided by the supplier and if there is value-in-use, value has been created. In the joint sphere the supplier has the opportunity to together with the customer through interaction co-create value. (Grönroos and Voima, 2013) Value co-creation will be more in depth discussed in section 3.2.3.

It is important to understand that the notion of value-in-use depends on the usage. A resource created by the provider that is of no use or even makes the customer’s processes more difficult cannot create customer value. Value is created in the customer’s processes when they use the resource leading to positive consequences. (Grönroos and Ravald, 2011) In other words, it is not the product or the service that enables value creation, it is through usage and the solution it provides. (Kauppinen et al., 2009)

3.2.1 Value Creation and Requirements Engineering

Value creation is a term mainly used by marketing scholars and practitioners and might be seen farfetched from a discipline such as requirements engineering. However, as Kauppinen et al. (2009) explains, there is a clear link between the two of them. The notion of value-in-use provides an important point to software developers, a feature is not necessarily a resource that creates customer value. Customer value is created when the customer uses the feature providing a solution for the customer. Companies should not develop features for customers, they should rather develop solutions that creates customer value. (Kauppinen et al., 2009)

The above mentioned puts requirements engineers and requirements engineering in a central position concerning the creation of customer value. As mentioned in section 3.1, RE is one of the most important success factors of a software project. A successful software is one that creates value for the customer (= it is used by the customer to solve its problems). Therefore, the solutions which are needs for the software has to be discovered, this is where
RE comes in. By fulfilling the requirements the software is usable and solves the customer’s problems giving the solution.

The link between RE and value creation can be simplified and quite easily understood by relating RE to the value proposition canvas by Osterwalder and Pigneur (2010) which is illustrated in Figure 3.3.

The value proposition canvas consists of two parts, the value proposition to the left and the customer to the right (Osterwalder and Pigneur, 2010). The idea behind the canvas is that a product or service should solve customer jobs which is similar to the notion of developing solutions that the customer uses to solve its problems (Kauppinen et al., 2009). A customer job is a task that the customer needs to solve, in case the product or service doesn’t solve the task, then value is not created.

The value proposition canvas emphasizes a deep understanding of the customer which also is a prerequisite for RE. In addition to the customer jobs, the right hand side of the value proposition canvas consists of customer gains and pains. A customer gain is a benefit or resource created by the product or service that helps the customer solve its jobs. In the case of software, a gain might be for example a functional requirement, something the software should do to solve a task. The customer pains are the negative emotions and problems related to doing the jobs (Osterwalder and Pigneur, 2010). In a software context this might be a steep learning curve of learning on how to use the software or trade-off’s from a previous product. Apart from understanding what problem the customer wants to solve with the product,
these are aspects that the requirements engineer needs to understand.

RE comes in between the left side and the right side. The right side consists of gain creators and pain relievers. Gain creators might be features addressing a functional requirement, pain relievers as the name says aims to minimize the pains when doing the job. Therefore the role of a requirements engineer is to understand what are those aspects that create customer gains and ensure that the corresponding gain creators are implemented. Correspondingly the pains needs to be acknowledge the pains and come up with cures for them. Putting it simply, the role of RE is to find the value proposition.

3.2.2 Value Based Requirements Engineering

There is a research direction in RE which takes into account the role of value called value based requirements engineering (Akkermans and Gordijn, 2003). Traditionally the software industry has worked in a value neutral environment where the links between technical and economical aspects are disregarded (Boehm and Sullivan, 2000). The value based approach tries to take into account the value surrounding a piece of software. Drawing on ideas from economic theory, value based RE tries to incorporate concepts such as product value, business value and value from a project perspective and align them with customer perceived value. (Aurum and Wohlin, 2007) Here of course rises the question which aspects of value are on the responsibility of the requirements engineer and which are not. Are requirements engineers supposed to see that the customer value created also maximizes the benefits for the developing company eg. in terms of time and money?

Debatable is of course the nature of value and what exactly value is. The definitions offered by Grönroos and Voima (2013) and adopted by Kauppinen et al. (2009) takes a more straightforward position. Value is created through use and the requirements engineer is supposed to find the solution that generates beneficial usage (see section 3.2.1).

3.2.3 Value Co-Creation

Grönroos and Voima (2013) defines value co-creation as function of interaction in the value creation process. Value co-creation happens in the joint sphere (see Figure 3.2). The interaction is reciprocal as all parties have the possibility to influence the others processes. In value co-creation the processes of each party is merged to an integrated process aiming for a common goal. (Grönroos and Ravald, 2011) As the customer is the one that is able to create value through value in use, the supplier assumes the role of a value
Figure 3.4: Requirements engineering as a part of value co-creation

facilitator. (Grönroos and Voima, 2013) By serving as a value facilitator the supplier can influence the experiences of the customer. (Grönroos and Ravald, 2011)

Value co-creation builds on interaction but important it also the type of interaction. Interactions of poor quality might actually decrease value for the customer. Therefore, it is crucial for the supplier to understand the customer’s processes and preferences. Only beneficial interactions with the customer will transform the supplier to a co-creator. (Grönroos and Voima, 2013)

The lessons learned from a requirements engineering point of view are twofold. As requirements engineering requires customer involvement and customer interaction the requirements engineering process needs to happen in the joint sphere. This is illustrated in Figure 3.4 that relates the value spheres to a software. Of course there are other activities happening in the value spheres but here the figure highlights the role of RE. The second lesson learned is that the interactions need to be meaningful and beneficial for the customer’s point of view. Requirements engineering cannot be conducted according to the suppliers preferences, the way of conducting needs to be tailored according to the customer.

3.3 Involving the Customer Organisation in the RE Process

Requirements can of course in one sense be “your own” eg. in an internal development project. However, there is always some party for whom the service is created that represents the “customer”. RE cannot be conducted without any interaction with the “customer” and to some extent the “customer” must
always be involved.

The clear and necessary involvement of the customer comes during the validation of the requirements. As typically the main stakeholder the customer will also need to participate in the elicitation of the requirements although a more passive role might be sufficient. Whether or not the customer is also the future user, user and customer involvement has a positive effect on the success of RE (Kujala et al., 2005; Kaulio, 1998; Hofnam and Lehner, 2001; El Emam, Khaled; Quintin, Soizic; Madhavji, 1996; Cao and Ramesh, 2008; Kauppinen et al., 2004). Kujala et al. (2005) also finds that there is a clear link between the final system quality and early user involvement.

Kujala et al. (2005) emphasize the distinction one must make between a customer and a user. Users are the one that will use the system in their daily work. The customer on the other hand is the “buyer”, purchasing the system on behalf of the users. Mostly, their interests are aligned and both are important stakeholders. In many projects there are product managers representing both the customer and the users. Kujala et al. (2005) finds that both are important sources of information but emphasizes the role of users in terms of quality and project success. This section was named “Involving the customer organisation in the RE-process” thus keeping customer organisation as an umbrella term for both customers and users.

Involving the user is not the same as having direct contact, it also involves activities done in participation with the user. From a RE point of view the main benefit is receiving more precise requirements. (Kujala, 2003)

Apart from the clear benefit user involvement gives requirements engineering other benefits are: Superior and differentiated service; Reduced cycle time; User education; Builds relationships (Alam, 2002); Avoiding costly unnecessary features; improved acceptance level; better understanding of the system (Kujala, 2003).

A more extensive user involvement can also have negative effects. Users need to be educated in regard of the system and the process itself for efficient communication with developers. Through their participative involvement in the decision making as well, they might late in the project demand changes. (Kujala, 2003) Whitehead (2007) also find that especially for enterprise software applications there is a need to deeply understand the product. Another challenge is finding the time and place for gathering the users (Alam, 2002).

In terms of agile RE, customer involvement is very important especially as there is a need for constant availability. (Inayat et al., 2015; Paetsch et al., 2003)

This section will be concluded by reviewing specific practices related to RE activities that promote customer involvement.
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Elicitation

The customer is always somehow involved in elicitation and apart of the contact through communication such as interviews and questionnaires there are customer participatory techniques. This can be achieved by simulating situations by eg. organizing organizational games. This was found especially useful for understanding exceptions. (Saiedian and Dale, 2000) In terms of really involving the end-users, focus groups provides a good opportunity to discuss specific issues with a distinct group of people (Alam, 2002).

Also, there are some frameworks explored by Coughlan and Macredie (2002) such as MUST, JAD and SSM that try to spur participative behaviour. The common denominator of these seem to be socially oriented practices highlighting the role and tasks of the user.

A challenge regarding Elicitation identified by Kujala et al. (2005) is that customers and users are not involved enough. One good way to involve the users is to go on site visits and talk directly with the users (Inayat et al., 2015; Alam, 2002). Prototyping can also be used as an elicitation tool, monitoring the usage or receiving feedback from a user is an efficient way of deepening the understanding regarding the requirements (Saiedian and Dale, 2000).

Modeling

A more passive way of conducting RE could mean customer created models or co-created models together with the supplier. Whitehead (2007) notes that the users could very well be part of design. If the users only take part in expressing their needs and during the final testing they become disengaged. Whitehead (2007) in overall advocates for a deeper involvement of the users.

Another interesting way of involving the customer also found by Whitehead (2007) is involving the customer in the development. Especially for large enterprise systems where there is need for customization a deep understanding of the technical aspect of the product is needed. A way to address this is to invite the customer to take part in smaller scale coding and customization tasks. This engages the customer and maintains the interest in the process, also enabling them to actively ensure their needs are met.

Validation

Stakeholders from the customer organisation, typically product managers at minimum need to be involved in validating the requirements. Although this can be done in many ways Inayat et al. (2015) finds that direct contact is the most efficient way. Techniques for validation are review meetings, accep-
tance tests, (Paetsch et al., 2003) scenario based validation (Van Lamsweerde, 2000), requirements checklists and utility tests (Jiang et al., 2008) to name a few.

It is important to involve the users and not only product managers in this process. Focus groups can also be a useful tool for validation. (Alam, 2002) As with elicitation, prototypes are as well a great way of validating requirements as it involves first-hand usage of a partially finished solution. A good practice regarding prototypes is initially keeping it rough and rudimentary enabling diverse feedback. (Saiedian and Dale, 2000)

Requirements management
A key principle of agile RE is prioritization of requirements (Cao and Ramesh, 2008). One of the most clear ways of involving the customer is letting the customer prioritize (Inayat et al., 2015). Inviting the customer to use collaborative tools for handling requirements is one tangible way of achieving this. The customer is then able to add and edit requirements using that tool. (Whitehead, 2007)

3.4 Understanding Customer Requirements

When a customer is understood a good solution can always be developed. To caricature this, one could say that requirements engineering is the process of gaining understanding of the customer.

This section will dive into the area of creating the understanding of the requirements.

