# Examination of the challenges in agile projects from the suppliers' perspective in Norway´s software industry

## Insight and recommendations

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## Abstract

This research aims at structuring understanding related to the core challenges faced by project managers and software developers while working with agile-based software projects in the Norwegian software industry. Agile methods are lightweight processes that employ short iterative cycles, actively involve users to establish, prioritize and verify requirements and rely on a team's tacit knowledge, as opposed to documentation. Two major results have emerged from this research: firstly there is a critical need to have more formalized approaches to regulate the relationship between software developers and customers. Evidence based on qualitative studies from this research suggests that contract management and ensuring customer involvement are the most critical challenges for agile-based development, as seen from the project managers' and software developers' perspectives. Another emergent result from this research suggests that embedded mechanisms in agile-based software projects, such as small iterations, frequent delivery and continuous assessment are a contributing factor in reducing the scope of the challenges outlined above. These mechanisms contribute, among other things, toward establishing trust and knowledge sharing which, in turn, enhances customer involvement and compensates for inadequately formulated contracts.

In this research, I distinguish between two perspectives regarding agile-based software perspectives: the customer's perspective and the project manager's or software developer's perspective. The point of departure for this research was to establish an overview of the challenges from the project managers/software developers' perspectives in the Norwegian software industry. One major result emerged from the first study that suggested that poor customer involvement and problems related to contracting were among the most significant challenges that needed to be addressed.

To dig deep into these reported challenges, the subject of the second study was related to contracting. The second study was conducted in order to shed light on the challenges related to contract selection and management, as well as its consequences. One important result that emerged from the second study indicated that these challenges are results of using the standard software contracts which were designed on the principle of waterfall-based approaches, which meant precisely that there is unequal sharing of risk. Other challenges that rise due to this waterfall mindset are that contract selection is based on preferences of the supplier/customer which, in turn depends on the share of risk rather than the suitability of the methodology. This is the reason public companies prefer to use fixed-price contracts while suppliers prefer to use Time and material contracts. This waterfall mindset consequently results in inadequate

customer involvement. Other problems that the results indicated include: unsatisfied customers, disputes, unpaid effort, early shutdown of projects, delays and increased costs. Based on these findings, second study suggests contract management strategies that can help software practitioners mitigate these challenges. There are certain factors that can help combat the challenges related to contracting. The second study listed these factors that requires clarification before writing a contract, and these include: customer vision, business goals, cost of project, software specification, role of customer and his degree of involvement and steering required, response times required by own organization, the jargon/language used for reporting and understanding the status of the project needs also (informal) consideration. Further, making efforts and following strategies to involve customer could help to address these challenges.

The importance of adequate customer involvement has been identified by practitioners as a key factor for ensuring a smooth contracting process and successful project development. The findings of third study suggested a list of enabling factors for customer involvement, including: understanding the customer's perception of success, effective communication, being forthcoming and accommodating, establishing trust, transparency and openness, having the product owner understand their role, having a good understanding of the technical and functional side and persistent cooperation. The findings also present barriers to customer involvement. One of the barriers is lack of understanding regarding agile methodology on customer's side. If a customer is not aware of the methodology, they will not understand that it requires them to collaborate closely during the project development process. It would also be challenging if people working on the project lacked essential skills, because agile project methods require a team of competent individuals.

A fourth study was conducted to look at the risk management process for agile software projects. The results of this study show that although agile methods themselves don't provide any process or mechanism for a risk management process, the embedded mechanisms in agile methods, i.e. are communication and collaboration, shorter iterations, frequent delivery, early feedback and delivering complex parts first, helps to implicitly manage risks in agile projects.

A study about success in agile projects showed that frequent deliveries help to evaluate the project deliverables in a continuous manner, and therefore it helps to have customer get the working parts of the project. In this situation, a supplier can then get early feedback from the customer about the quality of the deliverables and missing requirements can be made up in the next iterations. Thus, frequent delivery and early feedback also help support the risk

management objectives is shown in this study. The study presents findings that a second way of managing risk in agile projects is the same as in waterfall projects, and a fourth study defined the following strategies explicitly as risk management strategies: relative estimates, burn down chart, SWOT analysis and risk matrix.

Understanding a customer's perception of success has been identified as a key driver for ensuring customer involvement, and findings relating to this are presented in a third study. A fifth study showed that evaluation of understanding the perception of success happens through continuous assessment of project outcomes during a project's development. Furthermore, the assessment is handled jointly by both the supplier and the customer. This embedded mechanism of continuous and joint assessment creates an atmosphere of close contact with the customer, along with better knowledge sharing between both parties. This, in turn, builds stronger trust between the parties, which then facilitates conflict resolution. Sources of conflicts and their consequences are presented in the first study. Assessing the chances of success at the iteration level also helps to improve customer involvement and reduction in task uncertainty which, in turn, increases the predictability of project direction and project outcomes. This might help to increase control over changes and account for the various stakeholders' perceptions of success. Thus, this study presents its contributions in terms of presentation and an in-depth empirical study of the challenges that project managers and software developers face while working with agile software projects. These are related to contracting and ensuring customer involvement and risk management. The number of practitioners interviewed for this study numbered 56 in total. All of the practitioners were either from the supplier's side or they were from companies who had in-house development. The scope of this study is that it was conducted in the Norwegian software industry. Keeping in mind that with this relatively small number of informants, this research does not have a strong ground for generalizations; the results provide an overview of challenges experienced by the project managers and developers.

The method used for this research is Grounded theory. Using Grounded theory for any research has both advantages and disadvantages. The advantage of using Grounded theory is that the problem and solution are both grounded in the data, and therefore it provides new insight, enhances understanding, and provides a meaningful guide to action. Thus this study contributes to enhancing understanding about the challenges software practitioners face in agile software projects. The disadvantage is that studies using the Grounded theory methodology are said to be context specific. Limitations of this study are that access to participants was limited to their availability and willingness to participate in the study. Furthermore, this study presents a

supplier's perspective and was carried out in a Norwegian software context. These limitations provide hindrance to the results being considered as generalizable.

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## List of papers

Following five papers are included in this thesis.

1. **Grounded Theory Study of Conflicts in Norwegian Agile Software Projects: The Project Managers' Perspective**
   Lubna Siddique, Bassam A. Hussein
   Journal of Engineering, Project, and Production Management, 6(2), pp. 120, 2016.
2. **Grounded theory study of the contracting process in agile projects in Norway's software industry**
   Lubna Siddique, Bassam A. Hussein
   The Journal of Modern Project Management, 2016, 4(1), 2016.
3. **Enablers and barriers to customer involvement in agile software projects in Norwegian software industry: The Supplier´s perspective**
   Lubna Siddique, Bassam A. Hussein
   (Submitted to Information Technology & People).
4. **Managing risks in Norwegian Agile Software Projects: Project Managers´ perspective**
   Lubna Siddique, Bassam A. Hussein
   International Journal of Engineering Trends and Technology (IJETT), 41(2), pp. 56-65 November 2016.
5. **A qualitative study of success criteria in Norwegian agile software projects from suppliers' perspective**
   Lubna Siddique, Bassam A. Hussein
   International Journal of Information Systems and Project Management, 4(2), pp.65-79, 2016.

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# Summary

## 1 Introduction

The benefits of agile methods have resulted in its increased use by public organizations[1] to increase the quality of their IT projects (UK NAO, 2012; US GAO, 2012; VersionOne, 2016; Vacari and Prikladnicki, 2015). In addition to the benefits, however, agile methods offer many challenges, especially when they are adopted by public organizations. The reason for this is that generally the system, routines and working culture (Iivari and Iivari, 2010) are not adapted accordingly and thus several challenges arise (Hu et al., 2013; Wernham, 2012). . There could be several other reasons, but one of these is that whenever any organization adopts agile methods, the transition involves all kinds of uncertainties and organizational changes that can trigger conflicts (Horvath, 2012). Although there are some studies that present success factors for agile software projects (Chow and Cao, 2008; Misra et al., 2009), to best of my knowledge, no research has been carried out that solely focuses on challenges, particularly in a Norwegian context. This research attempts to fill this gap by empirically investigating the challenges that software practitioners face while working with agile software projects.

Another source of the challenges that arise with the adoption of agile methods relates to project stakeholders because project stakeholders often have conflicting interests with the project (Kwak and Stoddard, 2004). These conflicting interests, along with "miscommunication, lack of coordination, information asymmetry and conflicting incentives related to software projects" (Kujala et al., 2015) carry risks and unanticipated uncertainties (Barros et al., 2004; Hu et al., 2013; Li et al., 2008; Na et al., 2004; Wallace et al., 2004). Agile approaches have shifted the focus from command and control to collaboration (Cohn and Ford, 2003). This shift is often challenging for organizations because social skills and mutual cooperation between suppliers and customers and within teams is emphasized more than it would have been in traditional approaches (Cockburn and Highsmith, 2001). The need for effective collaboration both within the team and with the customer is shown by Chow and Cao (2008) and Misra et al. (2009). A lack of customer involvement is shown to be the main reason for project failure in IT projects (Chow and Cao, 2008; Misra et al., 2009), and therefore it requires effort on the supplier's side to involve the customer continuously throughout the process. Although significant research has been done regarding the importance of customer involvement (Chow and Cao, 2008;

[1]Public organizations: Government-owned organizations.

Hoda et. al., 2011), research that identifies the factors that can increase customer involvement is still missing. This study tries to address this research gap.

This research aims at investigating the challenges that practitioners face while working with software projects. The methodology used for this research is Grounded theory. The reason for using Grounded theory for this research is that the problem and solution (in the form of presented Grounded theory) are both grounded in the data and therefore they can offer new "insight, enhance understanding, and provide a meaningful guide to action" (Strauss and Corbin, 1998, p. 12). Therefore, using Grounded theory allowed me to examine the challenges from a participant's perspectives.

The scope of this research was to empirically investigate the challenges that software practitioners face while working with agile software projects. Most of the practitioners interviewed for this study were found on the internet. After looking up their profile and determining their suitability for this research project, an invitation was sent to them along with a detailed description of the study. After agreeing upon the time and place, interviews were conducted. To begin with, practitioners were asked open-ended questions in order to determine their main concerns when working with agile software projects. Asking open-ended question gave them the freedom to brainstorm and come up with the main concerns and challenges they face. After conducting preliminary interviews and after performing a Grounded-theory analysis of the data, more focused interviews were conducted that addressed the particular challenge identified in first study. The first study provided a list of the challenges that practitioners face while working with agile software projects. Some of the challenges mentioned in study 1 were taken up and investigated further. Results of the findings are reported in their respective studies.

### 1.1 Aim and Scope

This research project aims at structuring the understanding of the core challenges faced by software developers and project managers when working with agile-based software projects[2] in the Norwegian software industry[3]. This study was conducted within the scope of the Norwegian software industry. Participants' organizations varied from consulting organizations to in-house development organizations. The products and services offered by these organizations included web-based applications, front- and back-office applications and software development services. This is not a case study research, therefore, I collected the data not with specific project cases. Data is based on the collective experiences of the informants. Further detail is presented in section 2.4.1.

[2]Agile-based software projects: Software projects which use any of the agile methods.

[3]Norwegian software industry: Software development companies/organizations operating in Norway

## 1.2 Research Problem and Questions

1. What are the core challenges that software practitioners face while working with agile software projects in Norwegian software industry?
2. How do the mechanisms embedded in agile-based software projects, such as small iterations, frequent delivery and continuous assessment, serve as contributing factors in reducing the scope of the challenges outlined in this research?

## 1.3 Research Setting

This research project was carried out with software practitioners working in the Norwegian software industry. The methodology used for this research is Grounded theory.

## 1.4 Contributions

This research has made following contributions:

1 This research contributes in terms of structuring the understanding of the core challenges faced by software developers and project managers while working with agile-based software projects in the Norwegian software industry.

2 This research provides a detailed description of how embedded mechanisms in agile-based software projects, such as small iterations, frequent delivery and continuous assessment, are contributing factors for reducing the scope of the challenges outlined in this research project.

3 This research provides a list of factors that can act as enablers and barriers to customer involvement, along with providing a list of factors that can hinder customer involvement. Although the importance of customer involvement has been shown by numerous studies, studies focused solely on finding the factors that can enhance this interaction are still missing. This study attempts to address this research gap.

4 This empirical study addresses the need for more empirical studies on agile methods and agile project management, which has been shown to be required by many studies (Abrahamsson, et. al., 2009; Dybå and Dingsøyr, 2008; Suetin et al. 2016; Vidgen and Wang, 2009).

## 1.5 Implications

The challenges identified in this research show that in spite of widespread use of agile methodologies, relevant processes are not adapted accordingly. This implies that there is a strong need to restructure the ways in which work is being done with agile methods, including the need to restructure the mechanism of contracting. Despite wide adoption of agile methods, relevant processes are not adapted accordingly, resulting in the challenges presented in this study. Although several studies have shown that customer involvement helps to create success in agile software projects, none of the studies addresses the factors that act as enablers to this involvement. This research addresses this gap by presenting the factors that practitioners could use to enhance customer involvement in agile software

projects. This research project structures the understanding of the project managers and teams to show how mechanisms embedded in agile-based software projects, such as small iterations, frequent delivery and continuous assessment are contributing factors for reducing the scope of the mentioned challenges.

### 1.6 Limitations

Both the context and the methodology used for this research limit the ability of this research to be considered generalizable to a wider population. Moreover, this study only presents the supplier's perspective.

### 1.7 Thesis Structure

This thesis is organized as follows:

**Summary:**

Section 1 presents the research topic of this thesis and the thesis papers. Section 2 describes the research methods applied to this research. Section 3 presents the discussion, along with implications and limitations of this research project. Section 3 presents concluding remarks.

**Papers:** This thesis comprises of five papers and each of paper is briefly described below.

**Paper 1**, Grounded "Theory Study of Conflicts in Norwegian Agile Software Projects: The Project Managers' Perspective" (Siddique and Hussein, 2016a) presents the research finding of another challenge i.e. conflicts in agile software projects. Abstract states:

This paper aims to explore the process of conflicts in agile software projects. The purpose was to investigate the causes and consequences of these conflicts. For this purpose, we conducted a qualitative study involving agile software projects in Norway. Grounded theory was used to analyze the data and the interview findings are presented using Glaser´s Six C model (context, condition, causes, consequences, contingencies, and covariance). The research findings suggest that there are several causes of conflicts. These include: the role of the product owner, an inexperienced project manager, the customer's lack of knowledge about methodology organizational hierarchy in public companies, contracting, personal egos, financial issues, not getting the right team. Consequences of conflicts include: decreased productivity, wastage of time and resources, diverted attention from project objectives loss of motivation, poor decision making, loss of communication. Based on interview data, different conflict strategies are suggested and these include appropriately skilled project manager, communication and negotiation, defining clear roles, stakeholder analysis, managing stakeholder´s expectations, discussion, finding the root cause of conflict. Project managers are using these strategies to avoid or resolve conflicts. The competencies required to handle these kind of conflicts are also

discussed in the paper, while the implications of theory and practice of conflict management theory are also presented.

**Paper 2** "Grounded theory study of the contracting process in agile projects in Norway´s software industry" (Siddique and Hussein, 2016b) presents the findings of one of the challenges i.e. contracting process in agile software projects. Abstract states:

This paper provides practical insights into the challenges associated with the contracting process in agile projects in the Norwegian software industry. We conducted interviews with 32 agile practitioners from 25 different software development organizations in Norway. The data were analyzed using grounded theory. This analysis found several concepts that gave raise to two core categories, namely challenges involved in the contracting process and contracting process management. We used Glaser's six Cs coding family to represent the data analysis. The findings revealed the causes of the challenges related to the contracting process. The consequences are also discussed in the paper. Based on the interview data analysis, we present contracting process management strategies to overcome the challenges related to the contracting process.

**Paper 3**, "Enablers and barriers to customer involvement in agile software projects in Norwegian software industry: The Supplier´s perspective" (Siddique and Hussein, 2017) presents the factors that can enhance customer involvement in agile projects. This study also presents the factors that can hinder customer involvement. Abstract states:

The purpose of this study is to present the research findings about factors that contribute to making customer involvement work effectively in an agile software project and to explore factors that can provide hindrance to customer involvement. We conducted 24 interviews with practitioners working with agile software projects in Norwegian software industry. Grounded theory was used to analyse the data. Findings suggested a list of factors that can enhance customer involvement and make it more effective. We called these factors enablers to customer involvement. The factors that suppliers use for effective customer involvement are: understanding customer's perception of success, effective communication, being forthcoming and accommodating, transparency and openness and establishing trust. Factors that suppliers think the customer should pay special attention to are: customer attention, product owner who understands business, good understanding of technical and functional side and persistent cooperation. This study also presents factors that can hinder customer involvement, thus making the customer–supplier relationship less effective. We called these barrier factors. These are: not getting enough customer time, lack of understanding on the customer's part, people without right skills and lack of communication. Research was carried out in the Norwegian software industry and grounded theory was used for data analysis, therefore this research can be called context-specific.

Research participants interviewed were project managers, therefore this study presents project managers' viewpoints only. Another limitation is that most of the participants were from the supplier side. This study provides a theory/framework of enablers and barriers to customer involvement in agile software projects. Practitioners can use these factors to enhance customer involvement in agile projects.

**Paper 4**, "Managing risks in Norwegian Agile Software Projects: Project Managers´ perspective" (Siddique and Hussein, 2016c) presents the research finding about risk management in agile software projects its similarities and differences with waterfall projects. Abstract states:

The purpose of this study is to understand the role of project risk management in agile software projects. To achieve the purpose, we conducted a qualitative study. We conducted interviews with agile practitioners working with agile projects in Norway´s software industry. Grounded theory was used to analyse the data. This study aims to study the similarities and dissimilarities between the project risk management process in agile software projects and waterfall software projects, as well as identify the strengths and weaknesses in the current practices being used in agile software projects. Interview results suggested that risk management in agile projects is being done in two ways. One way is adopting implicit risk management strategies, which include communication and collaboration, shorter iterations, frequent delivery, early feedback, and delivering complex parts first. The other way is called explicit risk management strategies, which are relative estimates, burn down charts, SWOT analysis, and risk matrix. Limitations with implicit risk management strategies are also discussed. At the end, guidelines on how to maximize the impact of the risk management process on project outcome are also presented.

**Paper 5**, "A qualitative study of success criteria in Norwegian agile software projects from suppliers' perspective" (Siddique and Hussein, 2016d) presents the success criteria in agile software projects along with its similarities and differences with waterfall project. Abstract states:

This paper provides practical insights into the success criteria in agile projects in the Norwegian software industry. We conducted 32 interviews with practitioners working with agile projects. The findings revealed two fundamental differences that distinguish the perception of success in agile projects from that in projects that are based on the waterfall approach. Firstly, the evaluation is carried out on a regular basis after each increment. This regular and continuous measurement of success contributes several advantages, including greater commitment and involvement from the customer and a higher level of mutual trust between the supplier and the customer; and thus leads to better knowledge sharing and reduced task uncertainty. The reduction of task uncertainty provides more predictability about the direction of the project and better grounds for change control; not least, it allows room to

consider multiple and subjective assessments by various stakeholders. Secondly, there is a stronger emphasis on customer satisfaction. Customer satisfaction is measured in terms of how quickly the customer obtains value from the project. The continuous assessment of success at the end of each iteration also has a significant, positive impact on the customer's evaluation of the project outcome.

# 2 Research Methods

## 2.1 Research Context

This empirical study was conducted within the Norwegian software industry. Interviews were conducted with practitioners working with agile methods in software organizations in Norway. These organizations include organizations that perform in-house development and consulting organizations that deliver projects to customers. The practitioners interviewed had many years of experience within IT and agile methods ranging from three to 40 years. The main intention of this study was to empirically study the challenges agile practitioners face while working with agile software projects in the Norwegian software industry.

## 2.2 Research Paradigm

When starting a research process, it is very important to decide which research paradigm the research process will follow. The three main paradigms in qualitative research are positivist, interpretivist and critical paradigms (Punch, 1998). "A paradigm is a framework or a set of assumptions that explain how the world is perceived where the paradigm of a science includes its basic assumptions, the important questions to be answered or puzzles to be solved, the research techniques to be used, and examples of what scientific research looks like" (Neuman, 1991, p. 57).

### 2.2.1 Interpretive Paradigm

The interpretive paradigm was chosen for this study because this approach is typically used to gain a deep insight into "the complex world of lived experience from the point of view of those who live it" (Schwandt, 1994, p. 118). The ability of the researcher to interpret this interaction plays a vital role. This approach is useful for the researcher in regards to conceptual thinking and theory building, and in this approach the researcher views the world through participant's perception about the world (Edwards & Skinners, 2009).

## 2.3 Qualitative Research

This research is qualitative, which allows the researcher to use a variety of tools, including personal experiences, observation, interviews and interactional and visual texts (Burden and Roodt, 2007). This

2014). For the purposes of this study, interviews were conducted. In Figure 1 double arrows shows the path of this study.

## 2.4 Grounded Theory

This study used a Grounded theory approach. Grounded theory "approach is primarily based on the subjective experiences of humans and comes about while one gathers data" (Burden and Roodt, 2007). The two variations of Grounded theory, Glaserian (also called classic) and Straussian, differ in the perspective of how to approach the research problem, data analysis and coding mechanisms, among other differences. This research used the classic Grounded theory approach. To investigate the real world, interviews serve the best purpose. Grounded theory uses those themes, concepts and

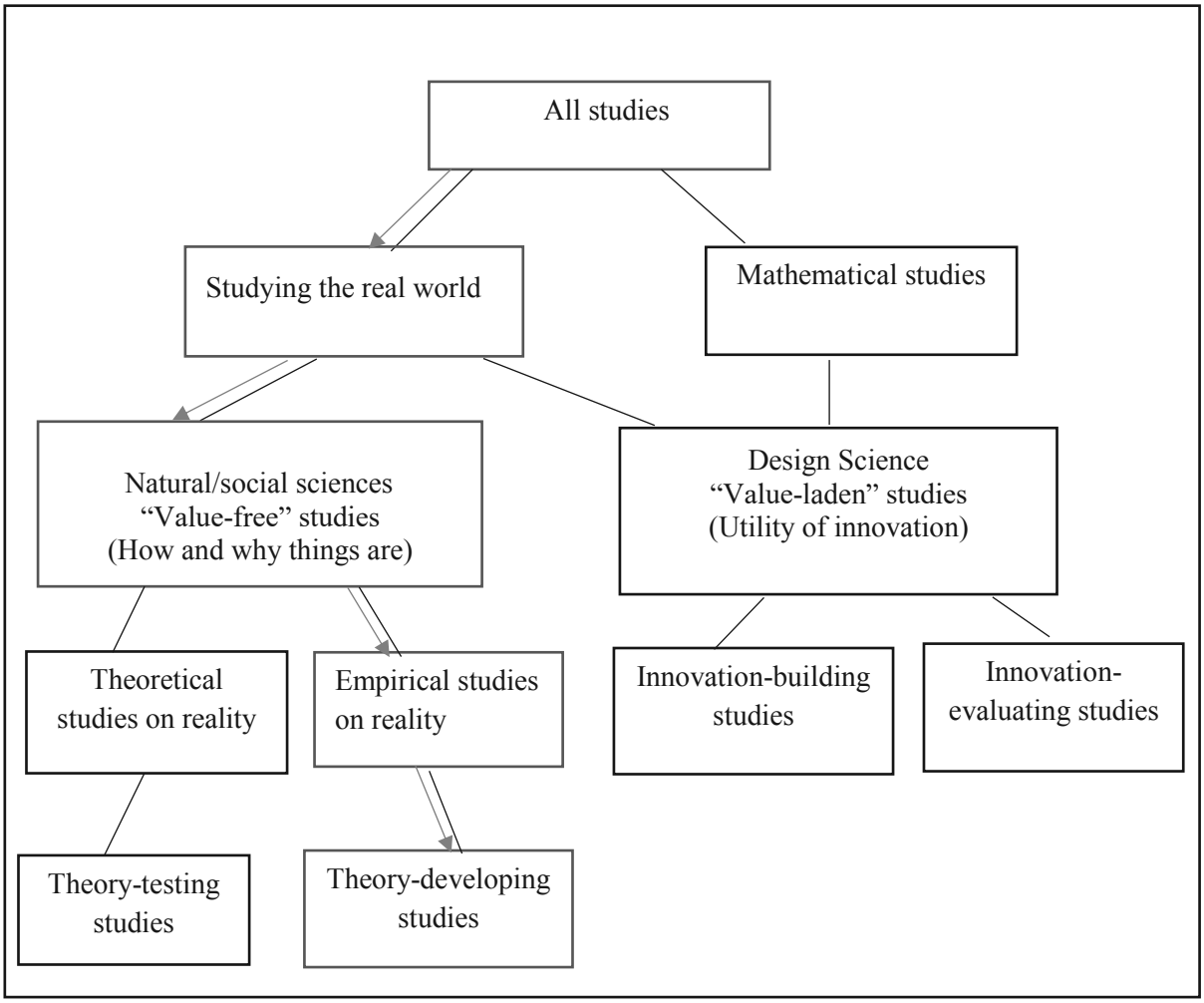


Figure 1: Taxonomy of research approaches (Stray, 2014 originally from (Järvinen, 2008)).

categories that emerge from interview analysis to build a theory that is an actual presentation of the information supplied by the research participants. The reason for using a Grounded theory methodology is that I wanted the findings to be grounded in the data and all codes and categories to

emerge from the data. The data for this study is based on several years of experience by project managers with software projects in general, and agile software projects in particular, and therefore Grounded theory is a suitable approach for such studies (Marshall and Rossman, 2014). Another reason was that Grounded theory is suitable for a study that has an emphasis on processes (Charmaz, 2006). Since I wanted to explore the whole development process in agile projects in order to find the challenges, Grounded theory is a suitable methodology for this research.

### 2.4.1 Data Collection

Semi-structured interviews were conducted primarily face-to–face, with two conducted via Skype. To get familiarized with the relevant background questions, including the participants' roles and the number of years of experience working with IT projects in general and agile in particular, practitioners were asked open-ended questions. For example:

What kind of challenges do you face while working with agile software projects?

Follow-up questions were asked to get better familiarized with their specific references, including:

What are the consequences of that (particular) challenge you mentioned?

How are you handling these challenges?

Asking open-ended questions gave them the freedom to brainstorm and come up with the challenges that they considered important based on their experience with agile projects. Details of each particular study are presented in the relevant study.

Semi-structured interviews were helpful for this research and it helped me to:

- Ask the participants open-ended questions
- Ask questions in multiple ways to find out the relevant and detailed information
- Be helpful to the practitioner for answering the questions by explaining with suitable details and relevant information
- Ask the questions in multiple ways, in order to check for validity and authenticity of the information provided by the participants.

For this study, I used non-probability sampling (purposive sampling, snowball sampling) (Devers et al., 2000; Tongco and Ma Dolores, 2007). Participants were selected based on their suitability for the research. Deliberate contact was made with the participants who had relevant experience with agile software projects. Most of the practitioners were sought out from internet searches and, after determining their suitability for the research question a request to participate in the study was sent to

them. At the end of each interview, practitioner was requested if he/she can refer to someone who could be contacted for this research (Snowball sampling…."Subjects may be able to recommend useful potential candidates for study" (Marshall, 1996)). Total number of participants interviewed for this study were 56 from 25 companies. Companies' (where participants were working at the time of interview) domain of businesses is presented in Table 1. To maintain anonymity (as agreed at the time of interview), I will refer to these companies with numbers (C1-C25). Participants detail is presented the relevant papers. Agile methods participants mostly worked with were Scrum, KANBAN and XP, DSDM.

This is a Grounded theory research, therefore this study didn't studied the particular projects in specific companies (not a case study research). Thus choice of the participants were made keeping in view their overall experiences with agile software projects. After conducting the first round of interviews, if there was a need for more information or if there was ambiguity regarding the data, a second interview was held with the concerned participant.

### 2.4.2 Data Analysis

In Grounded theory, data analysis is called coding. Coding by using a systematic approach of data analysis helps to understand the data (Corbin and Strauss, 1990). Data analysis in Grounded theory is a continuous process that starts very early after conducting first interview (Corbin and Strauss, 1990).

After conducting the first ten interviews, a Grounded-theory analysis of the data gave rise to several core categories (conflicts, contracting, customer involvement, risk management, success measurement). Each of the core categories were then taken as an independent study and theoretical sampling was done to further explore the specific category. Various coding steps are shown in Table 2 and the research process is depicted in Figure 2.

To represent research findings, Glaser's six Cs coding family (1978) was used in two studies (Study 1, Study 2). This coding family (causes, contexts, contingencies, consequences, conditions) is one of the several coding families used to represent the relationship between categories and to ultimately generate a theory (Glaser, 1978).

Table 1: Business domain of companies

| Sr. No. | Company | Business domain |
|---|---|---|
| 1 | C1 | Consulting, Management of ICT projects |
| 2 | C2 | Energy and telecomunication |
| 3 | C3 | Consulting services, information technology solutions provider |
| 4 | C4 | Telecommunications |
| 5 | C5 | IT consulting company (designs, develops, manages and advises on IT solutions and digital communications) |
| 6 | C6 | Consulting service |
| 7 | C7 | IT infrastructure services provider |
| 8 | C8 | IT company/supplier of IT software and services |
| 9 | C9 | Consulting company/ Communication and technology company |
| 10 | C10 | IT Consulting |
| 11 | C11 | IT services |
| 12 | C12 | Consulting services |
| 13 | C13 | Digital financial services |
| 14 | C14 | Consulting in technology and outsourcing |
| 15 | C15 | IT consultancy and software development |
| 16 | C16 | IT company and supplier of IT operations |
| 17 | C17 | IT consulting |
| 18 | C18 | Business and technology services |
| 19 | C19 | Information technology operation, outsourcing and consultancy service company |
| 20 | C20 | IT company that is the total supplier of consulting services, hardware, software, operating services, internet solutions |
| 21 | C21 | Deliver IT services |
| 22 | C22 | IT consultancy (IT infrastructure and related services) |
| 23 | C23 | IT application service provider technology company |
| 24 | C24 | Software development |
| 25 | C25 | Supplier of business software and services |

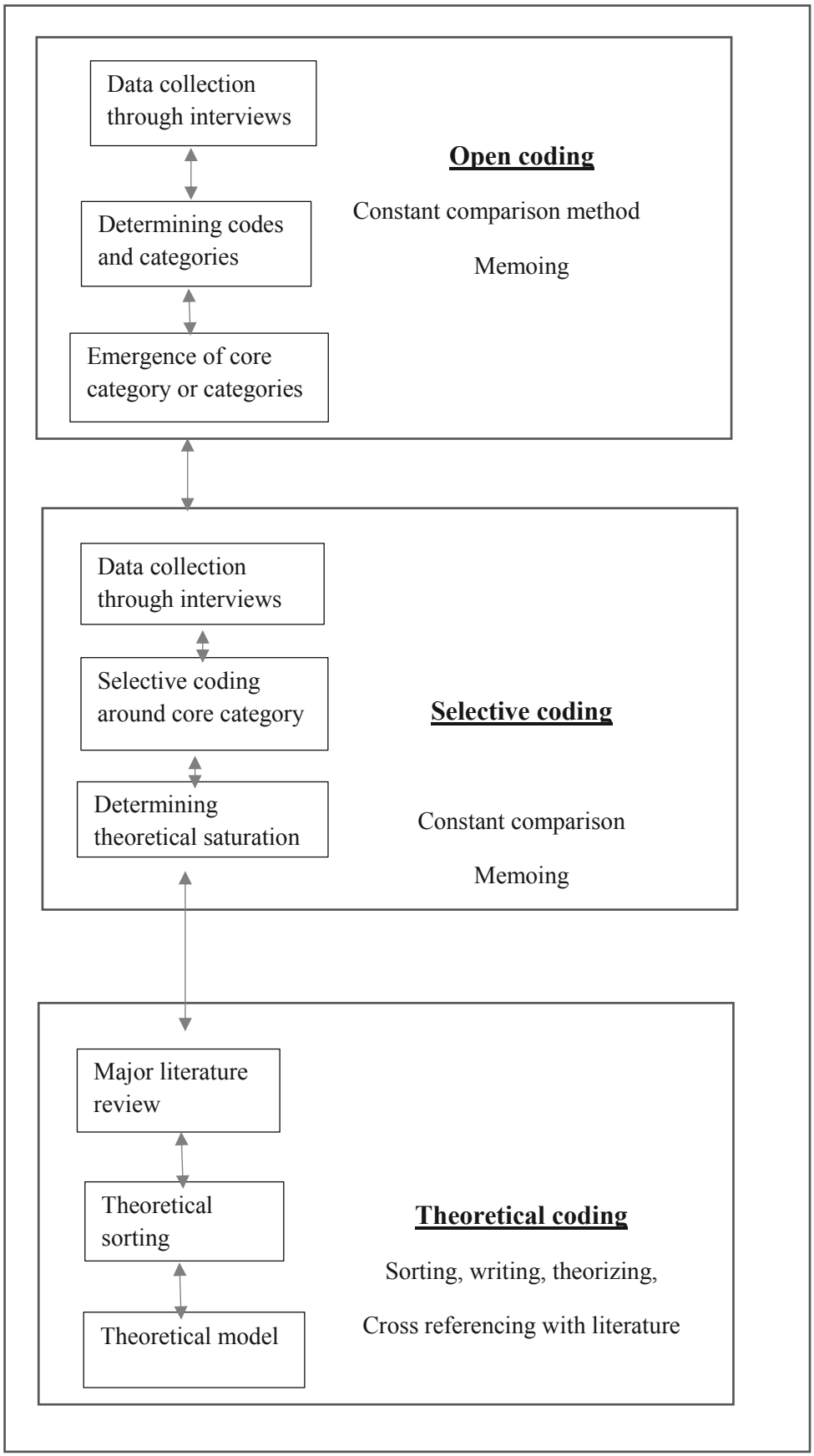


Figure 2: Grounded theory research process (adapted from Jone and Alony, 2011)

Table 2: Grounded theory analysis steps

| Step | Explanation |
|---|---|
| Open coding | This is the first step for data analysis. Open coding is marked by the emergence of a core category. |
| Theoretical Memos | Memos are written ideas of the researcher that he/she writes during the process of analysis of the data. |
| Selective coding | In this stage, coding is done for one core category. |
| Core Category | Core category is central to all the categories. There could be more than one core category in a study, but each core category should be addressed in separate studies. The core categories that emerged in this study are conflicts, contracting, customer involvement, risk management and success measurement. |
| Constant comparison | The researcher looks at the collected data to compare codes and categories in order to develop theory. |
| Theoretical Sampling | Theoretical sampling leads the researcher to determine what to collect next. Participants are selected, keeping in view their suitability for the study. |
| Theoretical saturation | When no new categories emerge from the new data collection and analysis then it means that theoretical saturation is reached. |
| Theoretical sorting | Theoretical sorting refers to the sorting of related memos that results in producing data and theory. |

### 2.4.3 Role of researcher

The role of the researcher in Grounded theory is important and the researcher is required to be a creative person that uses patience to tolerate the confusion that arises through the process of data analysis. This is described by Glaser (1999, p. 838): "The grounded theory researcher has three important characteristics: An ability to conceptualize data, an ability to tolerate some confusion, and an ability to tolerate confusion's attendance regression." Therefore, it is appropriate to briefly introduce myself here.

After completing my Master's Degree in Computer Science, I had a variety of experiences related to teaching and management. Working as a teacher for two years and later as an Assistant Manager with a team of approximately 40 people for three years, enhanced my interpersonal skills and gave me the ability to understand people's perceptions, insights and behaviors.

While studying a Master of Science in Engineering (Project management) at Norwegian University of Science and Technology Trondheim, I further polished my interpersonal skills through continuous interaction with international students, which helped me to become good at communicating by creating a comfort level with people of all ages, genders and nationalities.

Furthermore, I am a creative person and I used to participate in speech competitions right from an early age. In addition, I am a poet/writer and I started to write poems from very early age, thus I can say that I am creative person who has the ability to see things from multiple perspectives. My one book is already published and two others are in the process of publication.

# 3 Discussion

This research project is an empirical study. The need for more empirical studies on agile methods and agile project management has been identified by many other studies (Abrahamsson et. al., 2009; Dybå and Dingsøyr ,2008; Suetin et al., 2016; Vidgen and Wang, 2009). According to Abrahamsson et al. (2009) "more research required into the adaptability and extension of agile methods, a deeper understanding of how agile methods are deployed in practice, and an overall necessity to improve the level of rigor in agile system development research." The reason is "despite the popularity of agile methods in software development, there is debate about what agility is and how it is achieved. The debate suffers from a lack of understanding of agile concepts and how agile software development is practiced" (Vidgen and Wang, 2009; p. 355). In addition to this, relatively little research has been conducted to determine the challenges that occur specifically in a Norwegian context. In the light of this need for empirical research and the above-stated recommendations, this research project contributes to the field by building a solid, cumulative knowledge base which further leads to enhanced understanding of current practices that are used specifically in a Norwegian context. To further specify, this study explores two research questions.

1. What are the core challenges that software practitioners face while working with agile software projects in the Norwegian software industry.
2. How do mechanisms that are embedded in agile-based software projects, such as small iterations, frequent delivery and continuous assessment, serve as contributing factors in reducing the scope of the challenges outlined in this research?

One major result that emerged from the first study suggested that poor customer involvement and problems related to contracting were among the most significant challenges. The findings of this research work suggest that the reason for these challenges is the prevalence of a traditional mindset in public-sector organizations. This is because agile methods are adopted but relevant processes that relate to culture and mindset are not adapted accordingly (Iivari and Iivari, 2010). Consequently, using agile methods in such organizations tends to result in several challenges (Hu et al., 2013; Wernham, 2012). One of these areas is contracting, which is in accordance with Thamhain (2014) and Arbogast et al. (2012). Organizations want to have control over the project in the same way as they had in previous waterfall projects. Results of this research work shows that although agile methods are widely adopted in the IT software industry, the battle to combat the traditional mindset is ongoing and requires a significant amount of effort to alter it. Although this research was conducted in the Norwegian software industry, the overall prevalence of this waterfall mind set is evident in the Bird and Bird report (2012) and in Hoda et al.'s (2011) study that shows that companies need to evolve in addition to

adapting agile methods, especially in the area of contracting. This is especially true for public organizations.

The ongoing, common practice is that contracts are often selected based on a view that the contract safeguards the interests of the particular party instead of being based on the suitability of the contract with agile methods. Suppliers' preferred type of contract is Time-and-Material, as it safeguards their interests. Customers want to safeguard their interests and therefore they prefer to use a fixed-price contact while supplier prefer to use Time and material contract. The ultimate result of these approaches and mindset is that companies are driven to use Time and material and fixed-price contracts. Fixed-price contracts contradict the philosophy of agile methods, where "less planning and more flexibility is used in agile projects than in traditional project management" (Errador and Pinto, 2015). This is because the most of the standard software contracts, including fixed-price and Time-and-Material contracts have "the principle and philosophy of waterfall projects" (Bird and Bird, 2012). The findings of this study regarding use of agile methods with waterfall-based contracts are in alignment with Hoda et al. (2009) and Hoda et al. (2011). Change requests serve the purpose of welcoming any changes during the course of a project, but again these change requests have to be approved through the bureaucratic arena of the organization, and could result in unnecessary delays on the supplier side. VersionOne survey report (2016) indicates that agile adoption is on rise but when it comes to barriers, this report states "company culture as the reason for failed agile projects". Along with this, another limiting factor is "availability of personnel with the necessary agile experience".

The second major challenge found by this research project is the lack of customer involvement. This prevails despite the fact that the role of the customer and their involvement in agile-based projects has been emphasized in the current project literature as a precondition for success (Chow and Cao, 2008; Cockburn and Highsmith, 2001; Dybå and Dingsoyr, 2008; Martin et al., 2009; Misra et al., 2009). . In agile projects the customer is not only a decision maker but should also function as collaborator who is able to discuss functionalities and can understand the business value of these functionalities along the with prioritization of features (Fraser et al., 2004; Grisham and Perry, 2005; Martin et al. 2009; Nerur et al., 2005;). This importance of customer involvement is shown by various studies, including Serrador and Pinto (2015), who state, "Agile methods also depend upon early and continuous customer involvement, both in establishing goals for the project and providing feedback to progressive prototypes as the project moves through its life cycle." Despite this vital importance of the role of the customer, studies on how to achieve this involvement are missing, a gap that this study attempts to address. Lack of customer involvement, ambiguity about the role of the customer and the lack of understanding of functionality and its impact on business was reported by the respondents as a major source of the challenges that have appeared in the agile projects. This indicates that agile projects are

still driven with a traditional mindset from the customer side, resulting in the prevalence of a waterfall mindset in which the customer doesn't understand the importance of being involved in the project; this is in alignment with Hoda et al. (2009).

To counter these challenges, there is a solid need for restructuring the mechanism in terms of processes, culture and mindset. Regarding encountering the challenge of contracting, mixing different types of contracts could prove beneficial. Based on the types of contracts available, PS 2000 provides an equal share of risk for both parties, but it requires such detailed documentation that, for bigger projects, it takes months to complete. Regarding share of risk, this contract type gives an equal share of risk, unlike in fixed-price contracts and Time and material contract. However, when it comes to delivery, the supplier still has a greater share of risk than the customer, so the supplier has to conduct structured project management to ensure that delivery occurs in the time frame that was initially agreed upon. However, practitioners using this contract were satisfied with the amount of risk it provides. One of the options for agile projects that seems more agile-friendly is an incremental delivery contract. This contract type has the advantage of being able to terminating the contract at any time. This contract has several inspection points agreed upon by the supplier and the customer. At each inspection point, a review occurs that involves making a decision to continue or stop the contract.

An important question is, "How can contracts change the mindset of customers from upfront planning to agile principles?" (Dingsøyr and Moe, 2013). The results of this research work suggest a need to formalize the procedures and make them more agile-friendly for customers, in addition to outlining a complete understanding about agile approaches, its benefits and drawbacks when compared to the waterfall approach and the change process that is associated with the methodology. This is crucial, although it requires significant changes on the customer side. In addition to a careful choice of contract type, there are certain elements that should be made clear before writing a contract. These are:

1. Clarity regarding the level of collaboration, participation and engagement expected from the customer
2. Clarity regarding roles and responsibilities
3. The role of the product owner

Making clear the expected level of participation from the customer and designating clear responsibilities for dealing with related issues could help increase customer involvement in the project, along with ensuring enablers identified in this research. The role of the product owner should also need to be discussed. The customer is often represented on the supplier side by the product owner. All communication regarding customer's requirements are conveyed by him. He is the one who is responsible for the prioritization of features in the product backlog, along with his presence in all the

meetings (Bird and Bird, 2012). He is required to be a decision maker and have efficient knowledge of the methodology. However, one of the challenges identified in one study (Study 1) is that the role of the product owner is not typically that of a decision maker, which, in most cases, results in long delays on the supplier´s part. This research also provides a detailed description of how mechanisms embedded in agile-based software projects, such as small iterations, frequent delivery and continuous assessment are contributing factors in reducing the scope of the challenges outlined in this research. These findings are in accordance with (Serrador and Pinto, 2015). According to them, the iterative nature of agile methods "allows for frequent stakeholder interaction, adjustments made on the fly, and re-scoping project requirements in light of new information or customer requests" (Serrador and Pinto, 2015). This embedded mechanism also helps to manage the risk implicit in agile software projects. Thus, the results of this research fulfill the need for more empirical studies for the use of agile methods. The results of this research show that there is a strong need to restructure the ways in which work is done with agile methods, including the need to restructure the mechanism of contracting and involving customers in the project.

## 3.1 Comparison of Norwegian context with other countries

When I compare the results of this study (specific to Norwegian context) with the studies conducted in other countries, it is evident that irrespective of the context, challenges are almost similar when it comes to agile software projects. Following literature review prove this.

One empirical study conducted by Hoda et al. (2011) in New Zealand and India showed that inadequate customer collaboration and demand for fixed price contract were among the most common challenges practitioners were facing while working with agile software projects. Nuottila et al. (2016) presented challenges from a case study conducted in a public sector organization in Finland. Among the identified challenges stakeholder communication, involvement and roles in an agile set-up were found to be the main challenges.

A literature review conducted by Vacari and Prikladnicki (2015) listed the problems/challenges with agile adoption and implementation in public organizations. Challenges listed by this study includes: organizational culture, lack of knowledge and experience with agile methods, little or no involvement of customers/stakeholders. Later case studies conducted in a public sector organization in Brazil showed that organizational culture related issues i.e. little or no stakeholder involvement, lack of knowledge and experience with agile methods were found to be the barriers to adoption of agile methods and implementation in public sector (Vacari and Prikladnicki, 2016). According to Chang et al. (2016) "The culture and processes are the biggest obstacles to overcome" in ITA (United States Army Information Technology Agency) and DOD (Department of Defense). Wisitpongphan and

Khampachua (2016) presented case study results from a dairy farm project in Malaysia. The reported challenges were "unsupportive procurement process, change request management, and the lack of understanding of Agile as a concept." VersionOne latest report (2017) also list the challenges with agile adoption (Table 4). Respondents from all over the world took part in this study. Respondents` demographics are shown in Table 3.

Table 3: Respondents` demographics

| No. | Percentage | Area |
|---|---|---|
| 1 | 50% | North America |
| 2 | 28% | Europe |
| 3 | 10% | Asia |
| 4 | 5% | South America |
| 5 | 4% | Oceania |
| 6 | 2% | Africa |

Table 4: Challenges Experienced Adopting & Scaling Agile (VersionOne report, 2017)

| Sr. No | Challenge | Percentage |
|---|---|---|
| 1 | Company philosophy or culture at odds with core agile values | 63% |
| 2 | Lack of experience with agile methods | 47% |
| 3 | Lack of management support | 45% |
| 4 | General organization resistance to change | 43% |
| 5 | Lack of business/ customer/ product owner | 41% |
| 6 | Insufficient training | 34% |
| 7 | Pervasiveness of traditional development | 34% |
| 8 | Inconsistent agile practices and process | 31% |
| 9 | Fragmented tooling, data and measurements | 20% |
| 10 | Ineffective collaboration | 19% |
| 11 | Regulatory compliance and governance | 15% |

Results of this study as well as above discussed literature shows that although agile methods are widely adopted but maturity related to agile approaches is still missing. According to VersionOne report

(2017), “The vast majority of respondents (80%) said their organization was at or below a “still maturing” level.” This results in challenges shown by this study. These includes: using agile with waterfall mindset (demand for fixed-price contracts), organizational hierarchy in public companies, inadequate customer collaboration, role of the product owner, ineffective and inadequate customer collaboration and lack of agile understanding on customer´s part. These reported challenges are the same as shown by research from other areas of the world. Getting mature with agile mindset and approaches requires a shift both in mindset and culture which requires signification more time and effort before organization can reach the required level of maturity that agile methods require. Although this research was conducted in the Norwegian software industry, but the overall prevalence of this waterfall mind set is evident by the above mentioned studies. Thus it can be said that these challenges are not specific to Norwegian context but similar challenges are being faced in other countries too.

## 3.2 Implications

### 3.2.1 Implications for Research

This research addresses the need for further empirical studies in software engineering. The need for more theory-based, empirical studies has been identified by various studies (Hannay et al., 2007; Herbsleb and Mockus, 2003; Sjøberg et al., 2007). The need for empirical studies in relation to agile methods and agile project management is also evident by following studies (Abrahamsson, et. al., 2009; Dybå and Dingsøyr, 2008; Vidgen and Wang, 2009; Suetin et al. 2016). This research is context bound, however, this with structuring our understanding of the core challenges faced by software developers and project managers while working with agile-based software projects in the Norwegian software industry. A limitation of this research, as noted earlier, is that it is context specific. This research could be taken as a point of departure for further investigation. Challenges discovered by this study indicate that these challenges are created because of the relevant processes and that cultures are not adapted accordingly in public-sector organizations, which results in challenges outlined in this research. Future studies in different contexts could help to support or deny these identified challenges and their consequences. Keeping in view the importance of customer involvement, this research presented factors that would enable customer involvement. Future research could study if there are additional factors that play a pivotal role in making this involvement work. Furthermore, to make the results generalizable, such studies need to be conducted with a larger sample and a wider context. Research related to reasons for conflict in agile software projects is still underexplored (Behfar et al., 2010; Crawford et al., 2014). This study made an attempt to address this gap; however there is additional need for studies on this topic. Sources of conflicts could be further investigated to find out more about the challenges than could be outlined in this research. Risk management in agile software projects is also an underexplored area (Albadarneh et al., 2015; Odzaly et al., 2014). This study

attempted to address this research gap by empirically studying risk management in agile software projects.

### 3.2.2 Implications for Practice

This research has implications for project managers, teams and customers, as it provides information for project managers and teams by presenting the challenges that will help them understand the reasons behind these challenges.

Among the challenges found in this research, contracting and poor customer involvement are the most significant. These challenges identified in this research, indicate clearly that in spite of widespread use of agile methodologies, relevant processes are not adapted accordingly. Thus, the results of this research imply that there is a strong need to restructure the ways in which work is being done with agile methods, including the need to restructure the mechanism of contracting. Despite wide adoption of agile methods, relevant processes are not adapted accordingly, which results in the challenges that are presented in this study. The continuous use and demand by the public organizations to use fixed-price contracts with agile projects shows that there is a lot more to be done to adapt these processes according to agile methods.

The ongoing practice is that contracts are often selected depending on which contract safeguards the interests of the particular party, instead of being based on suitability of the contract with agile methods. Suppliers' preferred type of contract is Time-and-Material, as it safeguards their interest. Customers want to safeguard their interests and therefore they prefer to use fixed-price contacts. Although PS 2000 provides an equal share of risk for both parties, it requires such detailed documentation that for bigger projects, it takes months to complete it. Regarding the share of risk, this contract type gives equal shares of risk, unlike fixed-price contracts and Time-and-Material contracts. However, when it comes to delivery, the supplier still has a greater share than the customer, so the supplier has to conduct a structured project management to ensure that delivery occurs in the time frame initially agreed upon.