Understanding is gained through communication and not limited to verbal communication. Coughlan and Macredie (2002) notes that communication is based on three activities that applies to the requirements. Knowledge acquisition, gaining the raw knowledge and initial understanding of the requirements. Knowledge negotiating, knowledge regarding the requirements discussed and negotiated for sense-making. User Acceptance, aligning the viewpoints of the both parties essentially agreeing that the understanding is reciprocal.

Therefore, as communication is based on three activities according to Coughlan and Macredie (2002). This section been split into three parts representing activities for creating understanding; Gaining understanding, Cultivating understanding and Validating understanding. Roughly translating this to the RE process, gaining understanding would represent elicitation. Cultivating understanding could translate to the activities of modelling and
analysis. Validating understanding would represent validation & communication. However, the translation is rough and the three activities of creating understanding partly consists of overlapping RE activities. The section will be concluded by reviewing some of the most critical challenges.

3.4.1 Gaining Understanding

Gaining understanding is very tightly linked to elicitation. Coughlan and Macredie (2002) identifies six different communication techniques in elicitation, or more precisely mediums for the communication.

1. **Traditional** - Interviews, documentation, questionnaires etc.
   - Gather initial background information (Hickey and Davis, 2003), gain large amount of data quickly and domain understanding (Zowghi and Coulin, 2005)

2. **Group** - Workshops, focus groups, brainstorming
   - Gain diverse and all encompassing information, empowers creativity and enables gaining new requirements instead of perhaps taking the requirements from a previous system. (Hickey and Davis, 2003) Identifies the high level requirements, innovative knowledge (Zowghi and Coulin, 2005)

3. **Prototyping** - Paper, prototypes, mockups
   - Get detailed information and feedback (Zowghi and Coulin, 2005) enhances the understanding (Saiedian and Dale, 2000). Appropriate when there is a mutual trust (Hickey and Davis, 2003)

4. **Model-driven** - Scenarios and other models
   - Facilitates the thought process, deepens understanding through finding inconsistencies and missing information (Hickey and Davis, 2003). Gain insight in specialized knowledge (Dieste et al., 2008)

5. **Cognitive** - For example protocol analysis
   - Appropriate in later phases of the project (Hickey and Davis, 2003). Gain the rationale behind the processes (Zowghi and Coulin, 2005)

6. **Contextual** - E.g. ethnography i.e. observing stakeholders
• Good if there is an existing system or due to limitations in resources at the customer organisation (Hickey and Davis, 2003). Identifies the interaction between the users and the system (Zowghi and Coulin, 2005)

There is a grand variety of techniques that serves different purposes, one challenge already is to select the proper mediums for communications and the appropriate elicitation techniques under that. (Zowghi and Coulin, 2005) suggests that interviews, domain analysis and group based approaches can be used for finding the techniques that are applicable.

It is not only enough to select the ways of gaining understanding, they must be properly undertaken. Interviews should be prepared prior to the interviews so that answers to specific topics are gained (Zowghi and Coulin, 2005; Dieste et al., 2008). Communication needs to be done with the correct stakeholders (Saiedian and Dale, 2000). The requirements engineer needs good social and communication skills (Hickey and Davis, 2003). Also much depends on the customer, their communication preferences greatly affects the techniques that in practice can be realized(Saiedian and Dale, 2000).

Saiedian and Dale (2000) offers some general pinpoints of making the communication efficient.

• Don’t make assumptions repeat questions rephrasing from different perspectives
• Ask for clarification, do not be afraid of admitting not knowing anything
• Gather from multiple sources
• Be alert for inaccuracies

It is clear that the prerequisite for understanding the customer is to know from where to retrieve information and how to retrieve this. The complex nature of this task highlights the needs for the multidimensional skills the requirements engineer needs.

3.4.2 Cultivating Understanding

The techniques mentioned in the section above are related to elicitation. However, in terms of “cultivating” the understanding many of the same can be used, especially those related to deepening the understanding. However,
this section focus on the tasks not building on interaction with the stake-
holder. Those tasks that the requirements engineer internally has to under-
take to generate the “real understanding”.

One of the main goals is to build a model that a) makes sense to the
creator and can be analysed b) can be validated with the customer. A repre-
sentation only makes sense to the user if it can be related to the requirement
and the discussion that was done prior. (Coughlan and Macredie, 2002)

Although the cultivation of understanding doesn’t directly involve in-
teraction it doesn’t mean that customers cannot be involved in tasks such
as modelling. Hickey and Davis (2003) actually finds that models tend to
be much better when they are co-created with the customer. However, co-
creation builds on customer input and thus maybe more characterized as
elicitation and “gaining understanding” in this context.

3.4.3 Validating Understanding

Understanding can be validate in what Coughlan and Macredie (2002) refers
to as user acceptance. This is where viewpoints from both sides are merged
and discussed. As help models can be used such as prototypes.

3.4.4 Challenges

To conclude this section some of the challenges regarding gaining underst-
anding will be discussed.

The challenges are diverse and are not only related to communication.
Resistance is one issue that is common in any change process, such as a new
software. Another issue is articulation and expertise, perhaps most visible
through a different terminology and a different skill set. The perspective also
differs which can prove to be a problem, for developers it can be hard to fully
take on the hat of an end-user. (Saiedian and Dale, 2000)

Implicit information is also hard to gain, if the basic assumptions differs,
stakeholders can still believe they are discussing the same thing (Burnay
et al., 2014). Tacit knowledge is a good example of information that is seen as
implicit. Kujala et al. (2005) notes that the increased amount of automation
in computer systems also removes tacit knowledge. Users get accustomed to
triggering chains of actions instead of handling them separately effectively
removing the understanding of the sub- processes.
Chapter 4

Empirical Study

4.1 Current RE Practices at the Case Company

Every customer is unique and although customers might be in the same field their labs might work in a completely different way. This uniqueness is not something that only is seen in different requirements. It also means that each customer have their own set of preferences of conducting the project which naturally also affects how requirements are handled.

The case company implements a system that fulfils the requirements of the customer. Although, it is implicit one must emphasize the word “customer” here. The requirements engineering process is about the customer requirements and it is clear that the customer in the end is the party deciding what the requirements actually are. This does not mean that the case company doesn’t have a role in this process. However, this means that the case company’s role in certain project might be lesser. In these cases the role tends to be more of a supportive type and typically more of a facilitator. The end goal is of course for the case company to understand the needs so that the requirements can be defined and implemented. How active the case company is in also discovering the needs depends.

Varying preferences regarding the requirements engineering process itself, and the fact that the customer has the final say regarding the requirements means that the requirement phase of each project can differ greatly. In terms of extreme cases this means that either the customer provides a list of requirements which they want to have implemented, or they just expect a ready product. In the first case mentioned, it of course doesn’t mean that the case company swallows them as presented. However, this means that the case company might never actually take part in the process of discovering
them. On the other side of the extreme is the case where the “customer orders a LIMS”. This typically might be seen with customers without a prior system for whom it might not be clear what they actually want. A project as such means that the effort required by the case company is on a completely different level and actually needs to take the role of finding the requirements.

The extreme cases presented are of course extreme and in most cases the requirements engineering effort falls somewhere in between. As stated, in the end the RE process will depend heavily on the customer, but there are some common variables that affects how the work around the requirements generally turns out to be.

- **Sales**: How much project resources have been allocated to requirements engineering related tasks.

- **Size of the project**: Smaller projects are sometimes less formal and the division of responsibilities might be more loose.

- **Customer project team**: This will be discussed further but the most notable are effort, know-how and preferences

- **Previous systems**: With a previous system as basis it is easier for the customer “by themselves” to find and document the requirements

- **Process**: A formal project process such as a “waterfall model” requires dedicated resources for requirements engineering. A more agile process might mean that the requirements are more handled ad-hoc.

RE at the case company is very customer oriented and the practices used cannot be applied to all project. In this section the practices used will be described.

### 4.1.1 Customer Projects at the Case Company

Although, this section does not present results about how RE is conducted at the case company it is important to briefly explain how new projects in general are handled at the case company. Guiding the work of the employees at the case company are Work Instructions describing how projects ought to be handled. As the thesis focus on RE, all project steps and sub steps won’t be described as it is not relevant here. In this subsection a general description of how a project proceeds is described.

The process starts with sales, and the effort here might vary a lot depending on the customer. Typically, there is a competition between other
vendors of LIMS- systems and the criterion for selection varies and are not always known by the case company. Often the customer has a preliminary list of requirements and are interested in how they would be addressed in a solution provided by the case company. This means that especially in the latter phase of sales, developers can be involved to answer more technical questions and demonstrate solutions. In other words, the requirements dimension is already present in the sales phase. The sales phase falls out of the scope of this thesis but it is worth noting that requirements are present already at that phase. The other thing worth noting is that the sales proposal usually is split to parts where the design phase involving requirements engineering could be a separate phase. This means that the resources that should be put on requirements engineering is predefined. In practice this means that for keeping the budget project managers at the case company face time constraints. The general consensus according to the interviewees at the case company was that design phase usually takes at least a little bit more time than planned.

After successfully selling a project to a customer, the project actually starts as then the customer has ordered a LIMS. The following steps involves planning and internal preparation resulting in a project plan that is accepted both internally and by the customer.

This planning phase ends with both internal kick of meetings and kick of meetings with the customer, after which the project moves to the phase of execution. The execution phase starts by introducing the key users to the product and giving them some training. The project then proceeds to the phase referred to as “Specification Review”, during this phase all RE related tasks are covered and will thus be discussed in detail in the rest of this section. After this phase the project moves on to implementation followed by installations and various testing and ends in the signing of the acceptance document.

When the project has been implemented and accepted, the project is closed and internally evaluated by the case company.

4.1.2 Requirements Engineering at the Case Company

Formally requirements engineering as a term is not widely used at the case company. In the official work instructions the tasks related to requirements engineering is referred to as specification review. However, this does not mean that the term is unknown to the personnel at the case company.

One of the first questions asked by the staff in the interviews was “What is the first thing that comes to your mind when hearing the term Requirements Engineering”, the answers were twofold essentially alluding on the
same thing. Some reported that the first coming to mind are the requirements supplied by the customer and the work around involving them, others saw it more to be the interaction with the customer regarding the requirements.

When asking how RE in practice is seen in their work, most thought of discussions, emails, workshops and other interactions combined with all the documentation that are built around them. One concluded that RE actually constantly is present as anything he/she does are based on the requests from the customers.

In terms of process most acknowledged that it very much depends on the customer and the size of the project, as well as the type of project. Typically the customer has done some requirements engineering themselves prior to the beginning of a project. The main task for the case company in a new customer project is to provide the solution for those requirements. This is done in the functional specification, a document which is always created by the case company. However, the case company still has a role in finding the requirements. The initial requirements of the customer needs to be refined and specified. This is largely done in co-operation with the customer. Still, in terms of responsibilities the division of work is quite clear, the customer provides the requirements and the case company the solution. This is illustrated in Figure 4.1.

There was a general consensus that the multitude of the work regarding RE is done in the beginning of the project prior to implementation. Also, RE seems to be quite iterative needing refinement through inputs from both
CHAPTER 4. EMPIRICAL STUDY

parties. Regarding the RE process itself much depends on the general project methodology whether or not RE is agile or not. There was a clear bias towards more agile projects in general and agile RE. Many preferred agile project methodologies and in those projects RE is more or less embedded in the development process itself with an emphasis on minimizing excessive work prior to development.

When a project is agile the interviewees reported that the development tasks usually are split into amenable wholes and prioritized. Starting from refining requirements and discussing details regarding the implementation the feature or part of the system is then developed. In some cases even unfinished versions containing only the most critical features are shipped to the customer during the implementation project. This allows the user to actually see how the requirements are addressed in the system, also opening up discussion for detailed requirements regarding that specific part. When both the case company and the customer are able to look at the same screen with even just a prototype the final requirements can much easier be specified. One interviewee explained that the iterations help to specify but also find additional requirements that perhaps wasn’t clear from the start. Also, the documentation in one sense builds up by itself through the iterations especially if both the customer and the case company have a common platform for managing the development (eg. Jira). Figure 4.2 shows a simplification of this process where RE is embedded in the development.

One clear disadvantage with “waterfall” -type of projects is that it doesn’t give the flexibility regarding requirements that in many cases can change. As one interviewee explained: “especially if it is a customer without prior knowledge of LabVantage it is hard to explain the possibilities but also the limitations without having anything to show”. Predefining too much might thus be a clear disadvantage as it does not necessarily give the optimal product from a LabVantage perspective.

To put the process more in detail and opening up the process described in Figure 4.2, Figure 4.3 has been created to illustrate the most significant steps.

The process in Figure 4.3 is split into two parts one covering the first iteration and the second on the right the subsequent iterations. The first iteration covers the part where a new requirement is received by a customer. The requirement might already be quite precise and well document but it might also just be a high level description of something that the system should be able to do. This requirement is then processed by the case company. It is documented, visualized perhaps already in this phase piloted and then analysed. The analysis provides the means for understanding potential gaps in the initial requirement and issues it might cause. The gains of this
CHAPTER 4. EMPIRICAL STUDY

Figure 4.2: RE in relation to the development process

Figure 4.3: The typical RE process in customer projects
analysis is then presented to the customer using the models created essentially asking the question “is this what you are looking for?”. This enables getting feedback and precisions creating a new iteration of the process that is repeated as many times as needed. Typically at a quite early point the case company will also start developing the solution to that requirement. Demos and pilots are widely used for validating requirements.

Relating to Table 3.1.3 in section 3.1.3 and the practices described in the interviews it becomes clear that RE is done in a quite agile manner. Not only is the process iterative but fulfils many characteristics of an agile process. Documentation is light and informal communication is used extensively. Developers are involved with customers. Requirements are prioritized and requirements management is done throughout the process. Also to be noted 4.3 describes the RE process from a theoretical point of view. In practice and as seen by the staff at the personnel the process is not that complicated. The managers are given quite loose reins and in most cases it doesn’t consist of specific steps involving requirements engineering.

One clear and very beneficial agile method is the usage of pilots & demos along with rapid implementations. This provides quick results and perhaps one of the most fool-proof way of validating the requirements. A typical risk is redundant work if the requirements are understood. A fully developed solution to a misunderstood requirement likely costs a lot of working hours. Rapid implementations and iterations minimize this risk. This highlights the importance of really understanding the customer and their requirements and the need for constantly getting the feedback needed.

To conclude, based on the interviews there are no clear practices that can be said to be applied to all projects. It doesn’t only depend on the customer what path is taken, it depends also on the Project Manager from the case company. The grassroot work regarding finding the initial requirements are mostly done by the customer and the case company has to respond from them. Continuing from that, much is done co-operatively with the customer.

4.1.2.1 Work Instructions & Standard Operating Procedures

Before diving deeper into the results of the interviews, the results of the other sources of the empirical study will be described. This include the formal definitions of RE through work instructions and Standard Operating Procedures (SOP).

RE is quite loosely defined in the formal work processes at the case company. The SOP also emphasize that much is done depending on the customer preferences thus making a more loosely defined process legitimate.

The Standard Operating Procedures (SOP)’s are on a higher level than
CHAPTER 4. EMPIRICAL STUDY

the work instructions. The SOP for project management state that the
project may or may not include a functional specification in the beginning
of the execution phase for a project. The functional specification document
shall describe the functionality needed to fulfil the requirements. The SOP
leaves the manner this is done open but states it might include workshops.
Also, the format and the name is open for alterations. It doesn’t have to be
written text, it can be an Excel, Jira or other suitable tool and can be named
based on what is applicable.

The work instruction refers to this as “Specification review” that includes
functional specification. This consists of two distinct actions called informa-
tion collection, workshops along with some actions regarding the specification
document itself such as creation, review and approval.

4.1.3 Used Practices

After a few interviews it became clear that the managers also have their own
preferences regarding how to conduct RE in practice. Essentially they all
have the same palette of tools but there seems to be different emphasis on
them.

4.1.3.1 Workshops

The practice that was mentioned in all of the interviews was workshops.
Often more frequent in the beginning of the project concerning broader topics
such as the general workflow in the lab. As the project progresses they
typically become less frequent but concerns more specific topics.

Based on the answers workshops seems to be the primary tool for eliciting
the requirements. The main issue perceived was having too loosely defined
topics, the better defined the better the stakeholders can prepare. From the
case company’s point of view a successful workshop depends on whether or
not the desired input is gained. Unless the customer is prepared this can
be hard to achieve, some of the interviewees reported that they sometimes
actively have to push the customer to prepare.

The main benefits of workshops was having face-to-face communication
allowing seamless interaction.

4.1.3.2 Prototypes & Pilots

Although technically not the same, the case company both use pilots and
prototypes. In this context they do not necessarily need to be distinguished
as the means to achieve them are the same, the main difference comes through the underlying philosophy.

As the core of the system consists of “off-the-shelf” functionality which is then enhanced and customized by the case company it allows rapid showcasing of solutions. This is drawn advantage of already in sales but in many cases in the early phases of the project. This is referred here as a pilot.

Pilots are typically stripped down versions of the “Out of the Box”- product containing only that functionality that the customer might be needing. Many interviewees reported that this is an excellent starting point for a project. Without having done any “real” development nor specific requirements engineering there already exists something to build on and discuss.

If to make a clear distinction, prototypes on the other hand are what is referred to in Figure 4.2 as a partially developed solution. A prototype already addresses some specific request from the customer and typically already contains some customization. The prototype is a response to a customer requirement as it answers how the requirement could be addressed in the system. This then gives the opportunity to further discuss and define the real requirement.

The main strengths perceived with prototypes & pilots was that the customer get accustomed to the system by having something tangible to test, comment on and experience. It was also reported that many times it is easier for the case company to create and showcase instead of formally defining through eg. documentation. In many cases a “prototype” already provides a good part of a functionality desired.

4.1.3.3 Documentation

Although, the preferred way of working was keeping everything flexible none of the interviewees downplayed the role of documentation.

There seems to be two levels of formal documentation that commonly are used during projects; Functional Specification (FS) and Design Specification. A more informal way and quite common way is the usage of Jira\(^1\). Other informal types of documentation are sketches and the bare minimum can be as simple as emails.

The general idea behind documentation is that it serves as the answer to the customer requirements. Unless the customer is very flexible then this is almost always needed. In the end it is the customer requirements that are implemented into the system even though the case company can have a varying role in finding them. Thus meaning that the customer either

\(^1\)https://www.atlassian.com/software/jira
provides the list of requirements or signs off a list created in co-operation (the user requirement specification URS). The initial “list of requirements” might be incomplete or only encompass the most important ones, meaning that requirements engineering doesn’t end at that point. The documentation itself tends to be iterative and reaches its final form in the closure of the project.

Some of the interviewees prefer to split this “answer” to the URS into a functional specification and design specification, but essentially still responding to the same question “how are the requirements addressed in the system”. If applied a two-layered documentation, the functional specification tends to be more specific whereas the design specification is more broad.

Jira is a very common tool used in agile development and provides a mean to manage projects. If Jira is used for documentation it means that the requirements are gathered there. Especially for more specific requirements this can be very useful if also the customer has access to the Jira. In these cases the customer can easily add new requirements that are then addressed by the case company.

4.1.3.4 Other

In many cases the project staff at the case company also visit the customer site. The closer the site, the more frequent the visits tend to be. The site visits especially useful as it gives the case company an opportunity to actually see the processes in the labs that are to be supported by the system. This also gives the opportunity to ask questions directly from the personnel working at the lab but only one interviewee reported that also specific interviews have been made at the customer site.

Another practice used, tightly coupled with pilots is gap-analysis. Instead of trying to discover the requirements through other means they are defined through what is missing from an incomplete system.

4.1.4 The Customer Perspective

The perspective of the customer will here be reported according to the themes used for categorizing the data from the interviews; Challenges, Communication, Discovering Requirements, Documentation, Process and Roles. Suggestions, also a theme in the interviews will be reported in the following section (4.4 Improvement suggestions).
4.1.4.1 Discovering Requirements

The first clear contact the customer has with the requirements comes much earlier than during the start of the project. One of the very first tasks for the customer after deciding to purchase a LIMS is choosing a supplier. The customer naturally wants multiple offers from various suppliers, thus sends RFP’s (Request for proposal) to LIMS vendors.

In order to get a credible offer the customer must already at this point have an understanding of the requirements and communicate them to the possible suppliers. This already is a demanding task as one of the interviewees explained. Making a RFP containing all the requirements is already difficult enough. Making a RFP that suppliers easily can process is even harder. The interviewee experienced that it was helpful to listen to the suppliers when creating the RFP to in overall gain an understanding of the possibilities “out there” and thus also better being able to formulate the requirements.

The aforementioned customer didn’t have a previous system whereas another customer was replaced an old software with the new LIMS. That customer reported that it was a huge benefit being able to based on the old system start formulating the initial requirements. However, the interviewee emphasized that the new desired features must be taken into account and functionality perhaps needed in the future. Too much leaning back on an existing solution might create a “tunnel vision”. Also, in terms of moving forward demos and example solutions provided by the case company were seen as useful for elaborating and better understanding their requirements.

But whether or not the customer has a prior LIMS the interviewees explained that a practical approach is needed. What are the real processes going on in the lab and what are the processes the system must support in the future.

4.1.4.2 Process

The LIMS delivery projects of the interviewed customers had been more or less agile and iterative. The customers experienced that iterative work was feasible, especially breaking it down to parts was very helpful as it created clear areas of focus. One interviewee explained that they started with only one division in the lab. Not only was it a good way of limiting the scope but also limited the people involved. That interviewee experienced that part of the success was not having too many people involved at the same time.