The results of this research imply that there is a need to formalize the procedures on the customer's side and that the customer needs to understand the agile methodology, including its benefits and drawbacks compared with the waterfall approach and the change process associated with the methodology. Along with careful choice of the contract, customer role and their expected level of participation should also be discussed. Making a clear description of responsibilities will help to clarify the responsibilities, thus avoiding any kind of further challenges which will, in turn, create understanding on the part of the customer.

Results of this research suggest that despite being proven that adequate customer involvement acts as an enabler to success, people from the supplier side are still struggling with making this involvement work effectively. Agile methods provide the mechanisms, as identified in study 5, that help in both evaluating the progress and making adjustments accordingly after each iteration. These mechanisms could only prove to be beneficial if the relevant processes are modified to work in the way it requires. This challenge of poor customer involvement is addressed by presenting the enabling factors and barriers to customer involvement that can be used by teams to make this involvement work in an effective way. In addition, this research has implications for teams by structuring the understanding about how embedded mechanisms in agile- based software projects such as small iterations, frequent delivery, and continuous assessment are contributing factors to reducing the scope of the above-mentioned challenges.

### 3.3 Limitations

The following are limitations of this research.

1. This study was a self-driven project and there was not a formal arrangement between the university and the participants or organizations. Most of the participants interviewed were found and contacted through the internet and social networking site LinkedIn. Access to most of the participants was limited to internet searches and referrals from the participants who participated in the study and on their willingness to participate in the study.
2. Studies performed using Grounded theory are said to be context specific (Glaser, 1992; Nunes et al., 2010), and theories developed through Grounded theory are said to be "mid-ranged" theories, specifically applicable to the particular context in which they are generated. However, these theories can be modified by adding more data from other studies and contexts and by performing constant comparison methods (Glaser, 1992).
3. This study presents the supplier's perspective. Since most of the participants interviewed were working or had working experience from the supplier side.
4. This is not a case study research (not a particular case/project was studied). Therefore, participants were not asked questions particular to a certain project. They were asked questions related to their overall experiences working with agile software projects.
5. Another limitation of this study is its small sample size and the context in which it was conducted.
6. One of the challenges with Grounded theory research is knowing when the additional collection of data and coding needs to be stopped.
7. Another concern in Grounded theory is, "How many times did a code have to occur to be substantive" (Allan, 2003). Is one statement is enough, or how many number of statements

should declare a thing before it should be included? Allan's (2003) recommendation is that "one is enough if it is significant". It means that one concept could be enough to contribute to the emerging theory.

8. One of the limitations is regarding the interpretation of the interview data by the researcher. A researcher can come across four types of data while conducting interviews (Glaser, 1978).

a) Baseline data: Data that comes directly from a participant's description.

b) Properline data: Data that a participant thinks is relevant to the researcher.

c) Interpreted: Data interpreted by the researcher.

d) Vaguing it out: When the participant doesn't provide the actual information (Glaser, 1978), then researcher might have to struggle to find the relevant information. It might take researcher time to be trained well enough to ask for the right information from the participants and counter-check the answers by asking questions that might help to get the information. Therefore semi-structured interviews are helpful in this regard.

### 3.4 Standards of validation for Grounded Theory research

Table 5 shows the criteria for assessing the various types of research.

Table 5: Criteria for assessing qualitative research

| Quantitative criteria | Qualitative criteria | Original Grounded theory | Strauss Corbin's Grounded criteria |
|---|---|---|---|
| • Validity<br>• Reliability | • Credibility<br>• Transferability<br>• Dependability<br>• Confirmability | • Fit<br>• Work<br>• Relevance<br>• Modifiability | Two sets of criteria<br>• Research process<br>• Empirical grounding of findings |
| (Sheldon, 1994) | (Lincoln and Guba, 1995) | (Glaser and Strauss, 1967) | Strauss and Corbin, 1998. Corbin and Strauss, 1990) |

Validity in Grounded theory research is not done like traditional sense instead Grounded theory research should be validated for fit, work, relevance and modifiability (Glaser & Strauss 1967, Glaser, 1978, p. 134, Glaser 1998).

In order to ensure fit in the study, the generated theory must emerge from the data. All codes, concepts and categories are generated from the data. Work is ensured by explaining what is happening and predicting what may happen. This research work explained these perspective well. Relevance of the theory was discussed in the implication section. These generated theories have implications for practitioners and researchers. All the presented theories in this research are readily modifiable with the additional collection of data and by performing a constant comparison method. Correct application of

Grounded theory gives rise to concepts through conceptualization and these concepts are flexible enough to be modifiable with "immense grab" (Glaser, 2004). Abstract theory is generated by interlinking these concepts, which explains the "participants' main concerns of the participants in a substantive area" (Glaser, 1992). Participants were not invited to check the emerged theories, keeping in mind Glaser's recommendation that since participants are unaware of the underlying coding schema and concepts that gave rise to theories, they might not provide a validity check to the generated theories (Glaser, 2001, p. 11).

### 3.5 Suggested Research Topics

This research presented its limitation of being context specific and of having a relatively small sample. Further studies can be conducted with a wider sample size and in different contexts. One of the abilities of Grounded theory is that it can be modified through additional data collection and analysis (Thulesius et al., 2003). Thus further research could be conducted to make these findings generalizable to a wider population.

The third study presents the enabling factors for customer involvement. Whether these are the only factors, or whether there are several additional other factors could be investigated with a larger sample. Another aspect of further research that could be interesting, would be to examine how much each of the presented enabling factors contributes to customer involvement. Along with this, a detailed study of the effect of each of the presented barriers on customer involvement could be taken up for further investigation. Furthermore, the third study assumed that customer involvement has only a positive effect on a project's success. Future research could examine this in detail and determine if customer involvement has any negative effects. This study only investigated a few of the presented challenges. Further research could investigate the remainder of the identified challenges. Further, this research has the limitation of presenting only the supplier's perspective; further studies could present findings from the customer's side.

# 4 Conclusion

This research was conducted with the aims of structuring the understanding of the core challenges faced by software practitioners while working with agile-based software projects in the Norwegian software industry. Two major results have emerged from this research: firstly there is a critical need to have more formalized approaches to regulate the relationship between software developers and customers. Evidence based on qualitative studies from this research suggests that contract management and ensuring customer involvement are the most critical challenges in agile-based developments, as seen from the project managers' and software developers' perspectives. Another emergent result from this research suggests that embedded mechanisms in agile-based software projects, such as small iterations, frequent delivery and continuous assessment are contributing factors in reducing the scope of the challenges outlined above. These mechanisms contribute, among other things, to establishing trust and knowledge sharing, which, in turn, enhances customer involvement and compensates for inadequately formulated contracts. Evaluation of how to understand the perception of success is handled through continuous assessment of project outcomes during project development. Furthermore, this assessment is conducted jointly by both the supplier and the customer. Assessing the chances of success at the iteration level also helps to improve customer involvement and reduce task uncertainty, which, in turn, increases the predictability of project direction and project outcomes. This might help increase control over changes and take into account the various stakeholders' perceptions regarding success. This embedded mechanism of continuous and joint assessment creates an atmosphere of close contact with the customer along with better knowledge sharing between both parties. This, in turn, builds stronger trust between the parties, which then facilitates conflicts resolution.

One important result that emerged from the second study indicates that most of the standard software contracts were designed on the basis of the principle of waterfall-based projects, which means that there is unequal sharing of risk. Despite being emphasized repeatedly in literature, along with repeated recognition of the positive outcomes of customer involvement, supplier companies are still struggling to make this involvement work optimally. This shows that companies from the customer side need to focus more time and energy on making this relationship work for getting the desired benefits out of agile methods.

This research has implications for project managers, teams and customers, as it provides information to project managers and teams regarding the reasons behind the challenges they experience while working with agile projects. The results of this research imply that in spite of wide adoption of agile methods, related procedures are not adapted accordingly, resulting in the challenges outlined in this study. Thus, there is a strong need to revitalize the processes to make them more agile-friendly, as well as a stronger need to formalize the procedures on the part of the customer. This could be a very

challenging task, and thus requires significant work and a focused approach to modify current approaches.

As is evident from this research, making the choice of a particular contract type is driven by the share of risk which, in turn, is based on the share of risk related to cost and deliverables. All of this is related to uncertainties, for example, if a project costs more than initially estimated and if agreed functionality is not delivered, or if less is delivered than expected or goals are not met, then who is responsible for this? Thus, the risk ratio or the share of risk is the primary factor when deciding on a contract. Neither the customer nor the supplier want to use the contract type in which they assume a higher share of risk than their counterpart, thus the default preferred choice of by customers is a fixed-price contract because it puts risk on the supplier side. Similarly, suppliers want to safeguard their interests, which makes them prefer a Time-and-Material contract.

Finding a contract that ensures a balanced share of risk for both parties is the key. It is not necessary that a particular contract type should be used for the whole project. Mixing different types of contract could also prove beneficial. Based on the types of contracts available, the PS 2000 contract was found to provide the fairest share of risk, but the downside is that it requires very detailed specifications that are written at the start of the project. For bigger projects, it might take months to complete the documentation. One of the options for agile project that seems more agile-friendly is incremental delivery contracts. This contract type has several inspection points decided on by the supplier and the customer. At each inspection point, a review is conducted to decide whether to continue or stop the contract. This contract also has the advantage that either party may terminate the contract at any time. Along with careful choice of contracts, customers required level of participation in the project and clarity regarding roles and responsibilities should be discussed.

This will help customers understand agile philosophy and the required level of their participation in order to making a successful project delivery. Making clear descriptions of what the customer's responsibilities are while working with agile methods will have a significant impact and make customers understand the agile way of working. The role of product owner should also be discussed. The product owner is the person who is responsible for all communications, and he is also a decision maker. The role of the product owner, including the expected knowledge about the methodology, expectations regarding their role and their presence, along with the required understanding of functionality, must all be discussed and agreed upon. This will also help the customer develop awareness of the agile way of working. This research has the limitation of presenting only the supplier's perspective; further studies could present findings from the customer side. This research also has limitations of being context specific and having a relatively small sample size. Use of Grounded theory method for data analysis, along with these mentioned limitations creates a hindrance

to considering this research generalizable to a wider population. Further studies could provide further evidence that accept or deny the findings presented in this study.

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I

# Paper 1

## Grounded Theory Study of Conflicts in Norwegian Agile Software Projects: The Project Managers' Perspective

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**Abstract:**

This paper aims to explore the process of conflicts in agile software projects. The purpose was to investigate the causes and consequences of these conflicts. For this purpose, we conducted a qualitative study involving agile software projects in Norway. Grounded theory was used to analyze the data and the interview findings are presented using Glaser´s Six C model (context, condition, causes, consequences, contingencies, and covariance). The research findings suggest that there are several causes of conflicts. These include: the role of the product owner, an inexperienced project manager, the customer's lack of knowledge about methodology, organizational hierarchy in public companies, contracting, personal egos, financial issues, not getting the right team. Consequences of conflicts include: decreased productivity, wastage of time and resources, diverted attention from project objectives loss of motivation, poor decision making, loss of communication. Based on interview data, different conflict strategies are suggested and these include appropriately skilled project manager, communication and negotiation, defining clear roles, stakeholder analysis, managing stakeholder´s expectations, discussion, finding the root cause of conflict. Project managers are using these strategies to avoid or resolve conflicts. The competencies required to handle these kind of conflicts are also discussed in the paper, while the implications of theory and practice of conflict management theory are also presented.

Keywords: Agile methods, Grounded theory, conflicts, project manager, product owner.

## 1. Introduction

The Cambridge dictionary defines conflict as "an active disagreement between people with opposing opinions or principles." It is "the process which begins when one party perceives the other is frustrated or is about to frustrate some concern…" (Thomas, 1992, p. 891). Processes which there are exchanges of feedback, explanations and clarifications between different individuals may be conflicting (Zaheer, McEvily, and Perrone, 1998). Conflict could be of following types (Jehn and Bendersky, 2003).

1. Relationship conflicts "involve disagreements among group members about interpersonal issues, such as personality differences or differences in norms and values" (de Wit et al., 2012). Relationship conflict arises due to interpersonal incompatibilities or due to tension, animosity or annoyance. Relationship conflict is also called emotional conflict (Bradford and Weitz, 2009; Jehn, 1995).
2. Task conflict is differences in ideas, viewpoints and opinions relating to tasks (Reid et al., 2004). Task conflict is also known as cognitive conflict (Bradford and Weitz, 2009).
3. Process conflicts are "disagreements among group members about the logistics of task accomplishment, such as the delegation of tasks and responsibilities" (de Wit et al., 2012).

In this study, when we use term agile projects we are referring to software projects which use agile methods. When we use the term agile teams we are referring to teams which are working with agile projects. The most commonly used agile methods are the Dynamic Systems Development Method (DSDM), Extreme Programming (XP), Scrum, Lean or Kanban (Cohen et al., 2004).

Throughout this paper we will be using causes of conflicts and reasons for conflicts interchangeably. Reasons for conflicts can be differences in opinions and goals (Barki and Hartwick, 1994). In agile projects, there are more chances of conflicts occurrence (Walczak and Kuchta, 2013). According to Walczak and Kuchta (2013), "the probability and impact of conflict between team members are greater when the project team adopts the agile methodology." This is because when an organization adopts an agile methodology, according to Horvath (2014) "this transition to agile, with all the uncertainty and organizational changes involved, inherently carries the possibility of triggering conflicts." Horvath (2014) further adds that teams have their own challenges when working in a group according to Tuckman´s model as well as "the decentralization of management via self-organizing teams and of course the time pressure of working in short iterations" (Horvath, 2014).

According to Crawford et al. (2014), "agile software processes emphasize collaboration more than traditional methods. Collaborations and interactions are cited directly in two of the four values listed in the agile manifesto. Because of everything that involves communication contains the potential for conflict." Possible reasons for conflicts in agile teams were highlighted by Ozawa and Zhang (2013): "complex interaction of values, attitudes, behavioral norms, beliefs, communication approaches by members of a project with vastly different values may give rise to misunderstanding and misinterpretation of intent that may result in conflict, mistrust, and underutilization of talents" (Ozawa and Zhang, 2013).

The influence of personality has been found to be a major reason for conflicts in agile teams as certain members might not be well suited to these teams because of their nature (Licorish, 2009; Hoda et al., 2010; Melo, 2013) Conflicting priorities have also been found to be one of the six decision obstacles identified in decision making by agile teams (Drury et al., 2012). Barki and Hartwick (1994) showed that more collaboration provides more chances for conflicts. Their study showed that increased user participation is positively linked to increased conflicts and disagreements (Barki and Hartwick, 1994). Although conflict types and conflict management processes can have a wide range of impacts on the team or stakeholders' performance, these have not received much attention for research (Behfar et al., 2010).

According to Bano and Zowghi (2015), "the most prominent problems caused by user involvement are communication problems and misunderstandings between the users and the development teams

leading to all kinds of conflicts." Conflicts always make their way between the team and users, therefore the management must adopt conflict management strategies to handle them effectively Heiskari and Lehtola, (2009). Melo (2013) found that problems are caused by not being "able to manage the conflicts regarding the work procedures, leading to turnover and decreased productivity in the short term (teams were unable to deliver for a while), as well as loss in both knowledge and team overhead after the turnover." Moreover, conflict can reduce team productivity (Dreu and Weingart, 2003) because it "produces tension, antagonism, and distracts team members from performing their tasks" (Melo et al., 2013).

The importance of conflict management has also been shown by (Crawford et al., 2014), who argues that conflict "must be managed, not only as a way to optimize project success also to increase the satisfaction of project team members." In his view, software engineering lacks research about conflict management; therefore, he suggests investigating conflict management techniques and improving the software development process by designing a process which can manage conflicts. This research paper aims to study the conflicts in agile software projects. Thus, we asked practitioners the following questions:

1. Can you please tell me about your background?
2. How many years of experience do you have working with agile software?
3. In your opinion, what are the sources of conflict in agile software projects?
4. If conflict occurs in a project, does it have any affect?
5. How does it affect project outcomes?
6. What kind of strategies are you using to handle these conflicts?

For the purpose of this study, no distinction has been made regarding types of conflict. Instead, we will use the term conflict incorporating all types of conflicts. Grounded theory refers to research methodology while grounded theory refers to theory generated applying Grounded theory. We conducted a qualitative study and Grounded theory study was used to analyze the data. The rest of the paper is organized as follows: Section 2 presents the methodology;

Section 3 presents the results of the study and interview results are presented using the Glaser´s Six C´s coding model (context, condition, causes, consequences, contingencies, and covariance); Section 4 presents discussion and relevant literature; and finally the paper is concluded along with implications for future research.

**2. Methodology**

The reason we preferred to choose Grounded theory for our research is because this theory helps to analyze and understand the "phenomenon undergoing in the current scenario" (Glaser, 1992).

Grounded theory tries to find and explain the answers to the following questions: “what’s going on?”, “what is the main problem of the participants?”, and “how are they trying to solve it?” (Glaser and Strauss, 1967).

The reasons for using Grounded theory for our research are outlined as follows:

1. Grounded theory is said to be very well suited for research studies that involve social interactions between individuals and human behavior (Glaser, 1992). Since this study aims to study conflicts in agile software projects and conflicts always arise between individuals, this process has a lot of emphasis on social interactions and human behavior.
2. Another reason for using Grounded theory is that this methodology is a suitable research method for areas that are under explored (Birks and Mills, 2011). Research on conflict and conflict management has not received much attention for research in agile (Behfar et al., 2010) (Crawford et al., 2014) and consequently we think that more studies need to be conducted to explore the issue in this area.
3. Grounded theory is a powerful tool to gain insight into an individual´s experiences, perceptions and their feelings about a particular research area. The main focus in Grounded theory is on the everyday life experiences, opinions and perspectives of participants; therefore, it is descriptive in nature and relies on people’s words and opinions (Marshall and Rossman, 2014). Since our research is based on the experiences, opinions and perceptions of project managers to understand conflicts, their causes and strategies for handling them, Grounded theory is most suitable choice for our research.

**2.1. Data collection**

We performed 24 interviews with agile practitioners working in Norwegian software organizations. These organizations include companies which perform in-house development or consulting organizations who deliver projects to customers. The practitioners we interviewed had many years of experience within the software industry and working with agile methods and are project managers. We conducted semi-structured interviews through various media, including face to face (mostly) and Skype. Twenty four interviewees were selected based on the following criteria: (1) role (project manager); (2) number of years of experience in software project management; and (3) work experience and knowledge related to agile development. We asked practitioners open-ended questions. The sampling technique we used for our study is called nonprobability sampling (Devers et al., 2000).

Keeping the suitability for the research in mind, we used purposive sampling. Deliberate contact was made with the practitioners who had relevant experience with agile projects. We performed an internet search for the practitioners and after determining their suitability for our research question, we asked

them to participate in the study. After agreeing upon a time and place, interviews lasted for 30-60 minutes. We assured practitioners of anonymity regarding their names and organizations and therefore we will refer to practitioners with AP1-AP24. Practitioners' profiles are presented in Table 1.

**2.2. Data analysis**

In Grounded theory no guidance should be given to the interviewees to ensure they can talk about important points in the given context (Gorra, 2007). In our scenario the research context was conflicts. After asking about their background and experience, we asked the practitioners to tell us about conflicts. We let them speak about the topic before we asked them other relevant questions, for example "What strategies are you using to handle conflicts?" Important points arising from interviewee descriptions about the research area can be used by the researcher to generate codes, and categories are generated after grouping several relevant codes together (Gorra, 2007).

In Grounded theory data analysis is called coding. Coding using a systematic data analysis approach helps in understanding the interviewees' experiences and their interpretations of the world (Corbin and Strauss, 1990). Data analysis in Grounded theory is a continuous process that starts very early after conducting the first interview and continues until saturation is reached (Corbin and Strauss, 1990). Fig. 1, Fig. 2, and Fig. 3 present levels of abstraction in Grounded theory.

2.2.1. Open coding

The first step of data analysis in Grounded theory is called open coding (Glaser, 1978, 1998). Open coding can be done on a word by word or line by line basis and line by line coding has been utilized here. Open coding is done by answering the following questions: "What is actually happening in the data?", "What is the main concern being faced by the participants?" and "What accounts for the continual resolving of this concern?" (Glaser, 1998, p. 140). Open coding helps to identify key concepts in the data, and then a suitable code that presents the key point is assigned to these key points (Georgieva and Allan, 2008). Table 2 presents examples of codes that were assigned to statements in the open coding process.

2.2.2. Constant comparison

After reading and coding of all interview transcripts, initial codes and categories emerge. Each of these emerging codes are compared to codes within the same interview transcript and with codes emerged in other transcripts to produce a higher level of abstraction called concepts. This procedure is repeated on the resultant concepts to produce a further higher level of abstraction called categories. This process is called the constant comparison method (Glaser and Strauss, 1967).

Table 1: Practitioners' Profile

| Practitioners | Designation | Agile Methods worked with | Experience with agile |
|---|---|---|---|
| AP1 | Project manager | Scrum, KANBAN | 10 |
| AP2 | Project manager | Scrum, KANBAN | 9 |
| AP3 | Project manager | XP, Scrum | 9 |
| AP4 | Project manager | XP, Scrum, KANBAN | 10 |
| AP5 | Project manager | Scrum, KANBAN | 8 |
| AP6 | Project manager | Scrum, KANBAN | 8 |
| AP7 | Project manager | XP, Scrum | 10 |
| AP8 | Project manager | Scrum, KANBAN | 10 |
| AP9 | Project manager | Scrum | 9 |
| AP10 | Project manager | Scrum | 8 |
| AP11 | Project manager | Scrum | 8 |
| AP12 | Project manager | XP, Scrum | 10 |
| AP13 | Project manager | Scrum, KANBAN | 10 |
| AP14 | Project manager | Scrum, KANBAN | 9 |
| AP15 | Project manager | XP, Scrum | 10 |
| AP16 | Project manager | XP, Scrum, KANBAN | 12 |
| AP17 | Project manager | Scrum, KANBAN | 8 |
| AP18 | Project manager | Scrum | 7 |
| AP19 | Project manager | Scrum, KANBAN | 8 |
| AP20 | Project manager | XP, Scrum | 9 |
| AP21 | Project manager | Scrum, KANBAN | 8 |
| AP22 | Project manager | XP, Scrum | 10 |
| AP23 | Project manager | XP, Scrum | 9 |
| AP24 | Project manager | XP, Scrum, KANBAN | 11 |

2.2.3. Core category

Open coding ends when the core category is selected (Glaser, 1992, p. 39). Here, the core category selected for this study was "conflicts". The core category should be central and should relate to several

other categories (Glaser, 1978). There could be more than one potential core categories but a single one must be chosen. Glaser (2001, p. 201) states that the selection process requires careful consideration and commitment from the researcher and if more than one core category emerges within the study then the researcher can work on each of the core categories in separate research studies.

2.2.4. Axial coding

According to Strauss (1987), axial coding consists of ''intense analysis done around one category [i. e., variable] at a time, in terms of paradigm items (conditions, consequences, and so forth)'' (p. 32). "Axial coding involves re-building the data (fractured through open coding) in new ways by establishing relationships between categories and their subcategories" (Lawrence and Tar, 2013); categories that are developed through open coding are interlinked by establishing relationships between them in axial coding (Glaser, 1978).

These categories can be seen as pieces of a puzzle that are arranged together in the proper format. Every puzzle piece (category) is examined carefully to ascertain its relevance and accurate position. During the initial stages this procedure could be seen as trial and error, but with the passage of time theoretically sensitivity helps the researcher to make correct decisions more quickly and accurately.

2.2.5. Selective coding

After categories emerge and the core category is identified, the researcher can do selective coding. This means those categories that have a link with code category are considered. Therefore, selective coding helps to integrate and refine categories to form a theory which presents the phenomenon being investigated along with presentation of interlinks between concepts and categories (Darke et al, 1998).

Researchers use concepts and relational statements to explain "what is going on" (Strauss and Corbin, 1998).

We have used Glaser's six Cs coding family (causes, contexts, contingencies, consequences, conditions), which is one of the various coding families used to represent the relationship between categories and ultimately generated theory (Glaser, 1978). In this research selective coding has been conducted around our core category "conflicts".

2.2.6. Theoretical saturation

Data collection and analysis in grounded theory is done until theoretical saturation is reached (Glaser 1978, p. 71). This means data collection should stop when there is no new data emerging regarding categories or the relationships between them (Strauss and Corbin, 1998). For this study, we stopped data collection when we felt that no new categories were emerging.

2.2.7. Memos

Memos represent the theoretical connection between categories. These are ideas that the researcher writes down to gain a better insight into the determined categories.

Table 2: Example of codes developed after open coding

| Interview transcripts | Codes |
|---|---|
| I meet often conflict of interest with my back office | Conflict of interest |
| I need people with right competencies, right experience, right social skills | Need right people for team |
| and back office want to sell out people available. | People allotted on availability basis |
| These people are not necessarily right for my project | Not getting right people for team |
| For instance, I am very good at organizing teams | Good organizer |
| creating good working environment | Good at creating working atmosphere |
| but not analyzing and processing data. | Not good in analysing |
| I am not very analytic. I have a member in my team to look into these matters | Making someone else responsible for some tasks |
| I focus on project management. | Good at project management |
| I know little about product that other person make sure that product quality is good | Making someone else responsible for quality |
| People will spend time and energy on things other than work | Wastage of time and energy |

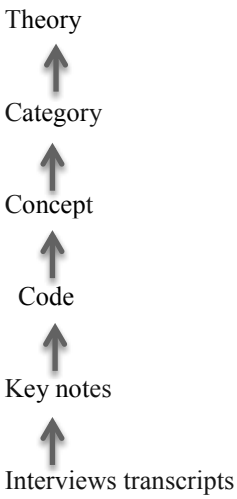


Figure 1. Levels of abstraction in Grounded theory

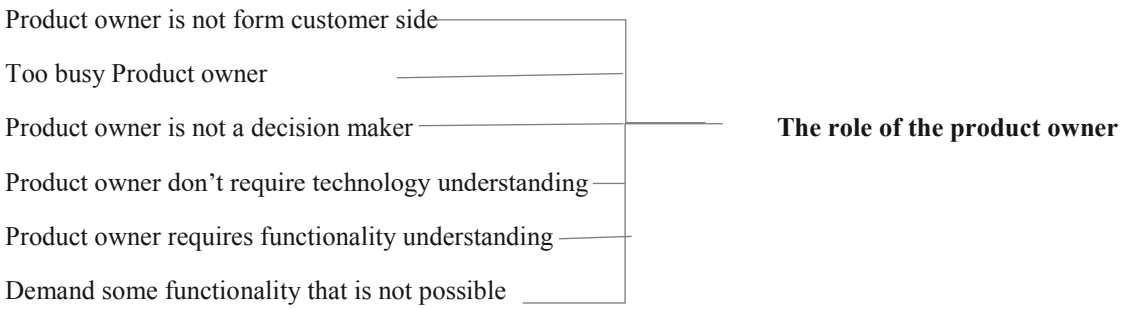


Fig 2: Underlying codes that gave rise to concept (the role of the product owner)

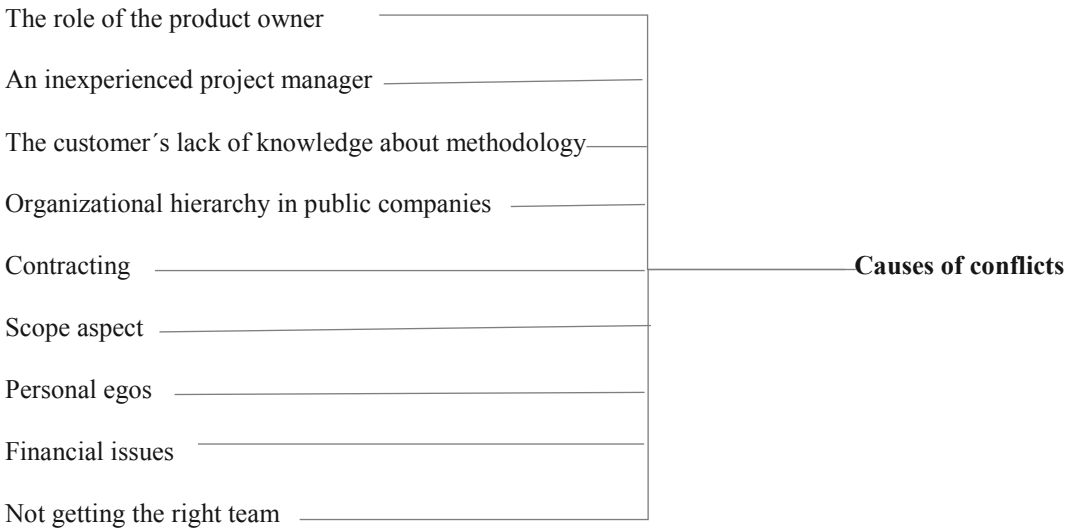


Fig 3: Underlying concepts that gave rise to concept (causes of conflicts)

Memo writing is an important part of grounded theory research as these memos are helpful during the theory writing process (Glaser, 1978).

## 3. Results

In this section, we will present our theory. To present our results, we used Glaser's six Cs coding family (1978). This coding family (causes, contexts, contingencies, consequences, conditions) is one of the various coding families used to represent the relationship between categories and ultimately generate a theory (Glaser, 1978) and has helped us to illustrate our theory of conflict management (Figure 4). We have used the six Cs model to present our results because there are certain causes of conflicts that have certain consequences. Thus, to present our findings in a concrete manner, the six Cs model was the most suitable choice.

In this model (Figure 4), the core category "conflicts" lies at the center of the diagram. The relationship of each of the six Cs to the category is also represented in the diagram.

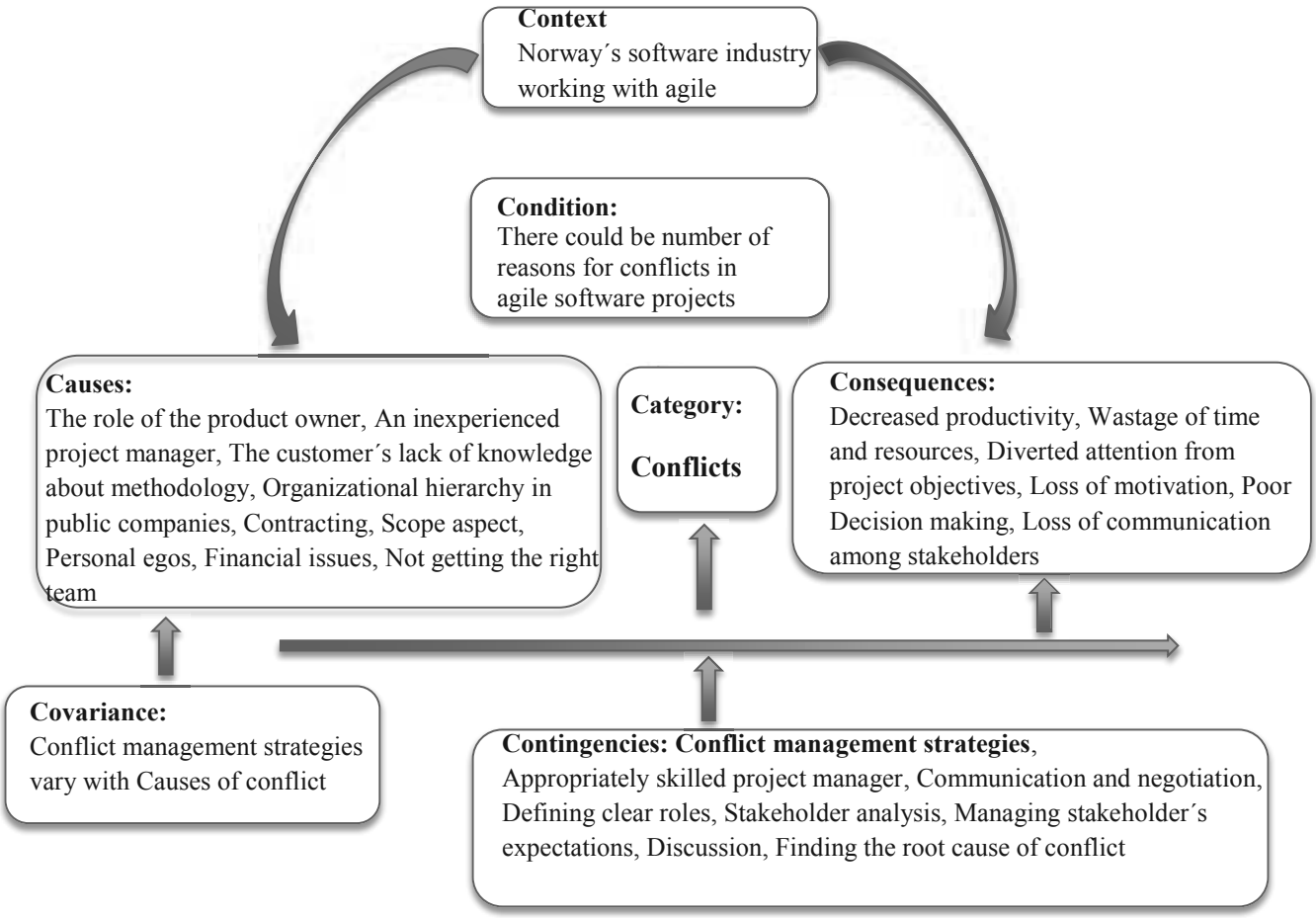


Figure 4: The theory of conflict management depicted using the Six C's model (Context, Condition, Causes, Consequences, Contingencies, and Covariance) (Glaser, 1978)

Selected quotations from the interview transcripts are presented in the following section to provide a better insight along with necessary explanation of the concepts that gave rise to the categories. We interviewed 24 practitioners, but due to the space limitation we cannot discuss all the underlying points, concepts, or codes arising from the interviews that laid the foundation for the codes and categories.

### 3.1. Context

We conducted interviews with agile practitioners from different software development organizations in Norway. A detailed description is presented in Section 2.

### 3.2. Condition

As discussed in Section 1 that agile methods put emphasis on communication, collaboration and close customer involvement throughout the development of the project and therefore there is a higher likelihood of conflicts in agile software projects.

### 3.3. Causes

Grounded theory analysis of the data highlights the main causes of conflicts in agile software projects and these are outlined as follows: the role of the product owner, an inexperienced project manager, organizational hierarchy in public companies, contracting, personal egos, financial issues, not getting the right team. Table 3 presents summary of all categories.

### 3.3.1. The role of the product Owner

Another conflict that often arises between project managers and product owners is that the product owner wants to develop a functionality that is not possible (due to scope, budget or technological restrictions).

According to practitioners, this is often because technologically developing that particular functionality is not possible. Other reasons may be that due to other constraints the project manager can't deliver what product owner is asking for.

"When a product owner wants something and it can't be done."__ AP3

Table 3: Categories generated for this research (along with numbers, presenting number of practitioners mentioned the specified category)

| | | |
|---|---|---|
| **Causes** | | |
| The role of the product owner (14) | An inexperienced project manager (12) | The customer´s lack of knowledge about methodology (10) |
| Organizational hierarchy in public companies (7) | Contracting (6) | Scope aspect (6) |
| Personal egos (5) | Financial issues (5) | Not getting the right team (4) |
| **Consequences** | | |
| Decreased productivity (18) | Wastage of time and resources (13) | Diverted attention from project objectives (12) |
| Loss of motivation (10) | Poor decision making (8) | Loss of communication among stakeholders (3) |
| **Conflict management strategies** | | |
| Appropriately skilled project manager (20) | Communication and negotiation (15) | Defining clear roles (13) |
| Stakeholder Analysis (9) | Managing stakeholder's expectations (9) | Discussion (7) |
| Finding the root cause of conflict (2) | | |

Practitioners believe that the product owner's role is particularly important. They believe that the product owner should have a role of a decision maker in the parent organization. He does not need to have knowledge of technology but he should have an understanding of the functionality.

"I think it's important to have a product owner that is involved and is a decision maker. Product owners don`t need to have technology understanding but they need to have functionality understanding."__AP14

According to practitioners the product owners sometimes lack a wide range of knowledge, but it is desirable if they have an understanding of functionality.

While working in one of the projects, AP14 encountered a product owner who was a professional person (IT person). Therefore, the project manager experienced the problem that the product owner was not available when needed and that person was not the decision maker; consequently, the project manager had to wait for a long time to get approval from the authorities.

"The professional product owner in this project was probably one of the big downfalls. She was not available (due to other work related commitments) and she was not a decision maker."__AP6

Practitioners asserted that ideally the product owner is the person who is responsible for all communication and decision making, but in real life this level of maturity is not present.

"Project organization is in the hands of the product owner and the product owner is responsible for all communication and everything, which is a very ideal picture, and based on that some conflicts will arise because it's difficult to reach that level of maturity in this situation."__ AP10

### 3.3.2. An inexperienced project manager

The respondents believe that sometimes conflicts arise due to the incompetencies of the project manager. For example, if the project manager is not competent enough and they are not equipped with the right skills needed to manage a project and people there are likely to be problems.

"Conflicts arise in two places. If the project manager doesn't know about a scrum there are more chances of conflicts, and this is also the case if the project manager doesn't conduct stakeholder analysis correctly as he doesn't involve the product owner. So, it is very important that the project manager and product owner are able to cooperate closely when doing stakeholder analysis."__ AP3

Another project manager we interviewed told us that he was the project manager on a big EU project and that the project in question might have been stopped a few months ago. The project was running at multiple locations and persons responsible at these locations did not convey the actual status of the project, resulting in delays and eventually the project being shut down. However, the bad part was that

this project might have stopped quite early. Based on her experience we think that this project manager should have had a clearer grasp over the project status and deliverables in order to avoid such extreme situations.

### 3.3.3. The customer´s lack of knowledge about methodology

According to practitioners customers tell the supplier company that the project should be done using agile methodologies. However, challenges arise here because an agile way of working puts a lot of responsibility on the customer's side and sometimes customers are not mature enough and lack knowledge about the way agile methods work.

"One of the main problems is that the customer demands that we work in agile. They ask for a methodology they don`t have knowledge about. The challenge with agile is that it puts a lot of responsibility on the customer's side."__ AP13

Another problem highlighted by practitioners is that although customers come for meetings, they don't come as often as expected or required. Thus, in order to run work smoothly, project managers have to write things down and send them via email or wait for the meetings before they proceed further in the project. Every change request is handled in a formal way and project managers don't proceed further until they receive a reply approving the change request. As a result, everything is handled in a very formal way. This is necessary to avoid any kind of issues related to budgeting. According to the project managers interviewed here, this is an issue because in agile projects it is necessary to be quick in responding to changes but a lot of time and effort is put into making any changes. They believe it is necessary because if the customers do not formally approve any change requests then they will not pay for the extra costs incurred on the project. Project managers believe that if you are working in an agile way there needs to be a lot of trust between both parties and individuals need to be quick to respond to changes, but in reality this doesn't happen.

AP13 expressed his opinion about extra work as follows:

"It's formal, it's heavy, it is negative and they wonder what happens to lean /agile philosophy."

According to one respondent an extreme issue in one project he worked on last year was the customer´s inability to define clear requirements.

"The customer always wanted to know how much it costs and the functional scope and prioritizing features and customers inability to clear requirement."__ AP20

Having continuous communication is necessary for successful delivery of the project. Sometimes, the problem arises when the project manager doesn't have direct communication with the actual stakeholders.

"We usually talk with workers who are not real stakeholders."__ AP5

Practitioners asserted that due to lack of direct communication channels message often fail to reach the concerned managers. Another problem is that practitioners are facing is that customers are not present when they need them.

Practitioners asserted that the cause of conflict is that the customer is not mature enough to work in an agile way and as a result product owners can't understand the customer side. In these situations one of the people from the supplier company acts as the product owner. In this case, there are further chances of conflicts because customers are not being represented or do not have any say about the project as often as they need to.

"I have been working with smaller projects in a context where the customer is not very mature and not a mature buyer of software service and when you do that it's very difficult to tell one customer representative you must be the product owner."_ AP10

**3.3.4. Organizational hierarchy in public companies**

Public organizations' way of working doesn't support agile philosophy because a lot of bureaucracy is involved in these organizations.

"Huge companies have a lot of politics and bureaucracy."__ AP11

"Public organizations work in a more waterfall way than in agile."__AP9

Respondent believe that bureaucracy on the customer's side means that they will have more control over the project. Another source of conflict is that when agile and waterfall processes are put together to work, conflicts often arise due to different mindsets and approaches.

"The trouble came when I realized that I have to combine waterfall and agile. I realized that they (customers) need control (over the project)."__AP19

Practitioners believe that this way of working cannot be changed in a quick manner.

"This way can´t be changed at once because these are huge organizations."__ AP13

Practitioners believe that the role of the product owner is extremely challenging in these organizations. The reason is that the product owner is not the actual decision maker. For all changes, project managers have to talk to someone else on the customer side to get the necessary approvals. One of the project managers experienced a three week delay in a project due to these formal procedures. Contracts state that if the delay is caused by the customer´s company they will be charged for this. Respondents argue that no one wants the situation of sitting idle and doing nothing. According to practitioners, private companies have different procedures and product owners understand that if they are the product owner they are supposed to take decisions.

"It's different in private companies as product owners understand that if I am the product owner I am supposed to take decisions. This is one of the cultural things."__ AP16

Another challenge with public companies is that they want to get every aspect specified in advance. Practitioners experienced that when they worked with small private companies they found that they are more adapted to working in an agile way. Practitioners believe that this has a lot to do with maturity and culture. In the traditional method of working, planning is done ahead but the plan is not always accomplished; on the other hand, in agile methods the opposite is true as to the focus is on delivering value and not caring much about detailing everything in advance. This means there is also a clash of cultures. The practitioners argued that bureaucracy in the public sector is really not very good at doing things in a quick manner as required in agile work.

### 3.3.5. Contracting

Practitioners believe that a major area that causes conflict is related to contracting because companies are using agile with fixed price contracts. According to the responses collected here, public companies have more waterfall approaches than agile ones and consequently they wanted to use fixed price contracts in agile projects. Practitioners asserted that using agile with fixed price contracts is a significant challenge in agile projects.

"You use a contract with fixed price and it's not possible to use agile with fixed price."__ AP5

"The contract is difficult and it is even more difficult that they demand and want us to be agile knowing that they are not agile themselves."__ AP13

"We have conflicts because we have more fixed price contracts."__ AP17

The reason for this is that when a fixed price contract is used the project requires a detailed specification that is planned ahead just like in a waterfall process.

"Contracting is probably a big source of conflict arising, especially in public companies."__ AP20

### 3.3.6. . Scope aspect

Practitioners asserted that one cause of conflict is that product owners want to have more functionality added without the necessary changes in other aspects.

"They (product owners and customers) want more features and I have deadlines to reach expectations."__ AP4

One of the project managers experienced a failure in a big project which was about to be terminated several days later. When we discussed the reason for this failure, he asserted that:

"Customer expected more than we promised to deliver and actually the customer chose a product that we could not deliver."__ AP14

According to practitioners the biggest reason for conflict in their projects was the fact that the customers provided high level specifications and expected get everything they asked for. When they use this scope to define sprints and details, serious issues arose because the customers did not define appropriate specifications or scope at the sprint level.

"I think they want it all in a bag."__AP14

"In our situation, conflicts are obviously that the customer has a waterfall perspective and as a result I think the biggest problem is the scope aspect."__AP22

**3.3.7. Personal egos**

Practitioners believe that although conflicts may arise due to different causes, personal egos can also generate conflicts. This comes under the category of relationship conflicts. One respondent's view is as follows:

"I suppose that roles and responsibilities conflicts come from many resources. One aspect is psychology and that is because of personal egos. People tend to form groups or strong small sub teams where they all have one or two technological strengths."__ AP11

**3.3.8 Financial issues**

The interview data suggested that another cause of conflicts is budget related issues. These often arise due to change requests from the customer's side, which creates discussion regarding whether this is based on the original requirements base or if there is a new requirement. Practitioners told us that then there is always a financial discussion relating to who should bear the costs.

"I see many conflicts we have are based on finance….. Then there is financial discussion about who should bear these costs; we argue that the customer should take them and they argue we should take them."__ AP7

"You have too much conflict where the main decision maker is the person who places the emphasis on money."__ AP14

**3.3.9. Not getting the right team**

Practitioners revealed that one area of conflict is that project managers want to have a team of competent, skilled, experienced and social competent individuals in order to deliver best results. Conflict of interest arises when back office allocates people to that project based purely on availability. Practitioners asserted that this is often the case in consulting businesses and in one practitioner's view the available people might not be the right people for the project.

"I often meet conflict of interest with my back office because I need new people in a project. I want people with the right competencies, the right experience, the right social skills and the back office wants to send out the people available. These people are not necessarily right for my project."__ AP1

"What I see problem with management is that when I need certain people in my team due to their capabilities and fit in the team but I don't get them."__AP16

### 3.4. Consequences

The consequences of these conflicts could range from minor to major. People involved in the conflict can divert their attention from the primary objectives by becoming involved in unnecessary activities. Conflicts if not addressed properly can have many consequences including the following:

#### 3.4.1. Decreased productivity

Practitioners think that if individuals are more often involved in conflicts, they could have decreased productivity.

"I think if you are busy with other things then how can you deliver something that you are supposed to deliver?"__AP11

"Whenever there is such issue it leads to poor working environment with less focus on work"__AP14

#### 3.4.2. Wastage of time and resources

Practitioners believe that a lot of time, effort and resources might be needed to resolve conflicts. If these conflicts are minor they can be solved quickly, otherwise a significant amount of time, effort and resources is required to create a harmonious solution that is acceptable for all parties.

"I see a lot of time is wasted in making people agree on one solution."__AP21

"A lot of time is wasted in handling such issues. Not bring benefit to anyone."__AP2

#### 3.4.3. Diverted attention from project objectives

Practitioners believe that one of the consequences is that individuals involved in conflicts might lose sight of the project objectives.

"People might spend time on unnecessary tasks."__AP17

"People can find other motives and they might not concentrate on tasks assigned to them".__AP7

#### 3.4.4. Loss of motivation

Respondents believe that unattended conflicts can cause major disruptions in work and processes. Individuals involved can lose work related motivation thus halting progress of the project work.

"People might not work the way they are supposed to."__AP2

"One thing which I see is that one might loss motivation to do something.___AP8

### 3.4.5. Poor decision making

Practitioners asserted their opinion that conflicts can result in poor decision making regarding work related activities because a significant amount of energy, time and resources will be wasted on conflicts. When the team has conflicting priorities they tend not to perform well. Agile methods heavily emphasize self organizing teams with considerable autonomy related to tasks and decision making, and practitioners think that conflicts can hamper the self organizing behavior of these teams.

"If conflicts are not solved I think then people could not reach goals together because of lack of shared understanding about goals".__AP11

"If things are not working as they should these might affect people in multiple ways. For example they might find them stuck in thing which are not really beneficial to do….Due to conflicts, it is not possible to catch or reach common goals because you don't have shared goals. It might also affect the way you make decisions to reach your goals."__AP13

### 3.4.6. Loss of communication among stakeholders

Practitioners argue that if there are conflicts then this may lead to further decreased communication or loss of communication among stakeholders which may create further misunderstandings and ultimately becomes the reason for more conflicts. Loss of communication further affects the productivity of the members,

"People have egos, therefore they stop talking to people they have conflicts with."__AP9

"The worst part is when you let things go on without actually getting the root causes to surface. People really don't feel comfortable to talk with people they have. As a result, conflicts remains hidden."__AP21

## 3.5. Contingencies: Conflict management strategies

We have discussed the causes and consequences of conflicts. We will now describe strategies that are being used or can be used by practitioners to avoid or resolve conflicts in agile software projects. These include appropriately skilled project manager, communication and negotiation, defining clear roles, stakeholder analysis, managing stakeholder´s expectations, discussion, finding the root cause of conflict.

### 3.5.1. Appropriately skilled project manager

Practitioners believe that project managers need to be equipped with conflict management strategies and they should have an objective approach towards doing their job. When we asked practitioners about the skills these individuals should have to handle conflicts, they argued that education, experience,

communication skills, being open to changes and a service minded attitude are highly influential skills for a project manager. They should be good at organizing teams and creating a good working environment as well as knowledge about project management skills. Finally, they must be open minded and should have interpersonal skills.

"Experience, learning to understand the organization and communication skills have a kind of service minded attitude."__ AP15

"I think you need to have a person with leadership skills able to go in and take direction."__ AP11

Practitioners argued that every project manager has different skills, competencies and personalities. Regardless of which skills they possess they should make sure to have someone else in the team to take care of areas where they are less experienced:

"For instance, I am very good at organizing teams and creating good working environment but not analyzing and processing data. I am not very analytical. I have a member in my team to look into these matters, and I focus on project management. I know little about the products and other people make sure that product quality is good."__ AP1

Practitioners stated that project managers should have a solid understanding of agile development. They also need to be able to manage the expectations of the customer. Furthermore, practitioners believe that project managers should be enthusiastic and ready to embrace any changes along the way.

"The project manager should be to be enthusiastic, open to changes, and should not take things not personally."__ AP4

"It's good to be open-minded and have interpersonal skills to understand people and customers."__ AP21

### 3.5.2. Communication and negotiation

Communication and negotiation play a vital role in solving a conflict. Communication is especially emphasized in agile methods and therefore practitioners believe that conflicts should be resolved with communication and negotiation.

"Communication matters to keep everyone happy."__ AP15

"The project manager should handle contracts and external communication to prevent conflicts."__ AP17

### 3.5.3. Defining clear roles

Another indication in the interviews is that a project manager needs to define clear roles otherwise there are more chances of conflicts regarding roles and responsibilities.