Another clear benefit was having the technical expertise available early on. Meaning that the participants in discussions and workshops from the Case Company were also the ones developing. This minimized the need for
“pure” project management where the manager or managers working for the Case Company only serves as inter-mediators.

Iterative work however needs structure with clear tasks and deadlines. One interviewee explained that this worked very well in the beginning with weekly iterative cycles and meetings. During the latter phases of the project some of this structure was lost and the efficiency decreased.

4.1.4.3 Documentation

In terms of documentation at least three types of documentation was mentioned during the interviews. Requirements specification, process documentation and then a “line in the sand” documentation containing the mandatory requirements. Although only mentioned by one interviewee the documentation also seemed to consist of internal and external documentation where external documentation was that which reached the Case Company. The external being the refined and filtered result of the internal documentation. Although not necessarily referring to requirements, the customers emphasized that taking notes during discussions was very important.

The “line in the sand” document consisting of the list of mandatory requirements was used by one of the customers and was also specifically written to the project plan. As the process was agile and requirements could change along the process the document was helpful as a reminder of what actually had been agreed on. This list of requirements was also the one sent out to the potential suppliers in the RFP phase.

Regarding requirements specification one customer explained that it was entirely new for them, none had done requirements specifications before. The challenge was how to formulate them correctly.

The customers that had used Jira also reported it was a nice way of maintaining low-level documentation. One customer also suggested that maybe documentation could be generated automatically from Jira as well.

4.1.4.4 Communication

The channels used for communication during the projects were email, phone, Slack\(^\text{2}\), VoIP, Jira and face to face. In terms of written communication mail was used for more larger questions, more informal questions were sent on Slack. The informal written communication was deemed useful as the process never stopped and information could be exchanged rapidly. Slack and Jira was also seen useful as it automatically kept people in the loop.

\(^{2}\text{IM software eg. see https://slack.com/features}\)
One key element was direct communication with developers and the customer. This ensured that the technical expertise always was present in the discussions and minimized misunderstandings. Not only is technical expertise needed, one interviewee mentioned the consultants also were able to talk with the customer without making it too technical. The same interviewee who was in charge of the project also told that his/her own technical expertise was very useful. That enabled the interviewee to also discuss technical matters with the case company and thus being able to bridge the gap between the technical expertise of the case company with the practical of the customer.

4.1.4.5 Roles

The customers interviewed experienced that the division of work was quite clear. The customer must provide the requirements and have the understanding about the problems. The supplier on the other comes with the solution and implements it. As one customer explained, “the roles derive from the knowledge which the persons represent”.

It was felt appropriate that the division of work also was clarified in the agreement. However, one interviewee mentioned that it was good that the roles were not too formal and thus didn’t create a sort of opposition between the two parties. Instead the different skills from the two parties were used to together take the project forward.

4.2 Strengths and Challenges with Current RE Practices (RQ1)

This section reports the current challenges the case company faces when conducting RE. It also reports the good practices in use that are deemed beneficial. Therefore, in this section the answer to the first research question regarding the strengths and challenges with current RE practices are given.

Section 4.2.1 and 4.2.2 takes into account the data gained from the interviews at the case company thus offering their perspective of the question. The latter two sections 4.2.3 and 4.2.4 offers the viewpoint of the customer.

4.2.1 Challenges

There are a multitude of challenges when conducting RE and some of the challenges have already been mentioned previously in this chapter. This section compiles them into a distinct entity and highlights the most common
ones. Based on the answers of the interviewees they have been grouped in Table 4.1.

The two dimensional table groups the challenges into categories horizontally and vertically according to a domain. The columns/domain (Customer/Internal/Common) describes where the challenge is perceived. Internal challenges are issues the project team might experience regardless of the customer behaviour and thus more or less independent. In contrast, challenges in the customer domain are challenges directly resulting in how the customer works and through interactions with the customer. The customer challenges are from the case-company’s point of view and thus not necessarily experienced by the customer. Common challenges affects both customer and the case company thus challenging the whole process.
### Table 4.1: Challenges conducting Requirements Engineering

<table>
<thead>
<tr>
<th>Category</th>
<th>Customer</th>
<th>Internal</th>
<th>Common</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Communication</strong></td>
<td>Making sure the customer actually understands</td>
<td>Expressing requirements to the developers</td>
<td>Establishing a common terminology</td>
</tr>
<tr>
<td></td>
<td>Communicating with the wrong customer representative</td>
<td></td>
<td>No language in common except English</td>
</tr>
<tr>
<td></td>
<td>Changing requirements in the end of the project</td>
<td></td>
<td>3rd-party requirements eg. compliance with standards</td>
</tr>
<tr>
<td><strong>Requirements</strong></td>
<td>Customer doesn’t know what it wants</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Resource</strong></td>
<td>Project team too large</td>
<td>Insufficient resources</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insufficient resources</td>
<td>Wrong resources</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waterfall projects</td>
<td>Explicit good practices not existing</td>
<td>Understanding the exceptions</td>
</tr>
<tr>
<td><strong>Process</strong></td>
<td>Too many/specific requirements</td>
<td>Making it too specific early on</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contradicting use cases</td>
<td>Adapting to the process preferred by the customer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Focus on solutions instead of requirements</td>
<td>Not challenging the customer regarding the requirements</td>
<td></td>
</tr>
<tr>
<td><strong>Documentation</strong></td>
<td>Inability to explain writtenly</td>
<td>Making it specific enough for developers</td>
<td>Misunderstandings through written documentation</td>
</tr>
<tr>
<td><strong>Constraints</strong></td>
<td>Customer team not motivated/committed</td>
<td>Budget constraints</td>
<td>Different timezones</td>
</tr>
<tr>
<td></td>
<td>Requirements that cannot change</td>
<td></td>
<td>No F2F meetings</td>
</tr>
<tr>
<td></td>
<td>Customer doesn’t understand the system</td>
<td>Not understanding the customer domain</td>
<td>Too large knowledge gap between customer and case company</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Internal disagreements at the customer</td>
<td>Making too specific pilots</td>
<td>Explanations without examples</td>
</tr>
<tr>
<td></td>
<td>Customer not able to answer questions</td>
<td>Mastering the skill of RE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inability/ reluctance to make decisions</td>
<td>Follow up of budgeted/realized hours</td>
<td></td>
</tr>
</tbody>
</table>
Some of the challenges are very obvious such as insufficient resources which is a problem experienced in both the customer and the internal domain. Although, in practice they might not be easily solvable they still have the clear solution of “adding more resources”. Internal problems at the customer such as disagreements are perhaps not even solvable through the actions of the case company.

The conclusion that can be drawn from the list of challenges is that there are no easy remedies. Much of the challenges are so to say variables of the people taking part in the RE process both on the customer and the case company side. This highlights the fact that RE is a discipline requiring social skills such as negotiation skills and communication skills.

4.2.2 Strengths

Similar to the previous section regarding challenges, this sections summarizes the strengths of the current RE practices. The strengths have been divided into two parts “Success Factors” (Table 4.2) and “Perks” (Table 4.3). The difference between the two of them is that the “Success Factors” have more impact and also identified by most of the interviewees. The perks on the other hand are more on a “nice to have” - level not maybe as powerful as the success factors. Some of the perks were also only mentioned by one of the interviewees thus also given less weight.
### Table 4.2: Success Factors in the current RE process

<table>
<thead>
<tr>
<th>Success Factor</th>
<th>Main Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage of prototypes</td>
<td>Something visual and tangible to discuss</td>
</tr>
<tr>
<td>Documenting the customer workflow</td>
<td>Ensures a clear understanding of what actually is going on in the laboratory. Done by the customer or by the case company</td>
</tr>
<tr>
<td>One clear project manager at the customer</td>
<td>Streamlines the work as the case company knows who to turn to. This person can then internally delegate and investigate if needed. Doesn’t mean other persons cannot be used for direct communication.</td>
</tr>
<tr>
<td>Having a common terminology</td>
<td>Ensures that both the customer and the case company refers to the same things in discussions.</td>
</tr>
<tr>
<td>Usage of Jira</td>
<td>Easy to use and agile tool that makes communication easy and visible for both parties. Cleverly used it serves as documentation as well.</td>
</tr>
<tr>
<td>Good relationship with the customer</td>
<td>Obvious but critical. Especially a sense of mutual trust is needed for working smooth.</td>
</tr>
<tr>
<td>Site visits</td>
<td>Through site visits the case company gains first hand knowledge of what is going on in the laboratory. Reduces misunderstandings and makes understanding the customer much easier.</td>
</tr>
<tr>
<td>Iterative work</td>
<td>Removes the need for “getting it right the first time”. Requirements that are allowed to change and that can be refined usually delivers a better solution and can also save resources.</td>
</tr>
<tr>
<td>Workshops with specific themes</td>
<td>Workshops are the main forum where requirements are discussed and defined. Making each of them count through careful preparation and follow-up and setting up clear themes significantly increases the productivity.</td>
</tr>
</tbody>
</table>
Table 4.3: Perks when working with RE

<table>
<thead>
<tr>
<th>Perk</th>
<th>Main Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asking and giving feedback</td>
<td>Transparent discussion all the time, makes it possible to identify problems perceived by one of the parties.</td>
</tr>
<tr>
<td>Specification phase sold separately</td>
<td>Removes anxiety of using too much resources on RE that might be needed for development.</td>
</tr>
<tr>
<td>Receiving written use cases</td>
<td>Reduces the need for going through everything in detail and reduces the risk of information getting lost in eg. meeting notes.</td>
</tr>
<tr>
<td>Assigning tasks to customer</td>
<td>Sometimes not needed and takes courage but beneficial for getting things move forward.</td>
</tr>
<tr>
<td>Utilizing existing knowledge inside the case- company</td>
<td>Instead of re-inventing the wheel draw on know-how from other similar projects</td>
</tr>
<tr>
<td>Give the customer training about the system</td>
<td>A customer that understand the Labvantage system can much easier give input and better understands what is easy and what might be difficult.</td>
</tr>
</tbody>
</table>
4.2.3 Challenges Experienced by Customers

Some challenges experienced by the customers have already been mentioned in this chapter. Here, similar to the challenges experienced by the staff at the case company, the challenges experienced by the customer are compiled to a single list and briefly explained.

**Challenge 1:** No one had worked with requirements specification earlier.

**Challenge 2:** Hard to make a RFP so that the supplier can answer it.

**Challenge 3:** Customer wasn’t aware of all internal resources available.

**Challenge 4:** Hard when it is a new system not a system replacing an older one.

**Challenge 5:** Documentation sometimes too light. At least more meeting notes should be taken.

**Challenge 6:** Limitations of “off-the-shelf” products. The requirements must to some extent also take into considerations the limitations of LabVantage.