"Project managers need to define roles clearly because if they don't define roles clearly it is possible that at some point you might end with two project managers, i.e. it is possible that the product owner will start acting like a project manager. The project manager needs to be very clear about his own role." __AP3

Making responsibility clear can help to ensure that conflicts related to this aspect may not appear.

### 3.5.4. Stakeholder Analysis

The respondents argued that conflicts can be minimized if all the relevant stakeholders are involved and managed properly. They further suggested that stakeholder analysis must be done by the project manager to determine the key stakeholders.

"I think the real way it (conflict) can be minimized is doing stakeholder analysis of where your stakeholders are coming from and ensuring that you are meeting their requirements. You can see who the key stakeholders are and then you can involve them more... You can see other stakeholders that should be kept informed etc."__ AP19

"If you (project manager) communicate enough with stakeholders you should be good at collaboration."__ AP19

"More work should be done to involve all people."__ AP15

### 3.5.5. Managing stakeholders' expectations

Practitioners asserted that in order to avoid conflicts, the project manager should be able to handle customer expectations whilst also maintaining a smooth flow of communication among all stakeholders involved in a project.

"It is important to be able to control customer expectations. Project managers have to have a deep knowledge and good communication with the scrum master and developer."__ AP17

"When you are working as an external project manager then you have to do a lot of customer expectation management."__ AP17

"Understanding customer expectations."__ AP20

### 3.5.6. Discussion

The interview data suggests that a project manager can solve problems by discussing them with people. Discussing a problem or conflict can help to find the root cause of the conflict along with its solution. Practitioners believe that conflicts should be discussed openly to find the appropriate solution for it as if these issues are left unresolved they can become more problematic. After reaching a solution everyone must agree to the solution. One practitioner adds:

“I fix it by discussing it with people.”__AP4

“The best solution is to sit with them and talk about the issues. Only discussion can lead to some useful result.”__AP3

### 3.5.7. Finding the root cause of conflict

Chance of conflicts cannot be removed but the likelihood of such incidents occurring can be minimized. However, if conflicts have arisen, it is necessary to find out:

1. What are the root causes of the conflict?
2. What are necessary steps that should be taken to resolve the conflicts and create harmony among individuals?

From the interview data, it is evident that conflicts arose due to reasons that cannot be completely eliminated. Therefore, we suggest careful tackling of these issues. Respondents believe the primary reasons for conflicts should be investigated before taking any steps towards their resolution.

“First thing to know is what is the reason? It is important if you want to get a solution”.__AP4

“Without knowing what is the reason behind, you cant find a solution.”__AP13

## 3.6. Covariance

Covariance refers to how a change in one category can have an effect on other categories (this relationship is shown by arrow pointing towards left). From the interview findings, we found that the categories related to causes of conflict are influenced by conflict management strategies. For example, categories related to causes of conflicts (the role of the product owner, an inexperienced project manager, organizational hierarchy in public companies, contracting, personal egos, financial issues, not getting the right team) and the categories related to conflict management strategies (appropriately skilled project manager, communication and negotiation, defining clear roles, stakeholder analysis, managing stakeholder´s expectations, discussion, finding the root cause of conflict) have an effect on each other and vary accordingly.

# 4. Discussion

A number of stakeholders are involved in a project. Different stakeholders have “different motivations and interests” (Krane et al., 2012), and these are major sources of conflicts in a project. One major stakeholder is the team. Agile methodologies put more emphasis on self-organizing teams (Hoda et al., 2013; Oza et al., 2013; Hoda and Murugesan, 2016). In agile projects, teams are not changed as often as in waterfall projects (Adkins, 2010). Therefore, if conflicts remain unresolved in waterfall projects it is not a big issue but in agile projects if teams remain the same throughout the project conflicts cannot be left untreated. As a result, in agile projects, it is vital to first determine the severity of conflict before

attaining a solution (Adkins, 2010). A team can be guided through this phase in finding a solution to the problem. Respondents' opinions about stakeholder analysis are in accordance with this literature.

The effect of communication was shown by Kawalek and Wood-Harper (2002) in their paper. They described that user involvement can increase communication and therefore conflicts can be prevented. Suggestions from the study participants of involving all stakeholders in communication and negotiation are in accordance with the literature.

Practitioners asserted that project managers should be competent enough to handle conflicts if they arise. This is in accordance with Robey and Farrow (1982), who suggest that strategies for conflict resolution must be prepared in order to encounter any kinds of conflicts that arises during the project life cycle. Project managers should be able to detect the early signs of conflict and take the necessary steps to solve them effectively before they become huge or insurmountable. Practitioners' opinions about communication and collaboration are in accordance with Ahimbisibwe et al. (2015), who argue that team members should have internal project communication to increase information sharing which in turn increases the level of collaboration and cohesion. This results in less conflict among team members. Detecting early signs of conflicts is in accordance with Jun et al. (2011), who suggest making arrangements to resolve conflicts at the very early stages to ensure greater satisfaction from the customer. Practitioners believe that conflicts can result in project delays. This is in line with the research of Yetton et al. (2000) which shows that conflicts among team members can result in project delays and the budget being exceeded.

Practitioners suggested that in order to avoid conflicts, stakeholder analysis should be performed to involve all stakeholders in the project. This is in accordance with May (1998), who suggested that all stakeholders should be given an opportunity to share their point of view and without these remedies there are more chances of conflicts between the organization and customers and within the development team. The respondents' opinions about communication and collaboration are in accordance with Highsmith (2002), who argued that collaboration and good communication helps to reduce conflicts among stakeholders and prevent misunderstandings and thus increases knowledge sharing.

Since customers are investing money in the project they want to get the maximum value and benefit from it. Product owner is the person who is representative of the customer side therefore product owner has all the interests related to get the maximum benefit from the project. The project team is concerned with delivering the project according to time and budget (Krane et al., 2012); as shown by Turner and Müller (2004), these two interests and priorities lead to conflicts. Project managers should keep in mind this fact and design strategies accordingly.

Practitioners' opinions about having a balanced team is in accordance with Reel (1999), who stated that "having too many stars creates ego issues and distractions, while not having enough can leave the team struggling with small problems".

Table 4: Levels of conflicts adapted from Spree Leas (Oza et al., 2013)

| Levels of conflict | Description |
|---|---|
| Level 1: Problem to Solve | Conflicts at this stage are often due to difference of opinions and misunderstandings. These can also happen due to conflicting goals and values. At this stage collaboration among stakeholders is present and stakeholders can work on the conflict if it is a result of miscommunication. An optimistic attitude is present at this level. Adkin (2010) regards level 1 conflicts as "constructive disagreement". |
| Level 2: Disagreement | At this level, stakeholders can distance themselves from each other; this results in disagreements and decreased initiatives to solve the problem. |
| Level 3: Contest | At this level multiple issues accumulate together resulting in a significant problem. Power politics can happen. The focus is more on the contest than on winning. |
| Level 4: Crusade | At this level people start thinking that other people will not change; therefore, they believe the only option is removing either themselves or the other person from the team. |
| Level 5: World war | People become so destructive towards each other that they think that no constructive solution is possible at this stage. |

People involved in the conflict can divert their attention from the primary objectives by becoming involved in unnecessary activities (Rubin et al., 2003). Individuals involved in these conflicts can get physical or psychological health problems (Rubin et al., 2003). Crawford et al. (2014) states that "persistent conflict complicates the management of the projects, causes practitioners to constantly disagree with each other about requirements, methods, techniques and solutions. The continued conflict damages the communication, coordination and control, reducing the team performance level and affecting the final quality of the product, the project deadline accomplishment and costing". Therefore, conflicts should not be left unattended.

Conflicts can be minor and ignorable or major with severe impact. We have summarized five levels of conflicts in Table 4. These five levels of conflicts were described by Speed Leas (1998) and further elaborated by Adkins (2010) in her book on team´s perspectives, but here they are written from the perspective of stakeholders involved in a project. We suggest that conflicts should be resolved before they reach level 4 or 5 or become insurmountable. Appropriate strategies to resolve conflicts must be followed because if these conflicts are not resolved they can "hinder communication and collaboration, resulting in decreased productivity of your teams, or even worse" (Horvath, 2014).

## 5. Implications

This theory of conflict management has implications for both theory and practice. These are discussed below.

### 5.1. Implications for theory

As discussed above, using an agile approach provides more chances of conflicts and consequently appropriate strategies must be taken into account to avoid or resolve conflicts. The implications of our conflict management theory are outlined as follows.

#### 5.1.1. Clarity regarding roles and responsibilities

The major concerns of practitioners were that they were facing roles and responsibilities conflicts, which could be solved by establishing a responsibility matrix. This is presented as a strategy in our study (Siddique and Hussein, 2016) in order to prevent such conflicts. Making a clear distinction regarding who is responsible for what can help to avoid ambiguities between individuals, resulting in fewer conflicts.

#### 5.1.2. Understanding and managing Stakeholders' expectations

Stakeholder analysis must be performed by the project manager in order to involve every important stakeholder in the project. Important stakeholders' expectations should be managed properly and all viewpoints must be taken into account in order to avoid conflicts at later stages (May, 1998).

Keeping in view stakeholders' importance, Johnson et al. (2016) suggested that project managers should engage themselves effectively in stakeholder management right from the beginning.

#### 5.1.3. Communication, negotiation and discussion

Instead of suppressing the conflicts, all kinds of conflicts should be surfaced and openly discussed with the concerned parties in order to reach a consensus. Otherwise, they can become insurmountable.

According to Hung and Lin (2013), a "high level of effective communication not only diminishes the negative impact of relationship conflict", it also increases team satisfaction.

In terms of maximizing an agile team's effectiveness, effective coordination is suggested to be an important factor by Strode et al. (2012). They also presented a strategy for effective coordination.

### 5.2. Implications for practice

The conflict management theory presented in this paper has practical implications and this can be used by project managers for agile software projects, traditional software projects or any other types of projects in general.

## 6. Evaluating grounded theory

The Grounded theory study "does not intend to generate factual results or accurate descriptions, but presents an integrated set of plausible, theoretical hypotheses about an underlying pattern of behaviour" (Breckenridge, 2010, originally from Glaser and Strauss, 1967). According to Breckenridge (2010), "[t]he emergent grounded theory offers an integrated probability statement that is not intended to be verified as right or wrong, but instead has relevant applicability and modifiability within the substantive area". Therefore, grounded theory should have fit, work, relevance and modifiability (Glaser, 1978).

### 6.1. Fit

Fit refers to the validity of concepts and categories and their fit in the data. Glaser (1978) suggests that "the analyst's goal is to ground the fit of categories as close as he can" (p. 4).

To ensure fit, researcher should avoid a pre-literature review in order to pre-conceptualize concepts and categories so that data analysis is performed without pre- assumptions about the research topic. Following these guidelines, no literature review has been conducted before all concepts and categories emerged.

### 6.2. Work

Work describes the ability of the theory to "explain what happened, predict what might happen and interpret what is happening in an area of substantive or formal inquiry" (Glaser, 1978 p. 4). The participants' main concern must be well presented in the theory and in this study the main concern was conflict and conflict management. Data analysis and systematic generation of categories helps to generate concepts, codes and categories which accurately present what happened in the area of formal inquiry. The main concern for this study is conflict and conflict management with an accurate depiction (based on data) of what is happening in this area.

### 6.3 Relevance

Relevance refers to whether the theory is grounded in the data and systematically developed through analysis. Relevance can be ensured by applying grounded theory procedures and problems and resolutions should emerge from the data. Accordingly, all the causes for conflicts, consequences of conflicts and strategies for conflict management categories have emerged from the data.

### 6.4. Modifiability

Modifiability presents the ability of the presented theory to be altered through adding more relevant data (Thulesius et al., 2003). Grounded theory is "ever developing entity, not as a perfected product" (Glaser and Strauss, 1967, p. 43). After generating grounded theory, it should not be intended to be proven but rather further modified through constant comparison of categories emerging from further

data collection (Glaser, 2003). The theory emerged "is only ever partially closed as new ideas will always hone it to better suit current circumstance" (Breckenridge, 2010). The theory of conflict management presented in this study is in a transitory state and is open to modification with new incidents, code and categories in the substantive area.

### 6.5. Limitations

This study has the following limitations:

1. Grounded theory research is strongly context specific; therefore, it cannot be generalized to a large population.
2. Furthermore, we collected the data not with specific project cases in mind but rather based on the collective experiences of the informants
3. All of the practitioners interviewed were project managers. This study only represents the viewpoints of project managers with the exclusion of all others.
4. Due to small sample, these findings might not be generalized to a larger population.
5. For the purpose of this study, no distinction has been made regarding types of conflict; instead, the term conflict is used to incorporate all types of conflict. This study is not particularly written about conflicts in agile teams. This study has taken into account conflicts from project managers´ perspectives. Therefore, it depicts conflicts with the management, conflicts with product owner, conflicts with customers, conflicts with suppliers and conflicts within teams.
6. Conflict management theory presented in this study is not presented to participants for testing because Glaser (2001, p.11) recommends for not doing so. Doing so can provide wrong validity check. The reason is they are unaware of empirical details that gave rise to codes, concepts, categories and theory..

## 7. Research contribution and future work

This study has made a contribution to the existing body of knowledge about conflicts in general and conflicts in agile software projects in particular. Since there is a lack of conflict research in agile projects (Behfar et al., 2010; Crawford et al., 2014), this paper has endeavored to address this research gap. Although significant research has been conducted regarding teams and productivity, research focusing solely on conflicts issue is still missing.

Systematically generating categories from the data means all results are grounded (based) in the data. These are not hypotheses but instead are based on and driven by real world experiences of project managers working with agile projects. In future research, we intend to study in each of the categories (causes, consequences, strategies) of conflict presented above along with their effect on various

stakeholders in more depth. One of the abilities of the grounded theory is it can be modifiable through more data collection and analysis (Thulesius et al., 2003). Future research may focus on causes of conflicts and their consequences to measure them quantitatively in order to find more empirical evidence. The limitations of this study already presented in terms of the specific context; we intend to do more work to make these findings generalizable to a wider population.

## 8. Conclusion

In this paper, we have discussed conflicts in agile software projects. The interview data suggested several possible sources of conflicts in agile software projects. These include the role of the product owner, an inexperienced project manager, organizational hierarchy in public companies, contracting, personal egos, financial issues, not getting the right team. Based on their experiences, practitioners suggested various strategies to handle conflicts. Although there are several sources for conflicts, a lack of affective communication could be the main reason for unnecessary misunderstandings and conflicts being generated. In order to avoid conflicts, agile principles must be adhered to. The principles of communication and collaboration help to foster positive relationships among stakeholders. It is very important that these conflicts are managed in a manner that can support collaboration and cooperation among all stakeholders. Strategies for handling conflicts include: appropriately skilled project manager, communication and negotiation, defining clear roles, stakeholder analysis, managing stakeholder´s expectations, discussion, finding the root cause of conflict. The project manager should have education, experience, communication skills, be open to changes and have a service minded attitude. This individual should also be good at organizing teams and creating good working environment. He should have knowledge about project management skills and he must be open minded and should have interpersonal skills. The project manager should have the right skills to avoid conflicts and if these occur he needs to be capable of handling them. Defining clear roles and managing customer expectations are important as this can prevent confusion, which can in turn create conflicts. If conflicts occur, the project manager should discuss the issues with the concerned stakeholders to obtain a suitable solution; thus, the project manager needs to be competent enough to handle such issues affectively.

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## Paper 2

**Grounded theory study of the contracting process in agile projects in Norway's software industry**

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II

**Abstract**

This paper provides practical insights into the challenges associated with the contracting process in agile projects in the Norwegian software industry. We conducted interviews with 32 agile practitioners from 25 different software development organizations in Norway. The data were analyzed using grounded theory. This analysis found several concepts that gave raise to two core categories, namely challenges involved in the contracting process and contracting process management. We used Glaser's six Cs coding family to represent the data analysis. The findings revealed the causes of the challenges related to the contracting process. The consequences are also discussed in the paper. Based on the interview data analysis, we present contracting process management strategies to overcome the challenges related to the contracting process.

## 1. Introduction

Contracting is considered to be a complicated process in software development because of the high levels of uncertainty and complexity inherent in software development [1]. According to Coldeway [2], "poorly constructed contracts have the potential to nullify any business objective the project has." Most of the standard software contracts were designed on the basis of "the principle and philosophy of waterfall projects" [3]. These contracts are based on the waterfall approach of long delivery cycles, distinct development, and sequential phases. This philosophy has led to the assumption that suppliers will follow all the steps in sequence and any failures that occur are the supplier's fault [3].

Agile project contracts and traditional project contracts are similar in their structural and legal aspects. The two areas in which they differ are the "approach to" and "understanding of operational process and delivery and how this is captured in or intersects with contract" and the fact that agile contracts are written with elements of collaboration, learning, and evolution [4]. Agile software projects put special emphasis on customer collaboration over contract negotiation [4].

In traditional projects, contracts are written to contain every detailed specification of the requirements before the contract is signed. Contracts written in this way are associated with increased project risk [1]. In software projects, requirements can change during the development process; therefore, it is not possible to state the exact scope of the work at the start of the project. Agile methodologies were introduced in response to this unpredictable nature of software projects. Agile proponents believe that software projects have an inherently

unpredictable nature, which makes it hard to fix everything at the start and to avoid failures. However, if a failure occurs, both parties need to fix it in a time- and cost-effective way to minimize the loss for both parties. Although development methodologies are adopted to work in an agile way, other relevant processes are not updated accordingly. One such process area is contracting.

To identify the challenges associated with the contracting process, we decided to conduct a grounded theory study of the process. The findings and analysis are based on interviews with 32 agile practitioners from 25 different software development organizations in Norway. Of the 32 participants, 26 were project managers (19 project managers were from the supplier side, 4 were from the customer side, and 3 were project managers of companies conducting in-house development), 4 were developers, and 2 were solution architects.

Their organizations varied from consulting organizations to in-house development organizations. The interview analysis was performed using grounded theory. Through our analysis, we found challenges concerning the contracting conducted. The interview findings showed that four types of contracts are mostly used in agile projects in Norway's software industry. Before we present our findings, the different types of contracts that are referred to in our findings are briefly presented. These are fixed-price contracts, time and material (T&M) contracts, target cost contracts, and PS 2000 contracts.

### 1.1 Fixed-Price Contracts

Fixed-price contracts mean price, scope and time contracts. These types of contracts are favored by customers because they provide them with all the incentives. In these types of contracts, all the risk is on the supplier side [5]. Fixed types of contracts are usually used by public companies and are granted through a bidding process, which itself involves considerable risk for the supplier [5].

### 1.2 Time and Material

In time and material (T&M) contracts, the supplier is paid for the amount of time that it spent on the project. In this type of contract, most of the risk lies on the customer side. Although this type of contract handles the uncertainties and complexities that are inherent in software projects well, convincing customers to use this type of contract is very difficult and a large amount of built-in trust is required [5].

### 1.3 Target Cost Contracts

This type of contract lies in between the previous two types of contracts. In fixed-price contracts, the supplier takes all the risk, and in time and material contracts, the customer takes the risk, while in target cost contracts, the risk and the obligation to achieve the project goal are shared between the two parties. A target cost contract needs both parties to understand that software project requirements are uncertain and that they must work collaboratively to attain the goals. If the price of the project exceeds the estimated price, the two parties will share it, and if there is profit in the project (by delivering it for less than the agreed cost), it will also be shared between the customer and the supplier [5]. Poppendieck and Poppendieck [5] presented two models: 1) Cost plus fixed fee. This means that if the supplier fails to deliver the project at the agreed cost, he will be paid an additional fee along with the original project cost. 2) The supplier will reduce the rates if the project cost exceeds the target cost. Target cost contracts can help to foster collaboration between parties [4].

### 1.4 PS 2000 Contract

This contract has two variations:

1) PS 2000 Standard (3.1)

2) PS 2000 Agile (Version 3.1)

The PS 2000 contract is a software development contract designed for iterative development based on integrated cooperation between the customer and the supplier. The main focus of the contract is on the process rather than on deliverables. PS 2000 contracts lie in between fixed-price and time and material contracts. They are closer to time and material than fixed-price contracts. The contracts include the following important parameters, which can be adjusted according to the needs of the project:

1. target price
2. delivery time
3. incentives and penalties.

PS 2000 Agile (Version 3.1) contracts address issues related to complexity, uncertainty, and clear role descriptions.

PS 2000 contracts focus on uncertainty management, close cooperation of the client and the customer, and a procedure for resolving conflicts [6]. The main advantages of PS 2000

contracts are that they contain elements that help to engender greater mutual trust between parties, handle change management, and include target cost elements. Their main disadvantage is that they require a large amount of upfront work, like fixed-price contracts. These contracts handle each iteration as a separate contract [6].

## 2. Methodology

We conducted interviews with 32 agile practitioners from 25 different software development organizations in Norway. These organizations varied from consulting organizations to in-house development organizations. The practitioners had long experience of working in the software industry, ranging from 3 to 40 years. Most of the software practitioners had been using agile methodologies since their inception or even started working with the methodology before it was named agile. The products and services offered by the practitioners' organizations include web-based applications, front- and back-office applications, and software development services. The interviewed practitioners include product owners, developers, a system developer, project managers, and a project architect. Through various media, including face-to-face, via email, and via Skype meetings, we conducted semi-structured interviews, which enabled us to view the research question from multiple perspectives. Since the purpose of our study was to create an understanding of the contracting process in the real world of agile software projects, we chose to follow the inductive case study approach in accordance with the guidelines proposed in the literature [7]. The inductive approach allows "research findings to emerge from the frequent, dominant or significant themes inherent in raw data, without the restraints imposed by structured methodologies" [9].

Inductive approaches help us to understand "meaning in complex data through the development of summary themes or categories from the raw data" [9]. We chose a descriptive case study for our research because this type of case study helps to describe a phenomenon in its real context. It also helps to develop informative conclusions [8].

We used the non-probability sampling technique for our research [10], specifically purposive sampling. This technique was selected in view of the purpose of the research. We deliberately contacted participants who had relevant experience related to the research questions. We searched for participants on the Internet, and after investigating their profiles, we sent them an invitation to take part in the study; individuals who were interested in participating in the research replied and accepted. After agreeing on the time and place of the interview, we conducted interviews of 20–25 minutes' duration. Data were collected over a period of almost

4 years from 2011 to 2014. Our priority throughout this research was to ensure the anonymity of our interviewees and their organizations. Thus, we refer to the interviewees throughout this research as respondents AP1 to AP32. This study presents limitations that affect its generalizability. This is because it is strongly context-specific, as it was mostly performed within the Norwegian context. Furthermore, we collected the data not with specific project cases in mind but rather based on the collective experiences of the informants.

### 2.1 Research Question

Although a common misconception about grounded theory is that there should not be a defined research question at the start of the research, it was necessary in this study because investigating a phenomenon requires an initial research question [11]. The purpose of this question is to identify the phenomenon, and the researcher should ensure that the question remains at the descriptive level. To summarize how a research question should be defined in a grounded theory study [11], it should:

1. Be open-ended.
2. Look into the phenomenon and try not to make any assumptions about it
3. Never use existing theories as a basic construct
4. Investigate the action and process rather than the states and condition.

Bearing the above-defined recommendations in mind, we defined the following research question:

1. How does the contracting process work in agile software projects?

We limited the scope of our study, and the following parts of the contracting process are not covered:

1. Bidding process mechanism details
2. Legal complications (in the case that both parties fail to execute the contract according to the predefined terms and conditions).

### 2.2 Procedure Adopted for Interview Analysis

The research method that we used for our study is grounded theory, which we chose because it helps to generate an understanding of the phenomenon in the current scenario. After delving into the current scenario, different problems can be identified that make the process under study more problematic. Another purpose of using grounded theory is that it helps to develop a new

theory [12]. The very first step is the collection of data, which was performed through interviews. After transcribing the interviews, an analysis was performed.

We used open coding for our research. As codes are developed, they are compared with the previous codes from the same interview and from other interviews. This is called the constant comparison method for data analysis and it was used for grouping the codes into concepts. These concepts were then combined on a higher level of abstraction called categories [13] [14]. As a result of the analysis, the following concepts were generated: formal documentation, unequal sharing of risk, using agile with the waterfall mindset, a fixed scope versus fixed objectives, contract selection based on preferences, and inadequate customer collaboration. All these concepts formed the category of challenges involved in the contracting process.

The other set of concepts includes the factors to be clarified before writing a contract, trust, right selection of contract type, frequent-delivery option, replacing risk sharing with gain sharing, focusing more on functionality than on budget, customer involvement, and adopting strategies for avoiding conflicts. These concepts gave rise to a category called contracting process management. Since contracting process management was an important category that affected the core category, we continued to code selectively for this category [15]. For insights into the categories developed from grounded theory data to emerge, Glaser [16] suggested using the six Cs coding family, which we use to present our data analysis results.

## 3. Results

In this section, we will present our theory. We used Glaser's six Cs coding family [16] to illustrate our theory of contracting process management (Figure 1). The category lies at the center of the diagram. The relation of each of the six Cs to the category is represented in the diagram pointing towards its subsection (Figure 1). Selected quotations from our interviews are presented in the following section to provide a better explanation of the concepts. We interviewed 32 practitioners, but due to the space limitation, we cannot discuss all the underlying points, concepts, or codes from the interviews that laid the foundation of the codes and categories.