**Challenge 7:** Learning about LabVantage. Without any knowledge of the system work is much more difficult.

**Challenge 8:** Specific requirements, such as contents of reports needs to be precisely specified.

The challenges identified were of very different types and quite customer specific. The challenges seems to be a variable of the skills and resources available as well as the environment.

4.2.4 Strengths from the Customer Perspective

This section is concluded by evaluating the factors the interviewees found to be useful. They are here referred to as *enablers*, factors enabling the process to be smooth and factors helping the customer to work with the requirements. Table 4.4 lists the enablers and similar to the internal success factors describes the main benefit.
### Table 4.4: Customer Enablers

<table>
<thead>
<tr>
<th>Enabler</th>
<th>Main Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demos &amp; Clear examples</td>
<td>The customer gets a clear understanding of how the requirements will be taken into account in the system.</td>
</tr>
<tr>
<td>Supplier ability to ask correct questions</td>
<td>The customer cannot know exactly what information the supplier needs. The supplier must be able to proactively acquire that information.</td>
</tr>
<tr>
<td>Informal communication</td>
<td>Rapid answers and keeps the process flowing</td>
</tr>
<tr>
<td>1 PM at customer and 1 PM at the supplier</td>
<td>One clear instance in both organisation to whom one can turn to. Also has the authority to make decisions.</td>
</tr>
<tr>
<td>Direct contact with the correct people</td>
<td>Minimizes the risks for misunderstandings, the need for extra project management related tasks are minimized as there is no overhead.</td>
</tr>
<tr>
<td>Keeping initial requirements on a broad level</td>
<td>Going too specific early on can be dangerous, start broad, discuss, iterate and only then specify.</td>
</tr>
<tr>
<td>Agile work</td>
<td>Makes changes easier and generates quicker.</td>
</tr>
<tr>
<td>Clear division of work</td>
<td>Preferably in the agreement, creates a good foundation for co-operation.</td>
</tr>
<tr>
<td>Start with smaller parts, enlarge later</td>
<td>Minimizes the risk for overextension where everything is trying to be solved at the same time.</td>
</tr>
<tr>
<td>Compact project team</td>
<td>Too many people damages the ability to make decisions and slows down the process.</td>
</tr>
<tr>
<td>Involve technical aspects early on</td>
<td>Makes it possible to create requirements based on the technical limitations and possibilities of the system.</td>
</tr>
<tr>
<td>Minimize pure project management related tasks</td>
<td>Saves time and makes it possible to focus on the important.</td>
</tr>
<tr>
<td>Customer PM as knowledge sharer</td>
<td>Shares and receives information within the customer organisation and communicates them to the supplier. Keeps PM up-to-date and minimizing the risk of information not reaching the correct instance.</td>
</tr>
<tr>
<td>Knowledge of the system</td>
<td>At least a rudimentary understanding of LabVantage enables the customer to better understand and also specify requirements.</td>
</tr>
<tr>
<td>Thoroughly thought initial requirements</td>
<td>Makes it clear in the big picture what the system should do and maintains the purpose of why the system was acquired.</td>
</tr>
</tbody>
</table>
4.3 Customer Involvement during RE (RQ2)

This section provides the answer to RQ2. It answers how the customers can be involved in the RE process. As involvement means having a part in something this section will start by examining the responsibilities between the two parties. Involvement requires both parties being responsible for their respective parts.

4.3.1 Responsibilities

There was a clear consensus among the interviewees what the customer is responsible for and the responsibilities of the case company. In a nutshell, the customer is responsible for providing the domain knowledge whereas the case company provides the knowledge of the product. Thus, the final requirements are dictated by the customer but the case company must facilitate the customer to being able to express them.

The customer must have a clear understanding of the work processes in the laboratory to be able to express what they need. The ideal customer also is able to express them in a comprehensive manner both written in documentation and orally. Typically the result of this is the user requirement specification that the case company can use to build up the specification for the system. Also, the customer usually maintains some kind of check-list to ensure that the specification matches the URS.

It is not always easy for the customer to express and understand the requirements. The case company isn’t responsible for finding the requirements, it is responsible for facilitating the process. It cannot be expected that the customer knows what the system can do and cannot do. Therefore, the case company must provide this information. When the customer understands what the possibilities are they are able to better express the real requirements. In one sense as one of the interviewees reported, the case company’s responsibility is to see that the requirements make sense. If a customer has a requirement that for some reason could be problematic to implement or contra productive they should rather challenge the customer instead of swallowing them directly.
4.3.2 Involving Customers

One of the main challenges reported is situations when not enough input is received from the customer. Also, most of the interviewees reported that they benefit from keeping the customer involved during the whole project. In practice this means frequent communication using different means.

A good practice identified is to give Jira access to the customers. Not only gives it a common platform to store requirements, it also gives the possibility to assign tasks. Whenever something is unclear, the case company can ask and assign the question directly to a customer representative. Vice versa the customer can follow the progress and add additional information. Face to face communication was also deemed very important, situations such as workshops where both parties together discuss the requirements. During these sessions input from the customer in many cases is instant and helps establishing the deep understanding. Another way of involving the customer is sending almost finished versions of the Functional Specification to the customer asking for comments and ensuring that the customer also agrees with the content.

Although, there are ideal customers that automatically are involved and interested the interviewees recognized that much depends on them. A good workshop might mean that the customer needs to be prepared to answer some questions meaning that the project manager needs to define the agenda. Workshop and meeting notes are good to send to the customer and ask for comments. Also a project manager might need to actively create follow-up tasks and assign them to the customer. Typically, during workshops training is also given to the customer regarding the system. This is also a good way to keep the customer involved as it keeps their interest up when the discussion becomes less abstract. Keeping them engaged can also be achieved by using prototypes, it is a good way of receiving precise input. It is more interesting and meaningful for customers to talk about something that reveals how their end product will look like.

Many parts of the system can also be configured without any technical expertise per se such as defining what to be showed to the user and what not. A very powerful way of keeping the customer involved is to teach one or a few persons how to do easy configuration tasks. This involves the customer directly in the customization of the product and thus also the whole project.
4.4 Improvement Suggestions (RQ3)

So far an understanding of the problem, the context, processes, challenges and strengths have been established both from the case company’s point of view as well as from the customers point of view. This section uses all the empirical results gained and draws on theoretical knowledge for creating relevant improvement suggestions. The improvement suggestions here cannot be universal as there are no “best practices” that can used in all projects. However, there are a lot of “good practices” that definitely could be taken advantage of.

As one of the interviewees concluded, “it all comes down to relationships” explaining that a customer relation is a relation between humans. How you act is based on the reactions from your counterpart. Also as another interviewee explained “a good relationship of trust makes everything work much smoother”, even though it might mean going along with the customer preferences even though it necessarily isn’t that productive. Therefore, much of the success of RE lies in good interaction with the customer.

Prior to diving into the suggestions the current practices for creating understanding are reviewed in 4.4.1. This section then proceeds by categorizing the empirical findings into three areas of interest; Opportunities, Development Areas and Retainable Aspects. Opportunities refers to practices the case company doesn’t yet employ, practices that should be evaluated for taking into use. The development areas are aspects where issues are experienced and thus should be solved. The retainable aspects are those that are currently in use that are deemed useful, the improvement suggestions for these is how the positive effects can be amplified.

When the topics of the three areas of interests have been identified theoretical findings regarding these will be used for creating the final improvement suggestions. In the following three sections (section 4.4.3 - section 4.4.4) these will be discussed. Each of the sections start with listing the topics. Then proceeds to motivating the reason behind the suggestion of why it is something that should be taken into account. Finally the means of achieving that goal will be described.

4.4.1 Creating Understanding

As the role of the customer is to provide the domain knowledge and for the case company the knowledge of the system always leaves a gap in between. In very rare cases there might be a person having both knowledge but almost in all projects this gap needs to be bridged.
One of the main challenges is to find a common terminology. The system uses certain terms for describing and classifying the data in the system which is what the case company personnel is accustomed to. The customer might be using completely different terms meaning essentially the same thing. Not only does the terminology differ, also, the data model can be quite different in respect for example to a previous system used by the customer. The data model is perhaps the one creating most restraints in regard to what is possible and not as it is hard and likely unwise to deviate from it. Thus, it is important for the case-company to ensure that both parties talk about the same things using common terms whether or not they are the ones the customer prefers or the ones that the case company prefers. In addition the customer must understand at least the basics of the underlying logic behind the system. In practice it means holding training sessions and taking the time to explain to the customer especially through examples. The Labvantage system takes time to learn and one interviewee explained that keeping the customer motivated is a challenge.

Demos was the clear number one identified by the interviewees to help the customer gain understanding. The case company must also understand the customer and it involves asking whenever something is unclear. Sometimes visualizations of the customer processes can also be very helpful. “Challenging” the customer to explain might also be beneficial for the customer as it requires them to think through the work processes and perhaps rethink some of the requirements. Another good way for bridging the gap is to have a technical person in the customer project team. Sometimes this comes automatically and sometimes the customer might not have that kind of resource, but if possible it is very useful for bridging the “technical” gap.

4.4.2 Opportunities

Opportunity 1: Automated documentation

Addresses challenges:

- Related to documentation
- Related to resources

Documentation is a time consuming task which often might mean that the personnel at the case company have to revisit issues only to document them. Especially during the development phase there is content created by the customer and the case company regarding the requirements. This content could perhaps automatically be used for creating final documentation. Specifically
the functional specification could be generated this way. This would create a situation where parts of the documentation actually is co-created by the case- company and the supplier. Thus also a good way of keeping the customer involved and up to date with the process. Ways to achieve this could for example be through standardised use of Jira together with Confluence\(^3\). Confluence is a tool for documentation and can be easily integrated with Jira. Also, Confluence is already in use in other parts of the case- company organisation. Other options should also be explored as Confluence might not render reports that can be directly used.

**Opportunity 2:** Process planning together with the customer

**Addresses challenges:**

- Related to process
- Related to communication and interaction

Of course this is done already and much regarding the process is already in the agreement. It is classified here as a possibility as it probably could be much further taken into account especially from a Requirements Engineering perspective. This work has identified many good practices and potentially damaging aspects, why not share this information with the customer. It is likely that the customer is doing Requirements Engineering for the first time. The case company on the other hand has expertise and a clear understanding of what typically works well. This is not limited to the process itself also the case company could help the customer identify important stakeholders within the customer organisation and thus help with building the project organisation on the customer side.

Naturally one walks a fine line here. The case company most likely cannot dictate how things should be done and the preferred ways of working is not necessarily the preferred ways of the customer. In anyway, thoroughly discussing the process and agreeing on it takes the both parties towards a greater way of co- operating. This creates a process that the both parties deems beneficial.

This could potentially already be done in the sales phase of a project even though it technically wouldn’t be planning if the project isn’t yet the case company’s it could be a tool of winning the customer to our side. It could also be shared to the general public and potential customers on the case company’s website.

\(^3\)https://www.atlassian.com/software/confluence/features
Opportunity 3: Internal knowledge sharing within the company

Addresses challenges:

- Doesn’t address a specific issue but aims to help others solve issues that might have already been solved in other projects.

From the internal interviews at the case company it became quite clear that each PM has somewhat their own style of working. The way RE is done of course depends on the customer but likely a lot based on prior experiences of what has been working well. As project works is done in teams sometimes only consisting of 1-2 people there is a risk that useful information gets isolated. For example it is very likely that not everyone is aware that Slack has been used to communicate directly with the customer. A tool that especially that customer found useful. Everything is probably not applicable in all cases but more actively sharing “success stories” also about Requirements Engineering could be very good. This enables project managers to take impressions from other project managers and possibly adapt to their own work.

A practical suggestion would be keeping annual “project management”-seminars. Project managers would take part of this seminar and share their experiences in project management. One topic would naturally be handling of the user requirements.

Opportunity 4: Usage of templates

Addresses challenges:

- Challenges related to communicating requirements
- Customers offering solutions instead of requirements

Communicating requirements seems to be a clear issue. The personnel interviewed at the case company experienced that they do not always completely understand what the customer wants. The customers on the other hand mentioned that they are unsure of how to do it. There seems to be a gap here which potentially could be bridged using some sorts of templates.

The templates would be created by the case company thus containing the information the case company is needing. This would also eliminated uncertainty at the customer of how they should formulate requirements. The templates could include topics such as use-cases, workflow diagrams. There could also be templates building on the user interface of the system where the customer could add more specific requirements ie. what a user should be
able to do from a certain page. This could be useful as it already serves as a paper pilot making it easier to grasp the context of the system. This is also something that could be in use when selling new projects as the customer already then needs to create preliminary requirements. Customers might be confused with what they should actually communicate to the potential vendors. Giving them a template for this would likely help them greatly and potentially win them over to the case company.

4.4.3 Development Areas

Development Area 1: Clarification of workflow

Addresses challenges:

- Related to process
- Limitations in tools and practices

The aim with this thesis was not to update the whole RE-process. It is a clear strength not having a formal and standardized process regarding RE as the project managers work with different customers each having their own preferences. However, very little is mentioned about requirements in the case-company’s work instructions even though many interviewees that customer requirements affect their work constantly.

The suggestion here is to open up the process a little and describe key steps and practices used during Requirements Engineering. The instructions do not have to be absolute and should be considered more as suggestions.

Development Area 2: Customer training

Addresses challenges:

- Related to communication
- Challenges related to customer not understanding the system

The customer has a hard time communicating with the supplier regarding aspects of the system if the customer has no experience with the system. As a starting point the system is quite complex and making it further demanding are the terms and data models which might be completely new for the customer. The better the customer understands the system the better it can put the requirements into context of the system. Also understanding the system means that preciser requirements can more easily be expressed.
CHAPTER 4. EMPIRICAL STUDY

One clear way of educating the customer is to teach how to do small scale development and configuration tasks. Especially for enterprise systems as Labvantage this is a good way to dive into the complexity and deepen the understanding.

Of course the customer is trained during the development process through usage of development and test system. However key concepts, limitations and possibilities should be discussed early on. This minimizes the risks for misunderstanding for both parties.

When the customers are trained the interaction becomes much richer and co-operation can truly be done.

Development Area 3: Maintaining an open dialog

Addresses challenges:

- Related to communication
- Related to process

Good interactions between the parties is crucial for the success of conducting RE. This is easier said than done in practice but means of keeping the interaction beneficial for both sides must be found. A social setting were feedback is seen as a natural part of the interactions is one clear way of achieving this.

Keeping the interaction beneficial is a driver for good co-operation. The customer-supplier relationship becomes much healthier when issues are talked about and they understand each other. Frustrations of why one party works in a certain way can be relieved by openly talking about them and offering the reasons behind them.

4.4.4 Retainable Aspects

Retainable aspect 1: Informal communication

Further strengthens:

- Communication & Interaction

Informal communication enables quick answers and a transparency that formal communication doesn’t allow. It lowers the threshold of taking contact and minimizes the need for extensively documenting requirements as the requirements using informal communication easily can be precised if needed. It creates an open dialog and the rapid answers likely improves the pace of the project by not having to wait for eg. e-mail answers.
Slack is a tool that can be used cross-organisation easily and a tool that already is used in some parts of the organisation. This should be considered to take into use for any new customer during the LIMS-project.

Without good and diverse communication good understanding cannot be established. Opening up the informal dimension facilitates this greatly.

**Retainable aspect 2: Usage of Jira**

**Further strengthens:**

- Documentation
- Communication of requirements
- Process

According to the interviewees Jira seems to be used across teams and more or less a standard tool in any project. It is a good tool for managing requirements as it can be accessible for both parties and has a easy interface. This also helps with requirements traceability as the changes for the requirements are easily seen through comments and edits. Using Jira both parties contribute and the process is very transparent.

If not in use or done in some other way, Jira should be suggested to any customer. However training and common rules should be established. Especially if Jira could be used for generating documentation a standardisation of the usage could be needed.

Another clear benefit is that it keeps the customer engaged. Receiving, e-mail notifications when the supplier updates information on a requirement keeps the customer in the loop. Without being engaged and involved good co-operation is hard to reach.

**Retainable aspect 3: Iterative/Agile work**

**Further strengthens:**

- Communication & interaction
- Keeping bureaucracy on a minimum
- Valuable feedback through usage of demos/prototypes
There was a clear consensus among the interviewees that iterative work was the best way to also conduct requirements engineering. Keeping RE embedded in the development process seems to be a very good way of getting things forward and minimizing bureaucracy. This means that the requirements sort of are validated using demo solutions that already can be quite close to the final solution. Demos and pilots are a great way of keeping the customer involved.

The key seems to be to get to development as soon as possible, something the customers also did appreciate. However, one must be able to break the total of the requirements into smaller parts before proceeding to this.

To further specify as there are perhaps perceptions by customers that agile work doesn’t work too well in regulated fields, agile as a term is perhaps not suitable to use when selling a project to a customer. Instead it is worth selling the real qualities agile work offers. It is about putting the customer in center, focusing on the people and minimizing excessive administration. Agile projects still can have a formality created by documentation and formal meetings and acceptances.

Retainable aspect 4: Maintaining direct contacts

Further strengths:

- Communication & interaction
- Relationships
- Knowledge physically in the same place

From the customer point of view it was appreciated that they were able to meet the people working on the project at the case company. Not only is co-operation easier after meeting someone in person it also enabled the technical expertise to be present in the discussions. The case company on the other hand benefit from visiting the customer sites. This greatly improves the understanding of the customer problems as they are able to see for themselves the processes going on in the laboratory. Especially understanding the general work flow is much easier after seeing for themselves.

Getting developers to the customer site of course comes with an expense, but the potential benefits likely exceeds that expense.
4.5 “Lessons learned”

4.5.1 RQ 1 - Strengths and Challenges with Current RE Practices

The first research question asked “What are the strengths and challenges with the current RE practices at the case company”. This question was answered through interviewing personnel at the case company in addition with reviewing SOPs and work instructions. Understanding the current situation provided the means of formulating improvement suggestions thus answering RQ2 and RQ3.

The most demanding challenges both from the customers and the case company’s perspective are listed in Figure 4.4 below. There are a lot of common denominators between the two perspectives creating the argument that the challenges listed are both important and relevant.

![Figure 4.4: Most demanding challenges faced during RE](image)

The links established also offer the opportunity to critically evaluate and see the reason behind them. By only looking on one side of the problem there is a risk of a harmful “blame-game” where both parties blame the other for the challenges they experience. The supplier might blame the customer for not being able to express their requirements. The customer on the other hand might be annoyed that they do not know what the suppliers needs to know. Rather than focusing on them as separate aspects the real challenge might actually be that there is insufficient means and mediums to communicate requirements.
The challenges highlights the fact that Requirements Engineering requires the collaboration of two parties. The challenges are solvable but seldom depends on only one party. Together the two parties should find the means of tackling them.

In terms of the strengths (Figure 4.5) and what in this chapter were referred to “success factors” and perks in the empirical part of the thesis there are less common ground. Perhaps not unsurprisingly as any challenge malignly affects both parties whereas a success factor can be more one-sided. Eg. the case company sees written use-cases received by the customer as a clear upside. From the customer’s perspective this might just be extra headache and a time consuming factor not offering direct benefits.

<table>
<thead>
<tr>
<th>Experienced by Case Company</th>
<th>Experienced by Customer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage of prototypes</td>
<td>Demos &amp; Clear examples</td>
</tr>
<tr>
<td>Usage of Jira</td>
<td>Case company “can ask the right questions”</td>
</tr>
<tr>
<td>Documenting customer workflow</td>
<td>Informal communication</td>
</tr>
<tr>
<td>Common terminology</td>
<td>1 PM at customer and 1 PM at supplier</td>
</tr>
<tr>
<td>Site visits</td>
<td>Direct contact with developers</td>
</tr>
<tr>
<td>Iterative work</td>
<td>Keeping initial requirements broad</td>
</tr>
<tr>
<td>One clear PM at the customer</td>
<td>Iterative/agile work</td>
</tr>
<tr>
<td>Giving and receiving feedback</td>
<td>Clear division of work</td>
</tr>
<tr>
<td>Usage of internal knowledge</td>
<td>Understanding the system</td>
</tr>
<tr>
<td>Written use cases</td>
<td>Minimize pure project management tasks</td>
</tr>
<tr>
<td>Customer training</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.5: Most significant strengths with current RE practices

The strengths to emphasize are the one both identified by customers and the case company. These are usage of prototypes, examples, pilots, clear division of work, direct contacts, training in the system and in overall a smooth and flexible process. If one were to broadly categorize the strengths one could say that they are of three types; smart documentation, seamless interaction and smooth processes.

One major observation one can take here is that understanding both the customer and customer perceptions offer a much deeper level of analysis. Only understanding one side gives a simplified view and doesn’t reveal the real underlying issues.
4.5.2 RQ 2 - Customer Involvement During RE

What was not completely anticipated was the dominant role the customer tends to have in projects regarding the requirements. The case company always does some requirements engineering but the bulk of the work is in many cases done by the customer. Thus there is not only a need to involve the customer in the RE process. Actually there is also a need for the case company to get involved in the customer RE process.

During the interviews most interviewees stressed the fact that the requirements are those of the customer and they in the end are responsible of them. The praxis also seems to be to officially note this in the formal agreement of the project. Thus there is never a case were the customer wouldn’t be involved. However, many interviewees had experienced that the customer organization is not always involved enough.

Table 4.5 below compares the tools for involving customers according to theory with the practices currently in use.