### 3.1 Context

We conducted interviews with agile practitioners from different software development organizations in Norway. A detailed description is given in section 2.

### 3.2 Condition

Software development contracts are based on the "principles of waterfall projects, which are chronologically scoped in design and execution, with an agreed statement of requirements up-front, governed by change control" [17]. This waterfall-based nature of contracts generates many challenges when they are used for agile projects without making the necessary adaptation.

### 3.3 Causes

From the interview data, we identified the causes of problems in the contracting process. These include formal documentation, unequal shares of risk, using agile with the waterfall mindset, a fixed scope versus fixed objectives, contract selection based on preferences, and inadequate customer collaboration (Figure 1).

#### 3.3.1 Formal documentation

The documentation requirement varies with the type of contract used. According to the respondents, fixedprice contracts require considerable upfront work, which is opposed to the agile philosophy. The respondents stated that PS 2000 contracts also require a great deal of work in advance. The interview findings suggested that PS 2000 contracts are the second most used type in Norway. They require every minor description to be written down. For large projects, it takes months to complete this preliminary work. Another problem with using PS 2000 contracts is that

"PS 2000 agile demands extremely professional management and involves scope management and architecture involvement whole way not user experience resources are extremely important" (AP26).

According to the respondents, PS 2000 contracts have the following drawbacks:

1. Many customers are not experienced and they do not know how the project will work when the contract is used.
2. From the documentation, it seems like the traditional way in which the price is given for the whole project.

### 3.3.2 Unequal sharing of risk

The interview findings suggested that T&M contracts are the most used type in agile projects, but its practitioners also perceived some drawbacks. According to the respondents, in T&M contracts, the supplier's incentives are not the same as the client's:

> The problem with time and material contracts is that it places all the risk on the customer side. (AP29)

According to AP26, "if used correctly, PS2000 gives a fair share of risk."

According to the respondents using PS 2000 contracts, this contract type gives equal shares of risk, unlike fixed price contracts, but when it comes to the delivery part, the supplier still has a greater share than the customer, so the supplier has to conduct structured project management to ensure that delivery occurs in the time frame initially agreed.

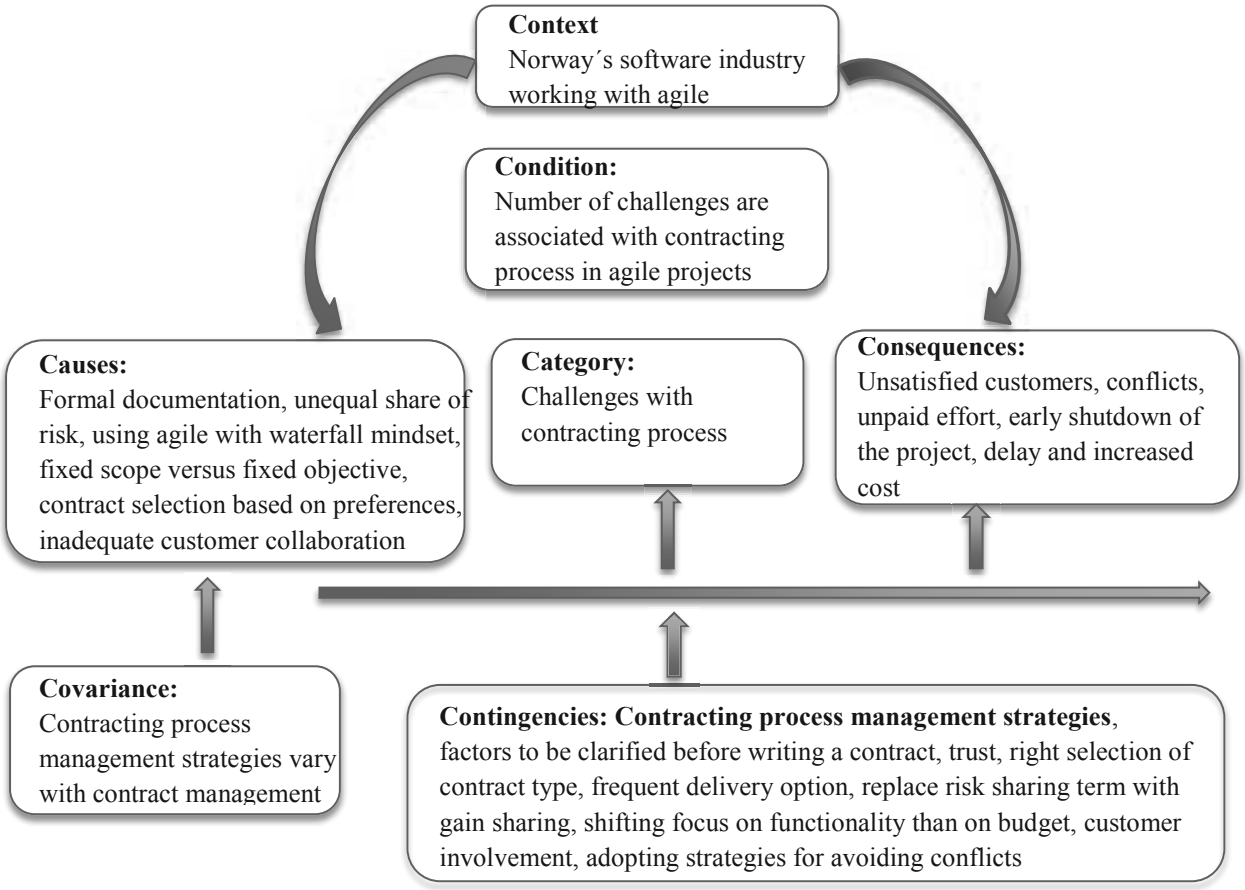


Fig2: The theory of contract management depicted using the Six C's model (Context, Condition, Causes, Consequences, Contingencies, and Covariance).

According to the respondents, target price contracts provide some risk sharing:

Target price is almost the same as fixed price except that you (both customer and supplier) have a share in the risk. (AP18)

The respondents believed that the issue regarding contracts is to find the right balance in risk sharing. In their opinion, T&M contracts have very little risk (on the supplier side).

The interview findings suggested that most public organizations work with fixed-price contracts and the process of granting projects is based on the bidding process, but this process also has drawbacks. Since suppliers have to win a project through a bidding process, a considerable amount of risk lies on the supplier side.

### 3.3.3 Using agile with the waterfall mindset

According to the respondents, for fixed-price contracts, the specifications need to be made upfront, so the approach appears to be more like the traditional waterfall approach than the agile approach. For any kind of changes, change orders have to be made. The respondents reported that public organizations prefer to use fixed-price contracts, while practitioners find it hard to use these contracts with agile projects:

Fixed-price contracts are a problem, especially if they want to have a fixed price, because if it is fixed price you will have fixed specifications and I do not think it is possible to have fixed specifications because they are changing all the time and especially you have discussions all the time. (AP18)

With fixed price you can't do agile. (AP31)

The respondents considered that using fixed-price contracts makes companies prone to more conflicts:

We have conflicts because we have more fixed-price contracts… if it is fixed price fixed scope, I wouldn't say it is agile. In fixed price, the customer wants as much functionality as possible and the vendor is most likely to earn quite as high as possible. (AP29)

Public organizations grant projects through a bidding process, which is not an agile way of working. For time and material contracts, customers often want to know the price in advance, which is hard to calculate.

### 3.3.4 Fixed scope versus fixed objectives

According to the respondents, one of the issues that they encounter is that customers have fixed objectives but they often confuse them with a fixed scope:

The main disadvantage of agile projects (and hence contracts which support them) is that they (customers) counter the intuitive idea that you have a fixed scope in mind when they purchase a project. Typically a customer has rather fixed objectives, but they are often confused with a fixed scope. So, communication and clarity issues are critical. (AP26)

The respondents' view about the disadvantage of target price contracts is that they limit the ability of the project to make use of experience as the project progresses. However, compared with fixed-price contracts, a typical target price contract leaves more room for interpretation.

### 3.3.5 Contract selection based on preferences

Both customer and supplier have personal preferences for certain types of contract and these are based on the advantages and disadvantages offered by that particular contract type. The interview findings revealed that the respondents from the suppliers' side prefer T&M contracts. The reason for this choice, according to them, is that T&M contracts are the most flexible for use with agile development and have the lowest risk for suppliers. Since most of the respondents were from the supplier side, our analysis concluded that T&M contracts are the most used type. The respondents thought that T&M contracts are mostly preferred in a situation in which customers have little idea of what they are having developed.

However, if customers have worked with the target process first, they will prefer to use a target price contract, because it gives equal shares of risk to the two parties.

PS 2000 and incremental delivery contracts are the second most used contract type, and fixed-price contracts are third, according to the respondents. Some companies use target price contracts.

We [company] have a draft of an agile contract based on sequences of sprints with a stop clause for graceful shutdown of the project. (AP4)

The respondents reported that customer companies prefer to use contract types with which they already have experience.

Practitioners believe that in target price contracts, the customer and the supplier have the same targets. If the supplier manages to deliver the final product more quickly and better than anticipated, then both the customer and the supplier will benefit.

Some respondents use a mix of fixed-price and time and material contracts. The respondents thought that target price contracts are difficult to administer:

Going for a target price where you have goals to win if you many that are mature enough to have that kind of contract. Time and material and fixed price are familiar things. (AP27)

The respondents believed that target price contracts work better than fixed-price ones:

Compared to fixed price, a typical target price contract leaves more room for interpretation. (AP9)

Suppliers prefer the type of contract in which they have the least risk. Customers want contract types in which they have full control, since they are investing money. For example, one of the respondents reported that:

It depends on the customer which type of contract they want. A lot of public sector organizations we are working with require us to be totally responsible for the results; therefore, they want fixed price. This is because they want to have full control. If any change comes they are required to submit a change request. (AP27)

### 3.3.6 Inadequate customer collaboration

In agile projects, close customer communication and collaboration are needed. Most respondents had faced the problem that the product owner is not actively involved in the project.

I think when a customer does not have time for us that is a problem, because the product owner is so busy working with other things, so then I (the project manager) have to act as product owner by proxy. (AP28)

The respondents believed that having customer collaboration and communication in place during the development of the project can help to achieve successful deliveries.

If customers work in much more collaboration, then we have very good experience of delivering results using time and material contracts. (AP27)

According to the respondents, as long as the communication between the supplier and the customer works well, they do not face many problems regarding project development.

Inadequate customer collaboration can also cause delays in the project delivery:

Customers often delay us and that is the challenge ... they (customers) don't really care because the only consequence for them is they pay less each hour, so we have to really push and make demands. (AP15)

### 3.4 Consequences

Not being able to manage contracts properly can have severe consequences for the successful delivery of the projects. The problems include unsatisfied customers, conflicts, unpaid effort, early shutdown of projects, delays, and increased costs (Figure 1).

#### 3.4.1 Unsatisfied customers

Customer satisfaction is an important success criterion for any kind of project. According to some researchers, customer satisfaction is one of the most important criteria for a project [18] [19] [20]. Customers can be satisfied only if they see that they are gaining more value for the money that they invested. If customers do not receive the required features, they will be unsatisfied.

#### 3.4.2 Conflicts

If the contracting process is not handled properly, it can give rise to many conflicts between customers and suppliers that can prove to be disastrous for the future customer–supplier relationship. The respondents believed that trust plays an important role in winning a project.

One of the conflicts that quite often arise regards roles and responsibilities.

We are using a PS 2000 contract in the current project. It is difficult because using that we have not been really agreeing on who should be responsible for what and how late in the process the customer can make changes. (AP15)

From the customer's point of view, if a project has a fixed-price or target price contract, any kind of change needs to be made through the proper change management process. The supplier

accepts a change order, but since it is not part of the contract, the client has to pay extra. Two of the project managers shared their experience in which the project manager (from the customer side) was not particularly involved; therefore, they faced conflict situations regarding product delivery. Both hired an external party to solve the conflict. This example shows the effect of a lack of close customer collaboration.

One of the project managers asserted that among the challenges involved in contracts is the fact that they do not contain information about the detection of responsibilities in the case of failure:

One of the risks for which a contract contains no details is what happens if we don't deliver or if the customer is not happy with the end project results. The second thing is detection of responsibility in the case of failure. (AP8)

### 3.4.3 Unpaid effort

According to the respondents, a great deal of effort is exerted to prepare to enter bids for projects in government organizations and this effort is unpaid if the supplier loses the contract.

PS 2000 contracts require a very detailed description of the project, which also takes considerable time, but all this effort is unpaid and the supplier has to bear the cost.

### 3.4.4 Early shutdown of projects

If customer involvement or cooperation is not handled properly, it can result in unhappy customers, which in turn can call for early shutdown of the project.

Close customer collaboration is necessary to run a project smoothly. If customers don't cooperate, it doesn't have good after effects. We (the supplier) might lose the project before we reach the end. (AP29)

### 3.4.5 Delays and increased costs

The respondents believed that government organizations involve a large amount of bureaucracy, which causes delays in the project delivery. Sometimes supplier companies have to wait for days before they receive approval for any changes requested by the customer. According to the respondents, although they charge this waiting time to the customer, sitting and doing nothing gives a poor impression.

When there is a change request, there is always a lot of bureaucracy connected to it; bureaucracy around changes is cost and in our case we charge that cost to the customer, so it will be an increase of cost to the customer. (AP19)

### 3.5 Contingencies: Strategies for Contracting Process Management

We have discussed the causes and consequences of the challenges associated with the contracting process. Based on our interview data, we will now describe some strategies for contracting process management. Some practitioners are currently using some of these strategies. These strategies could help to overcome the challenges produced by the contracting process. They are all based on our interview data and include the factors to be clarified before writing a contract, trust, right selection of contract type, frequent-delivery option, replacing the risk-sharing term with gain sharing, focusing more on functionality than on budget, customer involvement, and adopting strategies for avoiding conflicts.

#### 3.5.1 Factors to be clarified before writing a contract

The very first step before starting any project is to make sure that the customer and his needs are well understood. The respondents gave varying views about the factors that need to be clarified before writing a contract. As the first step, some respondents felt that it is important to make the customer understand the agile methodology, its benefits and drawbacks compared with the waterfall approach and the change process associated with the methodology. Other important issues that the respondents believed should be clarified at this stage include the customer vision, business goals, cost of the project, software specification, role of the customer and the degree of involvement and steering required, response times required by the organizations, and the jargon/language used for reporting and understanding the status of the project. Sometimes, technological restrictions also need to be known along with the scope of the work.

#### 3.5.2 Trust

According to the respondents, if there is enough trust between the supplier and the client, there is less need for documentation. According to the respondents, if two parties have trust, they do not need a contract.

I suppose even though it's not that conscious, it's all about trust. If you (both parties) have unlimited trust, you do not need a contract. (AP23)

At the beginning there was high tension on the vendor side, but as time went on, trust built up and then we had the contract but we had developed more trust to solve the conflicts. (AP31)

According to one of the respondents:

It is important to achieve a good relationship based on mutual trust._(AP3)

The respondents believed that trust is even more important when using T&M contracts. Establishing enough trust is difficult in situations in which supplier and customer companies come together for the first time.

T&M contracts work to a certain extent but there has to be a lot of trust. It is natural since two organizations are about to work together for the first time. There are chances that it will not work. (AP21)

### 3.5.3 Right selection of contract type/mixing different contracts for different parts of a single project

Mixing different types of contracts is an option used by some of the respondents. One of the project managers working on the supplier side told us that the company had used T&M contracts for three sprints before it started using target price contacts. One of the project managers described his experience as follows:

We used fixed price with parts of projects but not with the whole project. We try to use time and material for initial phases then we can use target price for the rest of the project. (AP28)

The type and size of the project also play a vital role in the choice of contract type:

For small projects, we usually use a fixed price. Sometimes, we have a fixed price and then combine it with a target price. We also use a combination. (AP32)

### 3.5.4 Frequent-delivery option

Delivering in iterations can help to obtain continuous feedback from customers, which in turn will ensure the project's final success. Continuous feedback from customers also helps suppliers to understand how customers perceive success, which can assist them in making improvements to their strategies for successful delivery of the project.

It is very important to deliver in iterations. Only then you are able to know that what you delivered and the customer can give feedback on your deliveries. (AP28)

### 3.5.5 Replace the risk-sharing term with gain sharing

The respondents said that the term gain sharing should be used instead of risk sharing. Gain sharing is a more attractive and proactive term.

I would say instead of using the term risk sharing use gain sharing because risk sharing is a kind of passive term whereas gain sharing is its proactive counterpart.

It sounds similar but it really makes a big difference. If you look into it, it would be my starting point is to have a focus on sharing gain rather than risk sharing. (AP23)

### 3.5.6 Shifting the focus to functionality rather than budget

The respondents believed that the way in which public companies conduct business is more waterfall than agile. They have a considerable focus on price. Therefore, projects are selected through a bidding process and these projects have a fixed price, with all the disadvantages that fixed-price contracts entail. According to the respondents, fixed-price contracts are not an agile way of working and this needs to be changed. One of the respondents stated:

I think it needs to change how government agencies do their budgets, meaning how they order new software, because now it is so focused on price. (AP19)

### 3.5.7 Customer involvement

In agile projects, continuous interaction with the customer throughout the development life cycle makes it easier to obtain customer feedback about the project. Another way to involve customers in the process is to deliver in iterations. This helps to gain continuous customer feedback, which is necessary for final project success. One of the respondents shared his experience about the way in which his company involves customers:

We invite them to demos and we make them participate in the development process and most of the time they are eager and want to participate. (AP17)

### 3.5.8 Adopting strategies for avoiding conflicts

Different strategies can be adopted to avoid any kinds of conflicts. The interview findings suggested that the most common type of conflict relates to roles and responsibilities.

One of the project managers shared his experience of handling conflicts:

The first thing we did was that we sat with the customer and agreed upon what is their responsibility and how we define agile and when change requests should be used: how far in the construction phase you (the customer) are allowed changes. We also worked very hard to establish trust. (AP15)

The respondents believed that it is very important to make a clear distinction of responsibilities because this can help to avoid conflicts in the later phases of the project.

According to one of the project managers:

I think it's very important to agree in the bidding phase, when you sign the contract, to be very specific about what are the customer's responsibilities and what are the supplier's responsibilities. (AP15)

### 3.6. Covariance

Covariance means that a change in one category affects the other categories. From the interview findings, we found that the categories related to the challenges involved in the contracting process (formal documentation, unequal sharing of risk, formal documentation, using agile with the waterfall mindset, a fixed scope versus fixed objectives, personal preference for the contract, and inadequate customer collaboration) and the categories related to contracting process management strategies (the factors to be clarified before writing a contract, trust, right selection of contract type, frequent-delivery option, replacing the risk-sharing term with gain sharing, shifting the focus to functionality rather than budget, customer involvement, and adopting strategies for avoiding conflicts) have an effect on each other and vary accordingly. In the contracting process, all the categories are very closely knit together and a change in one category can have a profound impact on the other categories.

## 4. Discussion

In this section, we will describe the related work, the implications of our results for theory and practice, and the limitations of the study.

### 4.1. Related Work

The interview findings suggested that fixed-price contracts are not the preferred choice of suppliers for agile projects, while customers favor their use. Customers want to have control over the contracting process and fixed-price contracts offer them this control. These findings

are in accordance with Fowler and Highsmith [21]. However, the suppliers felt that it opposes the agile manifesto of "customer collaboration over contract negotiation" [21]. The respondents, based on their experience, asserted that most public companies prefer to work with fixed-price contracts, and this is in accordance with Fulgham et al. [22], who stated that the way in which public companies practice contract handling are much more traditional than the agile way of working. The reasons behind clients' preference for fixedprice contracts are that they are simple to handle and that the risk lies mostly on the supplier's side. Another reason is that many customers want to know the exact budget for the project to make go or no go decisions. Therefore, they require a complete contract written with a full specification and details of the cost, time, quality, risk, and so on [22] before they decide whether to proceed.

The interview findings suggested that T&M contracts are the most used contracts in agile projects. The respondents believed that T&M contracts put most of the risk on the customer side and this type of contract does not provide any incentives for suppliers to boost their productivity. According to Eckfeldt et al. [23], it is very hard to convince customers to use T&M contracts; therefore, they suggested that T&M contracts should be used for smaller projects and for suppliers with the greatest degree of trust. For larger projects, customers prefer to use fixed-price contracts. This finding is contrary to the finding of Zijdemans and Stettina [24], who suggested using fixed-price contracts for smaller projects.The respondents reported that T&M contracts can only be used when a high level of trust exists between the supplier and the client, and this is in line with Poppendieck and Poppendieck [5].

According to Eckfeldt et al. [23], target cost contracts are more suitable for agile projects. This type of contract handles scope changes in a similar way to fixed-price contracts, but it shares the risk equally between the supplier and the customer. Target price contracts are said to give a fair share of risk and profit to customers and suppliers [25]. The respondents believed that using agile in government organizations produces many challenges, and this is in agreement with Thamhain [26], who stated that in such organizations the "overall requirements and project scope must be established up-front and become the basis for performance measurements throughout the project life cycle." Therefore, it is more challenging to work in an agile way in such organizations.

Trust is considered the most important success factor for any business [27]. Trust and risk are crucial in situations that do not involve simultaneous exchange [28]. Trust helps to save time and effort in the contracting situation [29] [30]. According to Coldeway, "agile development

is about building mutual trust between the business experts and the software people" [2]. The respondents' opinion about trust is in accordance with Boehm and Turner, who stated that "for a project to succeed, the stakeholders must trust that the developing organization will perform the needed work for the available, agreed-to resources" [31]. Although formal documentation will help to reduce uncertainties, it can lower the performance and hinder the effectiveness of the project [32].

Customers' involvement plays an important role throughout the software development process in agile software projects. Customers are represented by the product owner, and if he is too busy with other tasks, he will be unable to allocate an appropriate amount of time to the project. The respondents had often experienced the problem of product owners who were too busy, and as a result the supplier could not obtain feedback on time. These findings are in accordance with Hoda et al. [33]. The role of the product owner and his responsibilities need to be defined clearly when writing the contract, which can help to avoid any kind of conflict in the future [3].

The respondents' opinion about frequent deliveries is in line with Bird and Bird's report [3], which suggests that agile projects require more frequent deliveries. These deliveries could be in the form of small features and according to the specification defined in the contract [3]. Another option, suggested by Subramaniam and Hunt [34], is that "agile practitioners should offer to build a small portion of the system on a trial basis. After the end of the iteration, the customer will have the option to continue or cancel the contract.

### 4.2. Implications for Theory

The agile methodology's main focus is on "customer collaboration over negotiating contracts," but the interview data suggested that customers prefer fixed-price contracts. The respondents (from the supplier side) believed that it is not possible to use agile with fixed-price contracts and that public companies' way of working is not agile. Different contracts can be used for different parts of the projects to obtain the desired result. Fixed-price contracts, as they grant projects through bidding, involve many challenges. One of the implications of theory developed using grounded theory is that this theory can be applied to software projects other than agile ones.

### 4.3. Implications for Practice

#### 4.3.1 Right mix of contracts

Different kinds of contracts can be combined, keeping in view the nature and type of projects. Using the right mix of contracts instead of only one type can help to attain the desired project result.

#### 4.3.2 Close customer collaboration

Close customer collaboration is a key for delivering successful projects. Customer satisfaction is one of the important success criteria of agile projects. To attain customer satisfaction, it is very important to involve the customers in each and every stage of the project.

#### 4.3.3 The frequent-delivery option

Suppliers should make frequent deliveries. These will help to gain continuous feedback from customers, which in turn will ensure the final success of the project. Continuous feedback from customers also helps suppliers to understand how customers perceive success, which can help them to make improvements to the product quality.

#### 4.3.4 Responsibilities matrix

A responsibility matrix should form part of the contracting process. This matrix should represent the overall view of the role and responsibilities of the different stakeholders involved in the project. It should provide a clear description of who is responsible for what, which can help to avoid conflicts and misunderstandings about roles and responsibilities.

### 4.4. Limitations

Theory developed using grounded theory is said to be context-specific. Since codes and categories are generated from data, they have direct relevance to the context. When it comes to software projects, a number of factors could play a pivotal role in making them a success or a failure, but the very first step of any project is to make arrangements that could lead to successful project delivery. Therefore, contract management is a very important part of the project, and the key aspects that we found from contracting situations, such as trust, close customer collaboration, and equal sharing of risk, play a vital role in a project's success or failure. We interviewed 32 professionals, more than 50 percent of whom were from the supplier side; due to this, we feel that in our study the customer perspective on the contracting process

is not represented properly. If more participants are involved in the study, there are more chances for evaluating the results by comparing them with each other, hence helping to combat bias in the study [35]. For our study, we chose 32 participants, and using this large number of interviewees helped us to compare the results.

### 4.5 Validity and Reliability Issues

Validity measures how accurate the research findings are [36]. To determine the accuracy of the research findings, researchers have to measure them. This research was conducted with 32 practitioners in 25 different organizations, and the participants were chosen according to their suitability for the study. We also made sure that the participants had enough experience and knowledge of the subject under study. We asked the practitioners multiple questions to obtain the desired information.