Table 4.5: Involving customer

<table>
<thead>
<tr>
<th>According to theory</th>
<th>Current practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulations eg. organizational games (Saiedian and Dale, 2000)</td>
<td>Not used</td>
</tr>
<tr>
<td>Focus groups (Alam, 2002)</td>
<td>Not necessarily specifically focus groups but workshops widely used</td>
</tr>
<tr>
<td>Participative frameworks (Coughlan and Macredie, 2002)</td>
<td>Not used</td>
</tr>
<tr>
<td>Site visits (Kujala et al., 2005)</td>
<td>In use</td>
</tr>
<tr>
<td>Prototypes (Saiedian and Dale, 2000)</td>
<td>Widely and effectively used</td>
</tr>
<tr>
<td>Co-created models (Whitehead, 2007)</td>
<td>Receives models from customers and also creates own models but during interviews no mention of co-creation.</td>
</tr>
<tr>
<td>Participation in development and configuration (Whitehead, 2007)</td>
<td>In use, also one customer mentioned doing some small scale configuration.</td>
</tr>
<tr>
<td>Review meetings, acceptance tests (Paetsch et al., 2003)</td>
<td>More informal ways of validation, testing partially finished solutions used a lot.</td>
</tr>
<tr>
<td>Customer prioritization (Inayat et al., 2015)</td>
<td>Customer has access to Jira mostly</td>
</tr>
</tbody>
</table>
What can be noted that they are quite well aligned with each other. It is encouraging to note that customers might be involved in development and configuration related tasks as well. This was something Whitehead (2007) found to be a powerful tool especially for enterprise systems.

4.5.3 RQ 3 - Improvement Suggestions

The answer to RQ3 gave concrete improvement suggestions to the case company regarding what could be done to strengthen their understanding of their customers. When setting out to answer this question it was not expected that co-operation would have such a dominant role. Most of the improvement suggestions directly refer to practices done in co-operation with the customer or to improve the interaction. This was a result of the major impact customers usually have on the RE-process as noted in section 4.5.2.

The theoretical part of this thesis explored three steps of understanding customer requirements. They were divided into Gaining understanding, Cultivating understanding and Validating understanding. In RQ2 the links between the empirical findings and the theoretical were quite clear. Here the theory is quite on a high level offering less direct links to the highly practical empirical answers.

According to theory there were six different communication mediums for gaining understanding: Traditional; Group; Prototyping; Model-driven; Cognitive & Contextual. Of these only the last two are not employed by the case company (Cognitive and Contextual). The by far most used ones are Group (Workshops) and Prototyping (demos/pilots). The workshops provide good information about higher level requirements and the prototypes and demos enable gaining detailed understanding through customer response on the models (Zowghi and Coulin, 2005). The main issue for the case company is understanding what the customer perhaps considers to be more or less obvious and tacit knowledge. They might not be aware of what information is relevant or irrelevant for the customer and some information can be hard to explain. For filling this gap process models and scenarios are used by the case company as it identifies the gaps and enables the case company to ask precise questions for gaining the knowledge that is missing. These three seem to complement each other quite well. Although, the case company is typically also shown around the lab, contextual approaches such as observations was not part of the current practices at the case company. This could be a way for further enhancing especially understanding about the tacit knowledge. After the initial understanding of the requirements the
case-company typically moves quite quickly to implementation and thus a phase of “cultivating understanding” seldom is very dominant. In terms of validation it is mainly done by showing partially ready solutions. Although usually quite effective the case company is not too diverse at this front.

The stakeholder used for validating the improvement suggestions has over 25 years of experience in working in the case company. This offered great insight into the real processes and the vast experiences with customers the stakeholder had had.

None of the improvement suggestions was actually reformulated or deleted. The biggest gain was the concrete steps that could be taken based on the improvements. The suggestion had mostly been quite generic whereas the second iteration containing the current results are much more practical. Also some of the potential issues with the suggestions were identified and also reported.

A dimension added was the sales phase. Although the scope of the thesis doesn’t contain sales some of the suggestions were deemed applicable also here. During sales actually much of the requirements are already discussed.

Another lesson learned was that agile is a term one should be careful with in the circumstance of the case company. Highly regulated fields requires more formal processes. The case company shouldn’t sell agile projects. The advantages of agile development can be used but the term often can cause confusion.
Chapter 5

Discussion

5.1 RQ 1 - Strengths and Challenges with Current RE Practices

The challenges and strengths identified didn’t offer any direct surprises. Although, in this case specific for the case company they are identifiable in previous research. However, interviewing both the customer and staff at the case company enabled more in depth understanding especially regarding the challenges. Theory regarding requirements engineering tends to be quite one-sided usually focusing on the perspective of the supplier. Based on the results here perhaps a more multidimensional approach should be considered. Especially if the aim is to provide managerial relevance understanding both sides is crucial for proper problem diagnosis and remedies.

Many challenges were due to communication. This is something also noted by for example Coughlan et al. (2003). Communication issues can easier be resolved using practices typical for agile RE as identified by (Inayat et al., 2015). These are practices such as F2F meetings, site visits, and keeping the RE process integrated to the development process. These were all practices identified by the customers and staff at the case company as good practices. One key tool for facilitating communication was prototypes. This was highlighted by both customers as well as employees at the case company. Prototypes enabled precise communication and ensured that both parties actually discussed the same thing.

Documentation was also seen as a challenge especially from the point of view of the case company. Typical in more agile projects is a lesser focus on documentation which creates challenges (Paetsch et al., 2003; Cao and Ramesh, 2008). This also can further create issues with communications as there is an absence of official written communication materials (Inayat et al.,
Typical additional challenges were customer inability to make decisions, changing requirements, customer not being involved and resource constraints. These all were also identified in the review conducted by Inayat et al. (2015).

The strengths with current practices to emphasize are the one both identified by customers and the case company. These are usage of prototypes, examples, pilots, clear division of work, direct contacts, training in the system and in overall a smooth and flexible process. In other words, practices that mostly solves the challenges experienced. Prototypes are widely identified as a good practice in RE and especially agile RE eg. (Paetsch et al., 2003; Cao and Ramesh, 2008). Direct contacts is very valuable and also emphasized by many scholars eg. (Kujala et al., 2005; Cao and Ramesh, 2008), Whitehead (2007) also identifies training the customers in regards of the system as a good practice. Thus, the current strengths are easily identified in the literature as well. In addition, other upsides also reflects to the project work as a whole. RE at the case company is quite embedded in the development process and thus aspects improving the project work also has a positive effect on RE.

5.2 RQ 2 - Customer Involvement During RE

The second research question was “Which are the ways for the case company to involve customers in the RE-process”. The idea was to gain the understanding of how the customers can be used as an asset in the RE process. This research question was mainly answered in the theoretical part of this thesis, but also based on empirical data.

Typically the customer provides the list of the preliminary requirements. In the end of the project the customer also validates the requirements on some level. The customer is always somehow involved so the key issue is keeping the customer involved enough. If the case company experiences that the customer is not involved enough they need to engage the customer in various ways to keep them involved.

According to the literature, prototypes and workshops are ways to involve the customer (Saiedian and Dale, 2000; Zowghi and Coulin, 2005). These were also widely in use at the case company. Other good practices according to the empirical results were site visits and customer prioritization, these also were reported in the literature review (Inayat et al., 2015; Kujala et al., 2005) . In some cases customers also participate in small scale development and configuration something at least Whitehead (2007) identifies as a good practice.
Prototypes are widely used by the case company and it is also a way for the case company to keep the customers involved. It engages the customer and keeps their interest up. Prototypes were also for example highlighted by Kujala (2003). Prototypes also facilitate co-operative work Coughlan and Macredie (2002). Workshops, also used at the case company is a quite straightforward way to involve customers something also Coughlan et al. (2003) identifies as a popular elicitation technique. Preparing for workshops is also important and the correct people should be present (Coughlan et al., 2003). Preparation was also something the interviewees mentioned as an issue.

A potential problem might be the fact that the case company most often communicate with a product manager or similar representing the users but not always necessarily directly with the users. Communicating with the actual users is highly important as for example Kujala et al. (2005) reports. A reason for not being able to directly communicate with the users could be the increase in costs and time it might bring to the customer (Inayat et al., 2015). Another issue is that the customer doesn’t always have a good understanding about the system. The customer must be educated in the system for beneficial involvement (Kujala, 2003). Customers are educated by the case company but perhaps not emphasized enough especially as customers reported this to be an issue.

One aspect that was emphasized in the empirical results were the good relations needed to maintain a good co-operation. Good customer involvement is not only the result of practices enabling involvement, it depends heavily on the quality of the relationship in general.

### 5.3 RQ 3 - Improving the Understanding of the Customer Requirements

The third research question asked: *How can the case company improve the understanding of the customer requirements?*

Previous research showed that the understanding depends on the quality of the communication. As Coughlan and Macredie (2002) reports, communication has many forms building on interaction between two parties. The key to gaining a superior understanding of the customer requirements seems to be rich and efficient interaction. This was something also widely identified in the empirical part of this study. When there is good co-operation with the customer RE is easy to conduct. Vice-versa most of the difficulties tend to be a result of communication issues. The empirical results shows that
rather than adding new practices or taking in new tools it is the quality of the interactions with the customer that should be augmented for increasing the understanding.

Thus the main gains from the empirical results were tools and practices facilitating interaction. Based on the suggestions there are a few important observations one can make.

**Observation 1:** Interaction is only of value when both customer and supplier agree it is. The requirements engineering process should be agreed by both sides. If one of the parties sees the actions of the other party to be non-functional or redundant there is easily a chance for frustration. Even though the actions actually are feasible they are not considered that way before the other party understands the reason why. Thus, the rationale behind the process, practices used and responsibilities should be discussed before starting to work with the requirements. High quality interaction is something Grönroos and Voima (2013) identifies as a prerequisite for value co-creation.

**Observation 2:** Proper communications channels are invaluable. There must be mediums for communication such as Jira and informal and quicker messaging such as Slack if needed. Only relying on eg. e-mail will damage the quality of the communication. F2F-communication is also superior in most aspects. At least the managers of the two parties should know each other by face. The quality of communication and a diverse set of methods is also emphasized by scholars (Inayat et al., 2015; Kujala et al., 2005; Saiedian and Dale, 2000; Zowghi and Coulin, 2005)

**Observation 3:** Bridging the knowledge gap between the customer and the supplier is crucial. In a traditional supplier-customer relationship two worlds come together. Different skillsets, knowledge, working habits and even as plain as different IT-tools. Not only must there be mediums for communication there must also be tools to enrich communication so that both parties actually receive the input they want. This can be practical tools such as templates for customers to fill in. It can also be training enabling the customer to actually talk about the product. Differences in knowledge is considered a challenge by for example (Kujala, 2003; Whitehead, 2007)

**Observation 4:** People over processes and documentation. Almost a direct citation from the agile manifesto (*Manifesto for Agile Software Development, 2001*) perhaps symbolizing what is really important in agile software development. The process is not there for the process itself. The process shall facilitate solving the problem/tasks the customer wants solved. The lesson here somewhat summarizes the three observations above. It is about getting to know the customer, about finding the best path in that situation. It is about putting resources to the crucial tasks and not documenting for the
CHAPTER 5. DISCUSSION

sake of documentation. Achieving this gives a smooth process giving quicker and more tangible results in terms of RE.