Reliability measures the consistency of research. We ensured consistency by cross-checking the results of different participants and found them to be reliable. After transcribing the interviews, they were sent to the concerned informant to check for any omissions.

### 4.6 Future Work

To make the contracting process work more effectively in agile software projects, we suggested using different types of contracts for different parts of the project. Achieving the right mix of contracts is a challenge. Future studies could find a method in which the right mix of contracts can help in agile projects. Therefore, we intend to present a model for this as part of future research. We also suggested the use of a responsibility matrix to provide clarity regarding roles and responsibilities. The evaluation of projects that use such a responsibilities matrix can also help to generate a useful perspective as a future study.

## 5. Conclusion

To investigate the challenges associated with contracting, we conducted a grounded theory study. We interviewed thirty-two professionals from twenty-five different organizations. We presented our data using Glaser's six Cs model. The interview findings revealed a number of challenges associated with the contracting process. These involve formal documentation, unequal sharing of risk, formal documentation, using agile with the waterfall mindset, a fixed scope versus fixed objectives, contract selection based on preferences, and inadequate customer collaboration. Based on the interview findings, these challenges have several consequences.

These are unsatisfied customers, conflicts, unpaid eff ort, early shutdown of projects, and delays and increased costs. From the interview findings, we produced contract management strategies. These include the factors to be clarified before writing a contract, trust, the right selection of contract type, a frequent-delivery option, replacing the risk-sharing term with gain sharing, shifting the focus to functionality rather than budget, customer involvement, and adopting strategies for avoiding conflicts. We also discussed the implications of our results in theory and practice.

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## Paper 3

**Enablers and barriers to customer involvement in agile software projects in Norwegian software industry: The Supplier´s perspective**

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(Submitted to Information Technology & People)

III

## Paper 4

### Managing risks in Norwegian Agile Software Projects: Project Managers´ perspective

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IV

**Abstract** — The purpose of this study is to understand the role of project risk management in agile software projects. To achieve the purpose, we conducted a qualitative study. We conducted interviews with agile practitioners working with agile projects in Norway´s software industry. Grounded theory was used to analyse the data. This study aims to study the similarities and dissimilarities between the project risk management process in agile software projects and waterfall software projects, as well as identify the strengths and weaknesses in the current practices being used in agile software projects. Interview results suggested that risk management in agile projects is being done in two ways. One way is adopting implicit risk management strategies, which include communication and collaboration, shorter iterations, frequent delivery, early feedback, and delivering complex parts first. The other way is called explicit risk management strategies, which are relative estimates, burn down charts, SWOT analysis, and risk matrix. Limitations with implicit risk management strategies are also discussed. At the end, guidelines on how to maximize the impact of the risk management process on project outcome are also presented.

*Keywords* — Grounded theory, agile methods, risk management.

## 1. INTRODUCTION

According to the 5th Edition of the PMBOK Guide [1], project risk is "an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives such as scope, schedule, cost, or quality." As stated by Van Scoy [2], "Risk in itself is not bad; risk is essential to progress, and failure is often a key part of learning. But we must learn to balance the possible negative consequences of risk against the potential benefits of its associated opportunity" [2]. Need for risk management in agile projects is shown through the work of various authors [3] [4], [5]. Authors have also shown the importance of risk management for quality software delivery [4], [5]. Lack of risk management is shown to be a source of failure in projects [6].

Risk management is necessary because if it is left unattended it can have a negative impact on project objectives [7]. Risks become even more important to be identified and addressed if they create hurdles in meeting the success criteria (objectives, deliverables deadlines, cost, etc.) or significant resources are required to address them. According to Moran [8], if risks are not adequately identified or addressed, it can have following consequences:

As a result of inadequate information it becomes difficult "to make informed risk and reward decisions."

1. If risks are not identified, it is can result in "failure to identify appropriate risk response strategies based on risk exposure."
2. Consequence to the unavailability of risk related information it will cause "lack of oversight in risk monitoring leading to ineffective or inefficient treatment of risks."
3. Ignoring risks will lead to a "poor understanding of when to engage in risk activities."

The risk management process consists of the identification, analysis, control, and management of possible risks that may arise during the life cycle of a project [9]. In addition, this process also consists of a number of activities to collect information about events that can occur and affect project results [10, 11]. In agile methodologies, risk management is not defined explicitly [8] [38]. For example, scrum is a framework, but it does not describe how project risks should be managed [8]. Therefore, some kind of explicit risk management process needs to be in place in order to define and manage risks according to the needs of the projects.

Despite the fact that the risk management process is not defined explicitly in agile methods, possible risks are discussed at daily sprint planning meetings and retrospectives. Risk management in agile projects is also done by having fixed iterations with fixed deadline, providing support in changing requirements even late in the process, and maintaining close cooperation with the customer. This helps to have quick feedback to fix any deviations and bugs [12,13].

The purpose of the risk management process is to take into account all threats and opportunities that can come up during the project. This can help make decisions accordingly. Methodologies that don't have a risk management process implemented can miss the opportunity of making "informed risk and reward decisions" [8]. Appropriate risk response strategies cannot be planned if risk exposure is not determined, showing subsequent failure in the classification, prioritization, and designing of risk response [8]. Risk management in agile software projects is shown to be one of the project success factors [13] [28] and "failure to engage in the monitoring of risk results in an inability to judge whether or not risks are being adequately managed" [8].

In this way, agile methodologies provide some kind of implicit risk management [4]. In scrum, at the start of each iteration user stories are prioritized to address the most important features.

Before addressing the risks, it is very necessary to identify them first [5,14,15]. As agile processes do not provide a structured risk management process, they lack necessary activities such as risk identification, risk analysis, and mitigation plan [16].

Although significant research has been done in risk management in traditional projects, risk management in agile software projects requires further research [17] [18]. According to Odzaly and Des Greer [17], "Little work has been done to date on the role of risk management in agile methods." Albadarneh et al. also describe the need for research about risk management in agile software projects [18]. According to them, "While there is an extensive body of academic literature on risk management, few little researches have attempted to study risk management in agile development projects." This study is an attempt to address this research gap.

For the purpose of this study, we conducted 21 interviews. The goal behind this study is to:

Understand the role of project risk management in agile projects.

1. Gain an overview over the similarities and dissimilarities between project the risk management process in agile projects and non-agile projects.
2. Identify the strengths and weaknesses in the current practices.
3. Identify guidelines on how to maximize the impact of the process on project outcome.

Following are interview questions, we asked our practitioners:

1. Can you please tell me about your background?
2. How many years of experience do you have working with agile projects?
3. Why risk management is necessary for agile projects?
4. What do you do regarding risk management in your project?
5. Do you think agile methods provide some kind of risk management in itself?'

Depending on the answer to question 4, follow-up questions were also asked. If they answered yes we asked them,

Can you explain how?

If they answered no to question 4, we asked them how do they do risk management in agile projects.

6. How risk management in agile projects is different in agile projects than in waterfall projects?

7. In your opinion, how risk management process in agile projects can be improved? Do you have any recommendations?

## II. LITERATURE REVIEW

Tomanek and Juricek [38] describe that risks in Scrum and eXtreme Programming (XP) are implicitly managed by keeping smaller iterations, communication with the customer, customer involvement, continuous feedback, and prioritization of user stories based on business value, which also help to identify any kind of deviations and ultimately risks. Therefore, certain risks (related to cost, schedule, and quality) are automatically addressed in agile projects. Another important point is that agile approaches use the term "impediments" instead of risks, which are discussed in sprint review meetings and sprint retrospectives [39].

In agile projects, instead of focusing on planning, risk focuses more on delivering real working software in small working parts after each iteration. Agile teams are self-directed, therefore, in agile methods, it is not only the project manager who is responsible for the risk related activities, but the team also has a responsibility.

Thomas [40] explained the ways in which risks are managed in agile projects implicitly [40]. According to him risk management is done through the following techniques [40]:

1. Agile Roles and Responsibilities: It means that the project manager and product owner must work in coordination and according to their responsibilities [40]. Defining clear roles and responsibilities is also a suggested strategy by Siddique and Hussein [27] in their study for handling conflicts related to roles and responsibilities in agile software projects.
2. Agile Change Management: “When the product owner asks the project manager to add a feature to the scope, they use requirements trade off to ensure the overall scope, and hence the total effort is unchanged. The scope changes but the overall scope is stable in terms of effort” [40].
3. Agile Project Planning: It “ensures that the high priority requirements are delivered first. The product owner is continuously expected to make priority calls and move the important items to the top of the list. Low priority items are put at the end of the plan and if the schedule doesn’t have space these items are put out of the scope.” Our findings related to developing and delivering the functionality of highest business value first are in accordance with this.

According to Thomas [40], following risks are implicitly addressed in agile projects:

1. Risks related to time to market:

It takes months to get a working product in waterfall approaches while agile approaches to deliver a product more often; therefore, time to market is reduced. Another point is that in waterfall project, projects are delivered after a long period; therefore, all potential risks are required to be listed for the entire duration. He argues that agile doesn't require that type of risk management because of the short duration of sprints. The best way to discuss risks daily is by using daily stand-up meetings.

2. Risks related to budget:

In waterfall projects, budget risks are significantly high because delivery time is so far from the time of initial estimates; therefore, there are more budget risks in waterfall projects than in agile methods.

3. Risks related to cancellation cost:

If a waterfall project is cancelled because of some reason, there will not be any product delivered to the customer. On the contrary, if an agile project is cancelled, there are still some parts of the product that are delivered to the customer. Customers can still have some parts of the project or functionality delivered.

4. Risk related to scope creep:

Feature or scope creep means that the scope of the project increases. In other words, scope creep means an uncontrolled increase in requirements (not changing requirements). Missed requirements are added to the project without removing other requirements; this may result in scope crept. While in agile projects, a balance is kept in adding requirements by removing certain other requirements.

5. Risks related to requirements:

In waterfall, requirements are specified long ago, while in agile, requirements are specified for each sprint. There are fewer chances of errors related to requirements. Also, if some requirements are missed because of some reason, these can be added in the upcoming sprints.

It is easy to terminate a project when the customer feels that certain functionality is delivered and they want no more functionality to be developed or there are other constraints related to budget, time, etc.

6. Risks related to technology:

As a result of a large time frame between project specifications to delivery, there are greater risks regarding technology, because it can take several months to uncover the problems related to technology. In agile projects, frequent delivery and testing of functionality ensures that risks related to technology become evident early in the project.

According to Thomas [40], the following can be risks when using agile methods:

1. Agile can lead to inadequate design.
2. Agile can lead to silver-bullet syndrome.
3. Agile doesn´t address weak personnel.
4. Agile doesn´t address contractor failure.

Ylimannela [46] conducted empirical study and found different challenges while performing risk management in agile software projects. According to him, agile methods are meant to deliver working increments, therefore, finding a person who will be responsible for risk management for each sprint was a challenge.

Moran [8] argues that agile methods got attention in balancing the risk and delivery value through prioritization of tasks is "too limiting" and according to him, "Some of the risks, which a project must contend with are not inherent in the execution of specific tasks, but rather in the circumstances surrounding that execution and might otherwise be considered part of a project governance profile (i.e., the effective and efficient deployment of resources towards the achievement of the goals of the enterprise)." According to Odzaly and Des Greer [17], "Little work has been done to date on the role of risk management in agile methods."

Derfer [45] argues for the need of this explicit risk management and according to him, "Sprint retrospectives are the mechanism for identifying and mitigating risks or challenges to the team," but this is not enough for doing risk management. The reason for this, according to him, is that retrospectives are most focused on what happened in the previous sprint and don't discuss risks on the project level [45]. The author argues that during retrospective meeting not all the right people are present and team members are more focused on finding and discussing

improvements in previous sprints [45]. Different models for integrating risk management in the agile process can be found in the studies of [12] [8], but the question is: how effective are these models when used in agile software projects and are these models of any use for agile practitioners. Although new data collection was made for the purpose of this study, findings of this study are aligned with our previous research findings that were conducted about risk management [19].

## III. METHODOLOGY

We conducted 21 practitioners' interviews from 18 different software development organizations in Norway. These organizations vary from consulting organizations to in-house development organizations. The practitioners had many years of experience with the software industry ranging from 3 to 40 years. The interviewed practitioners were project managers. Most of the practitioners were using agile methodologies since its inception or before it got the name agile. The products and services offered by the practitioners' organizations include web-based applications, front and back-office applications, and software development services. We conducted semi-structured interviews through various mediums, which include face to face, email, and Skype meetings. To take multiple issues into consideration, the interview questionnaire was designed to incorporate different issues related to the risk management process in agile software projects. We asked practitioners open-ended questions. The sampling technique we used for our study is called non-probability sampling [20]. Keeping suitability in mind for the research, we used purposive sampling. Deliberate contact was made with the participants who had relevant experience with the agile projects. We performed internet searches for the practitioners and after finding out their suitability with our research questions we requested them to participate in the study. We assured participants of their anonymity. We will refer interviewed practitioners with AP1-AP21. The interview duration was 30 to 60 minutes.

### A. Grounded theory

The research method we choose for our research is grounded theory because:

1. Grounded theory is useful to understand the phenomenon undergoing in the current scenario [21]. Grounded theory tries to explain what's going on, "what is the main problem of the participants, and how are they trying to solve it" [22]. As the purpose of

this study was to know how the risk management process is being done in agile software projects, Grounded theory was a suitable choice for this research.

2. Grounded theory is the most suitable research method for underexplored areas [23]. Risk management in agile software projects is an underexplored area [17] [18], therefore, grounded theory was the most suitable approach for our study.
3. Another reason for using Grounded theory study for this research was that we wanted our findings to be grounded in the data. Our data is based on project manager´s several years of experiences with software projects and agile software projects in particular. Grounded theory is a suitable approach for such research involving participants' opinions [24].

This study is a part of larger study that implied Grounded theory study as a research method. This was another reason for implying Grounded theory in this study.

### B. Data analysis

In grounded theory, data analysis is called coding. Coding by using systematic approach of data analysis helps in understanding the data [29]. Data analysis in grounded theory is a continuous process. Therefore, we started coding very early after conducting the first interview.

**1) Open coding:** The first step of data analysis in Grounded theory is called open coding [30], which the data was analysed in [30] [31]. Interview transcripts were analysed to find key points and a suitable code was assigned to these key points [32].

**2) Constant comparison:** Codes that emerged after open coding are compared with other codes emerged from the same interview transcript and with codes emerged from other transcripts to produce a higher level of abstraction called concepts. This is called the comparison method [21] [22]. This method was also repeated at the concepts level to produce a higher level of abstraction called categories.

**3) Core category:** Open coding ends with the emergence of core category [30]. One of the categories that emerged after open coding is selected as core category. Core category "accounts for a large portion of the variation in a pattern of behavior." Therefore, it shows the "main concern or problem" for the participants [30]. It is central to all categories and all categories can be linked to this category. Core category in this study is "risk management."

**4) Selective coding:** Selective coding is done for "only those variables [concepts or categories] that relate to the core variable [category] in sufficiently significant ways as to produce a parsimonious theory" [30], [33]. After the emergence of core category, selective coding was done, i.e. risk management.

**5) Theoretical saturation:** Coding stops when theoretical saturation is reached. It means that newly collected data didn't give any new codes and categories [21]. We stopped data collection when we felt that there were no new codes emerging from the collected data.

**6) Memos:** Memos are the researcher´s ideas, which are written down regarding categories. These are the flow of ideas, which later can be used to write research results. Memos play a very important role in Grounded theory research [33].

## IV. RESULTS

Interview data was analyzed using Grounded theory. Grounded theory analysis suggested that risk management in agile software projects is being done in the following ways. To make this clear we have divided it into two categories. Table 1 presents the interview findings.

### A. Implicit risk management strategies

Some risks are handled implicitly in agile projects. By implicit, we mean that the strategies of managing risks are inherently provided in agile methods. When we asked practitioners whether agile provides risk management or not, they asserted that agile methods provide risk management in certain ways. Practitioners believe that with agile methods the need for rework is reduced. They believe that standup meetings in the mornings are a good way to discuss risks (called impediments in agile).

"Agile helps to decrease need of rework."__AP19

"Not in traditional way. [When teams] are communicating more it's easier to see risks and if you do standup in the morning … because one of the question is do you see anything that can prevent us from reaching goal if you do that and they see we see something; I think that's part of risk management, so if you follow up …, you should do I think that could prevent risk."__"__AP6

"In agile there is no definition of risk. The only thing agile does is you have standup each morning and there are questions to point out anything that might endanger the project. That's an informal and affective way to risk for the people of the team."__AP8

"In scrum, we don't exactly have risk management."__AP9

"I guess in daily scrum you are reporting impediments."__AP14

According to practitioners, another advantage of using agile methodology is that it is easy to make changes anytime during the project.

"You can work with risk all the time; therefore, it is easy with agile. In agile because you can make changes all the time. If something unexpected comes you can make changes and you don't need to have complicated change procedures. I think that's the big point."__AP15

"The only way risk management in agile projects is done is that you have standup each morning and there is question to point out anything that might endanger the project that's informal and affective way to risk for the people of the team."__AP8

"After every standup each morning. I will go through notes and see if there are some areas that really are risks".__AP11

Practitioners are using the following risk management strategies for managing risks implicitly in agile software projects.

1) ***Communication and close customer collaboration:***

Practitioners told us that they try to collaborate closely with customers and discuss all kinds of risks with them. They also ask customers for any kind of risks they feel can impose threats on the project. Practitioners believe that the agile philosophy that customer and supplier should work in collaboration helps to discuss any kind of risks and uncertainties in agile projects. If it is required, an appropriate action plan can be designed to address these risks. "I think communication with customers is a key feature. If we communicate on a daily basis, it's a lot easier to know risks and discover them as well. That may be the number one thing."__AP7

"We discuss that in every sprint planning, then we discuss what are known risks and what are potential risks in upcoming sprints. That's something we discuss on every sprint planning."__AP7

***2) Early feedback:***

Practitioners asserted that early feedback helps to manage risk related to deliverable quality and functionality. Practitioners believe that delivering frequent can help to get customer feedback along with building trust between supplier and customer. Customers can give feedback about deliverables quality, functionality, cost, etc. If a project becomes very expensive, customers have the option to shut down the project if it is stated in the contract. Even if the project ends in such an abrupt way, customers will still have some working parts of the project or part of functionality delivered.

***3) Short iterations:***

Another way practitioners are handling risks in agile projects is by keeping the iterations shorter. They believe that instead of delivering functionality in larger parts, delivering it in smaller parts can help to handle risks.

By keeping iterations shorter, the project manager and team can make sure that they work and deliver functionality to customers, because this smaller part can be delivered to customers to get feedback.

***4) Prioritization:***

Practitioners asserted that one way they use to handle risk is through prioritization. User stories with the highest business value are prioritized first. Prioritization in such a manner is very helpful to develop and deliver important functionality first. This helps to ensure that customers get the most important part of the software delivered first.

"In scrum, you have to decide which stories have the highest business value so you have to estimate those [risks]. From the start of the project in scrum, you have to do risk estimation and flag the stories with the highest risk. The product owner's job is to prioritize between business value and risk; they are given guidelines in scrum and Kanban."__AP4

"Also, by implementing the most difficult or high risk things early."__AP17

***5) Frequent Delivery:***

Practitioners believe that delivering frequent can help to manage risks to a certain extent. By delivering in iterations, customers can get the working software part and can give feedback to improve or change the software if needed.

***6) Dealing with the complex part first:***

Practitioners told us that they also prioritize tasks on the basis of complexity. Dividing the project into smaller parts and working with the complex parts of the project first helps to control risks related to complexity. It is easier to make functionality for smaller parts and get it tested. Therefore, practitioners try to work and complete the most complex task first followed by the next relatively less complex part.

"In this scrum team, the risk was part of the task; you estimate complexity and discuss risk. Most of the time when you get the project you do the risk assessment."__AP4

"Instead of delivering all the simple parts first, we can show off to the client that we can handle this. We do a lot of talking with the client and solving the complex issue first."__AP10

***B. Explicit risk management strategies***

Besides above mentioned implicit risk management strategies, practitioners are also using explicit risk management techniques for managing risks in agile software projects.

"The risk management process is done in a traditional way. Agile doesn't have project management techniques, but they need them."__AP12

These are relative estimates, SWOT analysis, burn down charts, and risk matrix.

***1) Relative Estimates:***

According to practitioners, risks related to estimates are handled by giving relative estimates. Relative estimates help to control risks that results because of inaccurate estimation.

***2) SWOT Analysis:***

SWOT analysis is another way for practitioners to find out the strengths, weaknesses, and threats in the project. According to practitioners, SWOT analysis can help to figure out threats in the projects and appropriate strategies can be designed in order to deal with threats pointed out through SWOT analysis.

***3) Burn down chart:***

One way that practitioners are using to manage risks are burn down charts. Burn down charts provide an effective way to track effort and schedule on a daily basis; therefore, according to respondents' risks related to effort and schedule can be mitigated with the help of the burn down chart.

***4) Risk matrix:***

According to practitioners, for smaller projects, an implicit way of risk management that agile methods are providing can be beneficial, but if a project is large and complex then it is necessary that traditional approaches of risk matrix should be used as defined in PMBOK [1].

Practitioners told us that they sit with the customer and brainstorm to find and list all the risks associated with the project. Brainstorming is used as a part of the risk identification step. These identified risks are listed and appropriate strategies are designed after finding the risks associated with the project.

"We do brainstorming and list risks in the form of matrix, then assess probability and impact."__AP4

"I have weekly reports about risks."

"You have to do some risk analysis anyway."

"We have been using risk matrix."__AP5

"I use risk management from traditional risk management."__AP8

"I normally do it using matrix."__AP15

"I always have some kind of matrix but on various levels. We make a risk matrix from risks that came through brainstorming with customers and the team. These risks are handled in the same way as in waterfall projects."__AP19

"We have it usually in the form of matrix."__AP20

Table 1: Summary of results (strategies of handling Risk management in agile software projects)

| | | |
|---|---|---|
| Risk management in agile software projects | Implicit risk management | Communication and close customer collaboration<br>Early feedback<br>Short iteration<br>Prioritization<br>Frequent Delivery<br>Delivering complex parts first |
| | Explicit risk management | Relative estimates<br>SWOT analysis<br>Burndown chart<br>Risk matrix |

## V. DISCUSSION

Interview data suggested that risks in agile software projects are handled in the following ways: communication and collaboration, prioritization of user stories, short iterations, frequent delivery, early feedback and relative estimates, burn down charts, SWOT analysis, and risk matrix. We have further divided these risk management strategies into two categories. Table 1 presents a summary of these results. These are described below:

### A. Implicit risk management strategies

Some risks are handled implicitly in agile projects. By implicit we mean that these strategies of managing risks are inherently provided in agile methods. Some of these implicit risk management strategies practitioners are using managing risks that include: communication and collaboration, prioritization of user stories, short iterations, frequent delivery, and early feedback. This is in accordance with Cohn [36] who states that "the short iterations, single-minded focus on working software, heavy emphasis on automated tests, and frequent customer deliveries help teams avoid the biggest risk most projects face—that of eventually delivering

nothing." Keeping the iterations shorter is also in accordance with Williams et al. They suggest keeping iterations shorter [37] because smaller iterations and frequent delivery can help to make a project successful.

Practitioners believe that frequent delivery helps to reduce certain risk. This is in accordance with Siddique and Hussein [25] who suggested frequent delivery options in agile projects are useful in order to build trust with the customer. Trust comes when customer can see that they are getting value for their money, which in turn is helpful for making the customer and supplier relationship work. Frequent delivery also helps to assess success for each delivery, point out any deviations, and address them accordingly [26].

B. Need for explicit risk management

SWOT analysis, risk matrix and burn down charts are explicit risk management techniques that practitioners are using for managing risks in agile software projects. Practitioners asserted that risk management in agile software projects is not provided explicitly. According to Moran [8], "Agile methodologies don't provide explicit risk management related to identification, recording, or management of risks" [8]. Tomanek and Juricek [38] also state that scrum doesn't provide explicit risk management process.

Practitioners told us that brainstorming is done with teams and customers to come up with all possible risk in the project. After that, risk matrix is made and each of the risk is listed in it. An evaluation of each risk is done, which is a necessary step to assess its impact and probability of occurrence. At last, mitigation action is planned for highly probability risks. This process is the same as it is done in waterfall projects. This is in accordance with Smith, who states that risk management techniques are similar in waterfall and agile approaches. He suggests using agile methods to reduce any kind of risks. For this purpose, he suggests using dedicated and collocated teams. According to him, communication is the key to avoid any kind of conflicts. This is in accordance with Siddique and Hussein [27], who suggested using communication effectively to resolve all kinds of issues in agile software projects. To make the project successful, Smith suggests using the risk management process in the same way as it is done in waterfall projects [41].

Smith suggests the risk management process in agile projects should be done in such a way that it should implement risk management activities into iteration planning activities. Risk management practices should be made very simple so that it is easier and quicker to follow by all team members [41]. According to Nelson [42], although agile methodologies address risk management implicitly, important risk management activities are ignored.