5.4 Limitations

The main limitation of this thesis is that the gains are somewhat limited to the case company. The practical understanding gained was solely from the case-company. Improvement suggestions were also formulated specifically for the case company and thus the generalizability of the results can be questioned. However, especially for customizable enterprise systems this thesis offers many remarks that can be considered important also for other companies.

The empirical data for the report was gained through interviews. The “in house”-data was quite all encompassing exploring the current situation at the case company. However the data gathered from the customers was not that diverse. The projects that the customer interviewees had been a part of were quite similar in terms of the nature of the project. Also, the amount of interviews conducted with customers were only four. Thus the amount of data derived from customers was not as large as the data coming from the case company. In addition, the interviews with the customers were not recorded and thus couldn’t be as detailed as the “in house” interviews. Although the empirical data was methodologically analysed they were done exclusively by the author. Even though not intentionally there can be a bias towards phenomena considered especially interesting by the author.

Another major limitation was that the results never were fully validated. The validation done together with the key stakeholder at the case company offered new insights. Fully validating would however mean testing the improvement suggestions. This is due to be done in the future.

In terms of theory the main limitation was that the study was selective especially in the more in-depth parts of the theoretical section. Articles relevant to this study was chosen an a full exploration was not done.
Chapter 6

Conclusions

6.1 Conclusions

This research set out to answer the question *What are the means for the case company to better understand the customer during the RE process in order to increase customer value?*. As help, three research questions were established and answered. The challenges and strengths sides with the current practices were found. Ways to involve the customer were identified and the question about understanding the customer was also answered.

The topic of customer value has thus far not been linked with the empirical results. This last chapter of the thesis will explain the link and the conclusions that can be drawn from the research. The chapter will be concluded by identifying potential areas for further research.

Customer value comes from value-in-use. Value-in-use emerges from using the resources of a product or service. This product or service is an output a development process and driven by the qualities the service or product should fulfil when in use. (Grönroos and Ravald, 2011) If the qualities are fulfilled the qualities can be utilized and thus customer value emerges. The usage creates value (Kauppinen et al., 2009) and taken from here the link to RE becomes quite clear. RE is responsible for finding the qualities that the product needs to have so that it in the end can create positive consequences for the user.

A prerequisite for finding this is understanding the customer. The requirements engineer needs to identify what the customer actually needs. Simply adapting to requests from the customer or listing features the product should have is not understanding the customer. Understanding the customer comes from knowing the underlying processes, seeing the business goals, being aware of their environment and recognizing the possibilities and limitations. This is
Creation of customer value requires a deep understanding of the customer where the customer processes, goals and environment truly are understood.

If customer value cannot be created without understanding the customer, it raises the question of how this deep understanding can be gained. The notion of value-in-use is the key to the question: *What will the customer be doing with the product and how is it advantageous for the user?*. Already widely accepted in the industry the Business Model Canvas (Osterwalder and Pigneur, 2010) offers one of the perhaps clearest interpretations of this.

A customer (or in this case a user) has jobs to do, this job involves both positive aspects and negative aspects. The implications of this is that the requirements engineer needs to know what actually is going on. This is seldom gained by simply asking questions or relying on some third person to communicate them. The customer needs to be able to communicate what exactly they are doing, what would they want to do in the future and what are the current negative aspects. When the requirements engineer understands this and can solve the issues, value-in-use can be created.

In order to understand the jobs, the requirements engineer must gain information through seeing, experiencing and communication. Not only must the information be gained it must also be made sense of through analysis. Information that is thought to be understood is not yet understood unless it can be validated. A requirements engineer must ask the customer “are these truly the jobs you are doing, is this the way it functions?”. Only then are the jobs solvable as then the solutions for them can truly be formulated. “Getting it right” the first time is an utopian thought, it requires redoing, rephrasing and continuous input.

Gaining deep understanding of the customer is an iterative and interactive process.

Deep understanding builds on iterations and interactions which enables value creation. The requirements come from future users and are interpreted and implemented by the supplying organisation. Requirements cannot be established in the absence of one of the parties. In this sense both parties have a responsibility to see the process through. The two sides depend on each other and must thus co-operate.

Both sides must know what their responsibilities are, what is expected from them and from whom. The process must be suited to enable interaction.
and the two parties working together. It is not only a question about co-operation. It is also a question about how to co-operate. The two parties must know what the other party want to consider the co-operation meaningful. If the supplier wants a list of preliminary requirements from the customer, the supplier should instruct the customer of what is important and what they really need. Vice-versa if the system is complex the customer must have an understanding about the system. The supplier must train the customer so that they truly can co-operate on this task. Also, the supplier must get the opportunity to understand the customer in terms of site visits and explanation about the domain.

It is crucial to facilitate this co-operation through good communication channels, mutually agreed processes and clear division of work.

**Co-operation enables a rich and interactive RE process catching the required knowledge from both customer and supplier**

Requirements engineering is responsible for finding the solutions creating value-in-use. Therefore, requirements engineering is linked with customer value. Considering RE as a co-operative activity has even further implications. If requirements engineering is done co-operatively then customer value actually is created together with the customer.

Value co-creation is a function of interaction in the value creation process where the supplier assumes the role of value facilitator. Value facilitation depends on good quality interactions that benefits the customer. (Grönroos and Voima, 2013) Widely reported by interviewees this good interaction is considered crucial for the success of RE.

Value co-creation requires being as close as possible to the customer sphere where value actually is created. This can be achieved by staying as close to the customer as possible through interaction and co-operation.

In practical terms for the requirements engineer this means keeping the customer involved and letting the customer also assume responsibilities. It is about letting the customer prioritize, analysing requirements together, maintaining communication, keeping the customer engaged and building models where both parties are allowed to contribute. This true co-operation leads to the solution being developed co-operatively truly taking into account the customer needs. With this in mind, RE done co-operatively is value co-creation.

**Co-operation during RE permits value co-creation**
Creation of customer value requires a deep understanding of the customer where the customer processes, goals and environment truly are understood.

Gaining deep understanding is an iterative and interactive process.

Co-operation enables a rich and interactive RE process catching the required knowledge from both customer and supplier.

Figure 6.1: Requirements Engineering related to creation of customer value.
6.2 Ideas for further research

The co-operative benefits of RE explored in this thesis further highlights the importance of the user and customer presence during RE. Most previous research focus on seeing the customer organization as an asset and how it can be taken advantage of in the RE process. This thesis suggests that rather than only seeing them as assets they should be considered as resources that play an active part giving practical contributions. Further research should consider investigating the role of the customer during RE and the way interaction with them should be made.

Buzzwords such as service design, growth hacking, agile development are popular in the industry. However, these can be hard to sell to customers in more regulated fields. One thing that this research also shows is that RE is not out of touch with the modern world, it is perhaps just branded. Requirements engineering still gives the sense of formality but is responsible for solving the real world goals. Another research that could be considered is an examination of what is actually RE in anno 2019. This could revive the discussion and perhaps regain some ground in the total of research around software engineering.

The third idea for further research is a dive in to the social aspects of Requirements Engineering. Many research paper emphasize the need for social skills for the requirements engineer but usually without further elaboration. As the interaction is such a crucial aspect it would be worth actually taking a deeper look into it. Research directions in social sciences likely have a lot to offer here.
References


URL: http://ieeexplore.ieee.org/document/4455622/


REFERENCES


URL: http://agilemanifesto.org/

REFERENCES


Appendix A

Interview Questions

A.1 Case company interview questions

Basic information
1. How long have you worked at the case company?
2. Title? (if applicable)
3. How many of these years have you worked with Requirements Engineering related tasks?

“General questions regarding RE”
4. What do you think of when hearing the term Requirements Engineering?
5. How does RE affect your work?
   (a) When is it done?
   (b) In a typical project, how much of the resources is put on RE?
   (c) Do you work alone or with others?
6. How is RE typically conducted?
   (a) Does it consist of distinct phases?
      i. Do they come in a certain order?
   (b) Are customers somehow involved in the RE-process?
   (c) What good practices, techniques and tools do you use? (describe how you use them)
      i. Written documentation?
      ii. Prototypes?
      iii. Others?
7. Which problems do you encounter when conducting Requirements Engineering?
   (a) Customer related?
   (b) Process related?
   (c) Tool related?

8. How do you solve them?

9. Which factors can affect the success of RE (are there patterns)?
   (a) Certain types of projects?
   (b) Certain types of customers?
   (c) Case Company organisation?

**In depth questions**

10. Which are typically the responsibilities of the case company respectively the customer?

11. How do you involve the customer in the RE-process?

12. What should be the role of the customer in RE?

13. How do you collect information from our customer to understand their requirements?
   (a) Workshops?
   (b) Interviews?

14. What do you do if you do not understand what the customer wants?

15. How do you make sure that the customer understands what we mean?

16. Which are the main problems you encounter when interacting with the customer?
   (a) How could they be avoided?

**Finishing questions**

17. How do you think the case company should improve its requirements engineering practices?

18. Anything else that has come to your mind?
A.2 Customer interview questions

Basic information
1. How long have you worked with IT projects?
2. Role during the LIMS project?
3. Amount of people in the project team?
4. When did you start preparing for the project, how much time did you spend on this? (the time before software point came in)
5. Did any of you have any prior experience with a Labvantage product?

Project information
6. How was the team organized for the LIMS project?
   (a) Did you have different responsibilities?
   (b) Were you able to work full time on the project?
7. Did this pre-phase consists of different phases?
   (a) at what point was the case company involved?

RE during the project
8. How did you define what the system should consist of and what it should do? (no need to speak about features)
   (a) Was the case company involved in this phase?
   (b) If so, how?
   (c) Did you get the help you needed?
   (d) Was this difficult?
   (e) What was the result (documentation?)
9. When you had done this, how did you communicate this with the case company?
10. How did you communicate overall with the case company?
   (a) Face to face? / workshops?
   (b) Email?
   (c) Other electronic?
11. What do you think was the most efficient way to explain this to the case company?
12. What kind of input did you find useful?
13. How did the case company explain how the requirements will be addressed in the system?

14. When it came to details how were these handled?

15. What do you think your role was in this process and what was the case company’s?

16. Which were the problems you encountered?

17. Was there something that you believe worked especially well?

**Finishing questions**

18. How do you think the case company should improve its requirements engineering practices?

19. Anything else that has come to your mind?