According to Hubbard [43], risk management consists of a set of risk identification, risk assessment, and risk prioritization, assessing impact of risks and planning mitigation strategies. Without having explicit risk management, it is very likely to ignore important risks that can prove very dangerous for projects.

Lu and Ma [44] studied the need for risk management and they found that risk identification is a very important step and it is required to be performed effectively for effective risk management. Nyfjord [50] also suggested the necessity of obtaining information about risk explicitly by performing risk identification activity. They think that if this activity is not performed correctly, then effective risk mitigation plans cannot be performed effectively, which further leads to ineffective risk tracking and control. Nelson et al. [42] states:

"Managing risks explicitly, but with techniques that stay true to the spirit of agility, is a necessary next step to improve risk management in agile processes and increase the probability of successful projects."

As a result of the importance of risk management in agile software projects, risk management is described as one of the knowledge areas in Project Management Institute's (PMI) [1]. The need of explicit risk management in agile projects is emphasized by many authors. According to Derfer [45], agile methods XP, Scrum, and Kanban are helpful "at delivering a software in a more collaborative, transparent, and predictable fashion than traditional waterfall processes. However, agile practices, by themselves, are not sufficient to address the risks that impact most medium-to-large software projects." [45]

## VI. RECOMMENDATIONS

Practitioners are using two types of strategies to handle risks in agile software projects. One we called implicit risk management strategies (communication and collaboration, shorter iterations, frequent delivery, early feedback, and delivering complex parts first) and explicit risk management strategies (relative estimates, burn down chart, SWOT analysis, and risk matrix).

It is clear from discussion that agile methods of delivering short iterations, close customer collaboration, and frequent deliveries can help to minimize risk to a certain extent. All of these activities can help to reduce risks that are associated with technology and the scope of projects. This is in accordance with Horvath [47], who thinks that agile methods have short iteration and risks are discussed in every sprint planning meeting and risk register is revaluated quite often usually at sprint planning meeting and retrospective meeting after each iteration. Using agile methods "can reduce a variety of risks related to budget, time to market, scope creep,

requirements, and security. However, you'll still need to define a process to manage risks" [48].

Although some risks are handled by implicit risk management strategies that agile methods offer, there are a number of other risks that a project comes across during its life cycle. Therefore, explicit risk management is required for such projects.

Small and low risk projects can rely completely on agile methodologies for implicit risk management, but for large and complex projects explicit risk management has a vital role to play [19]. Although agile methods claim that they provide risk management in a form of delivering multiple iterations or sprints, this doesn't mean that for a given project, these are the only risks, which are required to be managed at the iteration level. There are other kinds of risks that need to be managed at the project level.

As agile methods lack explicit risk management, writers suggest using risk management from traditional approaches [9] [38]. Risk management in the waterfall project is a comprehensive way to address all types of risks, so we suggest continuing its use in agile projects as well. Interviewed practitioners were also satisfied about using risk management activities the same way it is used in waterfall projects. It is evident from interview data and discussion that explicit risk management in agile projects is necessary and practitioners are doing it in the same way. Based on interview data and discussion we came up with following suggestions:

1. One suggestion is making risk matrix for all the identified risks. Risk matrix can help to manage risks. Risk matrix should be made and risk response strategies must be chosen for "avoiding, transferring, or mitigating risks" [47]. Positive risk strategies are to "exploit, share, or enhance" [47]. Our suggestion of explicit risk management is also in accordance with Lant [48], who thinks that implicit risk management will be effective if "only things that affected the outcome of the project were the decisions that the developers made to implement the solution," but because of the existence of the number of factors that can affect the project success, "explicit risk identification and management can further improve on the success rate of agile projects" [48].
2. Teams can use wall charts and post-it notes to make risks more visible to all stakeholders and is not only held by project manager [49], but team members must also contribute to make this process effective. The team´s experience with previous sprints and iterations can help them provide better estimates for upcoming sprints [49].
3. In traditional approaches, the project manager is the one responsible for all the risk management activities held in a project and creating a strategy for addressing the risks. But in the agile approach, the whole team can be made responsible for managing risk.

Nelson et al. [42] suggested explicit ways of risk management in agile projects. According to him, as agile teams are self-organizing, every member of the team must be responsible for identifying and prioritization of risks. However, for facilitation of this work, they suggested to make a person responsible for managing risk called the "risk manager." They suggested to make a risk register to write risks and use small workshops for risk evaluation [53]. We also suggest making a risk register as an effective way of managing risks.

## VII. EVALUATING A GROUNDED THEORY RESEARCH AND LIMITATIONS

### A. Evaluating a grounded theory

The product of a Grounded theory is called grounded theory. According to Breckenridge [34], "The emergent grounded theory offers an integrated probability statement that is not intended to be verified as right or wrong, but instead has relevant applicability and modifiability within the substantive area." Suggested criteria for evaluating a grounded theory is the fit, work, relevance, and modifiability [30].

**1) Fit:** Codes, concepts, and categories must be validated in terms of their fit in the data. Glaser [30] suggests "the analyst's goal is to ground the fit of categories as close as he can" (p.4). One way for ensuring fit is avoiding literature review before the emergence of all concepts and categories. This can help the researcher to avoid any pre-conceptualization and pre-assumptions about the data and the research topic. Keeping these guidelines in mind writers didn't performed literature review before all categories were emerged.

**2) Work:** Work describes the ability of the theory to "explain what happened, predict what might happen, and interpret what is happening in an area of substantive or formal inquiry" [30] (p.4). This must be assured by presented participants´ main concerns. For this study, the practitioner's main concern of managing risk was taken into account and presented. Following theory data analysis guidelines, all codes, concepts, and categories are grounded in the data.

**3) Relevance:** Relevance shows if the developed theory is grounded well in the data and is developed systematically through careful analysis of the data [30]. This is ensured through Grounded theory analysis of the data; this analysis gave rise to codes and categories related to "risk management" that are presented in this study.

**4) Modifiability:** Modifiability refers if a grounded theory is modifiable or can be altered by further data collection and analysis [35]. The grounded theory is an "ever developing entity, not as a perfected product" [22] (p.43) and the theory of "risk management" presented in this study can be modified with further data collection and analysis.

### B. Limitations

This study has following limitations:

1. Grounded theory research is said to be strongly context specific [28]. Therefore, it cannot be generalized to a large population.
2. Data collection was performed without keeping any specific project cases in mind. Therefore, data for this study is the collective experiences of participants working with agile projects.
3. Interviewed participants were project managers. Therefore, this study might present project managers' perspectives, excluding all other stakeholders involved in a project.

## VIII. CONTRIBUTION AND FUTURE WORK

This study has contributed to an existing body of knowledge by studying risk management process empirically in agile software projects. The need of more empirical studies in agile software projects are identified by Odzaly and Des Greer [17] and Albadarneh et al. [18]. This study will contribute to understand the role of risk management in agile software projects. This study will help to understand the similarities and dissimilarities between project risk management process in agile projects and non-agile projects. This study has made contribution in terms of identifying the strengths and weaknesses in the current risk management practices in agile software projects, and presented guidelines on how to maximize the impact of the risk management process on project outcome by implementing risk management practices appropriately. Practitioners can use these presented risk management strategies (presented in the recommendation section) to manage risk effectively in agile software projects. We intend to find further empirical evidence from agile projects to make this study more generalizable to the wider population and make the risk management process more effective.

## IX. CONCLUSION

This study made an attempt to focus on the agile risk management process in agile software projects. This study presented the ways through which agile risk management is being done in agile projects. Interview data suggested that practitioners are handling risks in agile software projects mainly by two strategies: implicit risk management strategies (communication and collaboration, shorter iterations, frequent delivery, early feedback, and delivering complex parts first) and explicit risk management strategies (relative estimates, burn down chart, SWOT analysis, and risk matrix). In this study, the role of project risk management in agile projects is discussed along with providing an overview over the similarities and dissimilarities between the project risk management process in agile projects and non-agile projects. Strength and

weaknesses in current practices are also presented. Based on interview findings, risk management recommendations to make the process more effective are also presented.

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# Paper 5

## A qualitative study of success criteria in Norwegian agile software projects from suppliers' perspective

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**Abstract:**
This paper provides practical insights into the success criteria in agile projects in the Norwegian software industry. We conducted 32 interviews with practitioners working with agile projects. The findings revealed two fundamental differences that distinguish the perception of success in agile projects from that in projects that are based on the waterfall approach. Firstly, the evaluation is carried out on a regular basis after each increment. This regular and continuous measurement of success contributes several advantages, including greater commitment and involvement from the customer and a higher level of mutual trust between the supplier and the customer, and thus leads to better knowledge sharing and reduced task uncertainty. The reduction of task uncertainty provides more predictability about the direction of the project and better grounds for change control; not least, it allows room to consider multiple and subjective assessments by various stakeholders. Secondly, there is a stronger emphasis on customer satisfaction. Customer satisfaction is measured in terms of how quickly the customer obtains value from the project. The continuous assessment of success at the end of each iteration also has a significant, positive impact on the customer's evaluation of the project outcome.

**Keywords:** Success criteria; agile projects; suppliers; qualitative study.

## 1. Introduction

It is important to emphasize that the importance of project success criteria extends beyond the final evaluation of the project outcome [1]. Jugdev and Müller emphasized the importance of defining project success criteria up front to align stakeholders and to create a common vision about the project's outcome and how it will be evaluated [1]. Although much research has been carried out on project success criteria for projects that mainly follow the traditional waterfall model, it does not take into account the emergent characteristics of agile software projects. Software projects based on agile projects have some features that distinguish them from projects following the traditional waterfall approach [2]. The waterfall approach follows an engineering discipline in which the development is predictive and repeatable; therefore, the final evaluation is performed once a phase or the final deliverables are complete.

On the other hand, agile methods are lightweight processes that employ short iterative cycles, actively involve users to establish, prioritize and verify requirements and rely on a team's tacit knowledge as opposed to documentation. A truly agile method must be iterative (take several cycles to complete), incremental (not deliver the entire product at once), self-organizing (the teams determine the best way to handle the work) and emergent (processes, principles and work structures are recognized during the project rather than predetermined) [3]. Software systems

are so complex that full specifications cannot be given at the start of the project; therefore, agile methods (XP, Scrum, Kanban, etc.) help to deliver projects associated with uncertainties [4].

Project success criteria include several dimensions spanning from criteria concerning the efficiency of the project management effort (project management success) to criteria that reflect the impact of the project on end-users, on business, on societies (project success) and on creating opportunities for the future [5]-[8]. The main purposes of these criteria are to define a clear rationale for deciding whether the project was a success/failure and, to some extent, the degree of success/failure. There is also increasing recognition of the need to consider the dynamic nature of projects and look at success from a subjectivist viewpoint as well [9]. De Wit first suggested a distinction between project success and project management success. Project success embodies the perceived value of a project when the result or product is in operation [10]. Focusing on project success may lead to the consideration of criteria such as product use, user or client satisfaction and benefits to users or clients [11]. On the other hand, meeting the requirements concerning time to deliver, specifications and budget embodies project management success.

This paper is exploratory and seeks to investigate the categories of success criteria used in agile projects and the conditions that must be met to achieve project management success as well as project success. The similarities and dissimilarities between agile-based projects and projects based on the waterfall approach concerning how success is perceived and managed will be analyzed and presented. The findings and analysis are based on interviews with 32 agile practitioners from 25 different software development organizations in Norway. Of the 32 participants, 26 were project managers (19 project managers were from the supplier side, 4 were project managers from the customer side and 3 were project managers of companies performing in-house development), 4 were developers and 2 were solution architects. Their organizations varied from consulting organizations to in-house development organizations.

This paper is structured as follows. First, we will review the literature to determine how success criteria are defined in general. Then, we will investigate how the success criteria in software projects differ from those in other types of projects. Next, the interview findings will be presented, followed by a discussion and conclusion.

## 2. Literature review

According to Wateridge [12], success for software projects is not a “black and white” concept. Unlike construction projects in which project success is easier to measure [12], software

projects are more visible when they become operational; therefore, at this stage, there are more chances for the product to be evaluated regarding its use and business value. During the operation phase, different stakeholders' perceptions of success are easy to measure [13]-[15].

According to some researchers [16]-[19], the measurement of software project success has a multidimensional perspective. Many stakeholders are involved in a project and they can have a variety of interests depending on the outcomes of the project. Contingent on the use of the project, different stakeholders (supplier company, customers, project team, end-users) can have different perspectives, interests and roles in the project [15],[19]; therefore, they have different perceptions of success [20]-[24]. These stakeholders have strong control over the project and they can exert an impact on its results [25]. For example, developers might have success criteria for software projects that consist of substantial learning and reusable codes instead of time and budget [26]. Customer satisfaction, process efficiency and functional requirements might be the most important success criteria for suppliers [27].

According to Christenson and Walker [28], establishing an agreement on how and when a project will be evaluated helps in creating a common vision about the outcome, which is in itself a significant driver of project management success. Hussein [29] supported this view and recommended defining a project's success criteria at the start as good project management practice.

Creating a common reference point at the start of the project to define how projects will be evaluated is an important factor in aligning the project team and establishing commitment to the project objectives. Korzaan [30] showed that commitment to project objectives has a positive influence on the perceptions of project performance, both directly and indirectly, through individual propensities to report project status information. Hussein [29] showed that failing to use project success criteria actively in the management of projects can lead to numerous and frequent changes to these criteria, which in turn result in poor project performance, frustration and even losses. Poor management leads to poor intermediate results. Poor intermediate results lead to changing project priorities and these cause a project to lose focus, according to Dvir and Lechler [31].

The importance of measuring success while keeping different stakeholders' perspectives in view was introduced by De Wit [10]. A framework was presented by McLeod [11] et al. to measure success based on the different perspectives of stakeholders. Although a project can involve a number of stakeholders, there are two main stakeholders: one is the customer and the

other is the supplier. Both of these stakeholder types can have different expectations of the project; therefore, according to Jugdev and Müller [1], all the stakeholders need to be involved in defining the success criteria. Customer companies want the maximum functionality delivered within a limited budget and time span, while supplier companies exist to make profits along with delivering successful projects.

Therefore, it is very important for project success to be measured by taking into consideration the perceptions or business values of the project from the viewpoint of those stakeholders who are possible beneficiaries of the project. Some studies have suggested the same [32],[33]. Some researchers have argued that practitioners should avoid measuring the success of software projects in terms of triple constraints, and practitioners should measure projects' success depending on the project type and stakeholders' interests [27]. Different studies have attempted to investigate the effects of stakeholder perspectives [11] at different points of the project life cycle [34]. Wateridge [12] suggested "meeting user requirements" as the most important success criterion, but this could vary from stakeholder to stakeholder. End-users consider success criteria from their perspective (for example, the ease of use of the system). Project managers consider a project to be successful if it has been delivered within the available time and budget [35].

Procaccino and Verner [36] presented a study about the stakeholders' different perceptions of success. They found that the ease of using a system and meeting customer needs are considered to be important success criteria by software practitioners. The perceptions of stakeholders can vary to the extent that a project that is considered to be successful by the client may be considered a complete failure by the end-users or contractors (suppliers) [37],[38]. According to some researchers, customer satisfaction is one of the most important criteria for a project [39],[40]. Meeting the budget, schedule and requirements targets are not enough for project evaluation; therefore, success criteria like process efficiency and stakeholder satisfaction must also be included in project evaluation [41].

Agarwal and Rathod [42] defined success from the perspectives of the internal stakeholders of an organization. In their opinion, delivering the full scope of a project is the most important success criterion. Shenhar et al. [8] found that success has different meanings for different stakeholders and depends on the circumstances and the type of the project. Müller and Turner [43] suggested that project success criteria vary depending on the project manager's influence

on the project. According to them, success criteria depend on many factors, including the age and nationality of the project manager [43].

Taking into consideration the supplier's perspective, Savolainen et al. [44] presented a framework for measuring the success of software projects. From the very start of software development, success is measured based on triple constraints, but can a project be called successful if it meets the triple constraints but does not produce customer satisfaction? Conversely, if a project fails to meet the triple constraints criteria but the customers are highly satisfied with the end product, can it be called a successful project?

The Standish Group's report published in 2015 [45] introduced a major change in terms of accessing project success. The success criteria were revised to include six factors, namely on time, on budget, on target, on goal, value and satisfaction. The reason for including these criteria is that, according to the report, there are "many projects that have met the Triple Constraints and did not return value to the organization or the users and executive sponsors were unsatisfied." According to the Standish Group, "changes in this criteria was not done quickly or lightly"; they were made after careful consideration and a survey.

## 3. Methodology

We conducted interviews with 32 agile practitioners from 25 different software development organizations in Norway. Of the 32 participant interviewees, 26 were project managers (19 project managers were from the supplier side, 4 project managers were from the customer side and 3 project managers were from companies performing in-house development), 4 were developers and 2 were solution architects. Their organizations varied from consulting organizations to in-house development organizations. The practitioners had considerable experience with IT, ranging from 3 to 40 years. Most of the practitioners had been using the agile method since its inception or had started working with the methodology before it was named "agile." The products and services offered by the practitioners' organizations included web-based applications, front- and back-office applications and software development services. The practitioners interviewed were scrum masters, project managers, system developers and product owners, enabling us to view problems from multiple perspectives. We conducted semi-structured interviews through various media, including face to face, email and Skype. To take multiple issues into consideration, we developed a research instrument consisting of 6 open-ended questions to conduct the interviews:

- How often do you evaluate the project?
- What are the success criteria for your company?
- Do you think that different stakeholders have different perceptions of success?
- How are success criteria in agile software projects different from those of other types of projects?
- In your opinion, how can project success be achieved?

We then asked the follow-up question:

- How can customer satisfaction be achieved?

We used a non-probability sampling technique for our research [45], specifically purposive sampling. This technique was selected bearing in mind the purpose of the research. We deliberately contacted participants who had relevant experience related to the research questions. We searched for participants on the Internet, and after looking into their profiles we sent them an invitation to take part in the study. The participants who were interested in participating in the research replied and accepted. After agreeing on the time and place of the interviews, we conducted interviews of 20-25 minutes' duration. Data were collected from 2011 to 2014. Our priority throughout this research was to ensure the anonymity of our interviewees and their organizations. Thus, we refer to the interviewees throughout this paper as respondents AP1 to AP32. We used a thematic analysis method for data analysis [47]. First, we transcribed the interviews. Second, we read the transcripts several times to familiarize ourselves with the information. Third, we identified patterns in the informants' answers. Fourth, we labeled sections according to those patterns. After clustering the information, we were able to organize, compare and analyze it. This study presents limitations that affect its generalizability, because it is strongly context-specific, as it was mostly performed within the Norwegian context. Furthermore, we collected the data not with specific project cases in mind but rather based on the collective experiences of the informants.

Validity measures the accuracy of research findings [59]. This research was conducted in 25 different organizations. We chose practitioners by considering their experience and suitability for the study. We also ensured that the practitioners had enough experience and knowledge of the subject under study. We interviewed a large number of practitioners (32) to reduce the bias in the study [59].

Reliability measures the consistency of the research. We guaranteed this reliability in our study by cross-checking the results of different practitioners. The transcripts of the interviews were sent to the concerned practitioner so that he/she could check for any omissions or errors.

## 4. Interview findings

In this section, interview data are presented. Due to space constraints it is not possible to present all interview data. We have presented selected quotes in Table 1.

Table 1: Interview data

| Questions | Respondents response |
|---|---|
| How you often judge the success of the project? | *"That's up to the customer how they judge success. As a supplier, we judge success after each iteration.".__AP1* |
| | *"It depends on the role, hitting financial targets, customer satisfaction. Meeting financial targets determines the health of the current business. Providing customer satisfaction ensures the continued existence of the business. A degree of increased organizational learning and expertise is also a factor, but again depends on the point of view of who makes the evaluation."__AP4* |
| | *"Success in agile projects is measured how quickly you can deliver business value. Since you are delivering in iterations it is easy to get feedback from the customer and you can analyze where are you heading."_AP30* |
| | *"We have check after getting delivery of the product pieces. If we feel that the project is heading towards wrong, we can take measures to get it fixed."__ AP3* |
| | *"We have extensive routines and methods to follow up and evaluate projects. This is done at a continuous basis and at project close-up."__AP11* |
| What is success criteria for your company? | *"The only criteria for us is customer satisfaction."__AP20* |
| | *"On time and budget and finishing the user stories/features (providing required functionality)."__AP13* |
| | *"Delivering on time is more important than finishing within budget."__AP5* |
| | *"Only criterion to judge success is to know if the customer is happy, and he buy more services."__AP8* |
| | *"To us happy customer is the only success criteria"__Ap14* |
| | *"To my knowledge, the only criterion is money".__AP10* |

| | |
|---|---|
| | *"Meeting end user requirements is most important success criteria."__AP17*<br><br>*"Customers got value of money only that way they will be happy and bring more business"__AP27*<br><br>*"Criteria is happy customer and amount of money we got from the project."__AP18*<br><br>*"The only criteria for us is that we get value of money, we invested."__AP31*<br><br>*"The only criteria is money."__AP16*<br><br>*"There are two aspects that need to be evaluated to judge project success or failure:*<br><br>*Customer satisfaction is judged by evaluation of forms and interviews. Interviews with the customer are done to judge, whether the delivered project has added the promised value and whether the customer would recommend us to someone else.*<br><br>*If the company has made money.*<br><br>*Both of the above, mentioned criteria, need to have answer in yes. If either of the criteria is not fulfilled the project is a failure from our perspective."__AP7* |
| Do you think that different stakeholders have different perceptions of the success? | "*Every stakeholder has different perspective of success and it depends on whom you ask. The technical staff is happy if everything worked nicely, no serious bugs, and we learnt something new. Management is happy if we get more customers or keep the existing one and ultimately advertisers money".__AP29*<br><br>*"Developer's perspective of success criteria is to deliver complete stories within time. They care less about other success criteria."__AP6*<br><br>*"Evaluation meetings with customers and end users are held to judge customer satisfaction. Success criteria is different for every stakeholder involved in the project. We as supplier judge success of the project if customer is happy and we made some money."__AP3*<br><br>*"It depends on the point of view. The customer decides if the software is functionally sound and generates business value. The development team/maintenance team decides if the software is technically sound and is cost effective to maintain and add more features to."__AP16* |
| How success criteria in agile software projects is different that other type of projects? | *"Customers are more involved in agile projects Whereas in waterfall suppliers and customers work at distant."__AP5*<br><br>*"In agile project, it is very easy for us to have a check on project. With every piece we deliver, we can asses the performance. With* |

| | |
|---|---|
| | *every delivery, we have a check with the customer that whether we are heading towards right direction. In waterfall, project delivery is done once it is fully developed therefore it is not possible to have insight whats going on during the course of the project."__AP27* |
| | *"We have check after getting delivery of the product pieces. If we feel that the project is heading towards wrong, we can take measures to get it fixed. In worst scenario we can also stop it. In that case too we have certain working parts of the project. In waterfall this type of supervision is not possible." __AP28* |
| | *"The main advantage of using agile method is communicative – the communication between supplier and customer is so much higher than with traditional methods that whatever is the outcome of the project, it's hardly a surprise for either. So it's usually a joint evaluation. Besides, projects which follow agile management approaches do require agreement under way, so they tend to be seen as successful (so long they are properly executed)."__AP2* |
| In your opinion, how project success can be achieved? | *"Project manger needs to be so skillful that he should take into account perspectives of different stakeholders. "__AP31* |
| | *"Continuous feedback from customers will make sure that how they perceive success." __AP24* |
| | *"Getting continuous feedback from customer helps to get customer satisfaction at the end of the project."__AP19* |
| | *"Customer involvement is very important in agile projects. When they are involved at every step of the project it is more easy to judge that whether they are happy with the product or not". __AP21* |
| **Follow up question** | |
| How customer satisfaction can be achieved? | *"In agile, customer is involved in the development process therefore they can provide valuable feedback. We can use this feedback to improve the product and ultimately product delivered according to the specification of the customer which makes them more happy with supplier. Whereas in waterfall suppliers and customers work at distant."__AP5* |
| | *"Customer can only be happy if they get more value for their money. Sometimes they are very unclear about what they want so we have to invest more time in understanding the requirements of the project. Once we understand and deliver the product."__ AP22* |
| | *"We need return on the investment we made. Since we are investing in the software project. We have to get maximum return on it. Once we are sure we are getting it this make us as customer more satisfied than anything else."__ AP25* |

### *4.1 Summary of the findings*

The findings suggested that the success criteria in agile projects are not very different from the success criteria identified for projects that follow a waterfall model. They typically include criteria that fall within the *project management success* category, such as delivering on time, on budget and according to the specifications. They also include criteria that fall into the *project success* category, such as customer satisfaction, providing value to the customer, having an impact on business in the supplier organization, creating new opportunities in terms of new contracts, learning and sustaining the supplier business.

Based on information collected from the informants, we identified two fundamental differences that distinguish the perception of success in agile projects from that in waterfall projects:

Firstly, in agile projects, the evaluation is carried out on a regular basis after each increment. This regular and continuous measurement of success offers several advantages over projects that use the waterfall approach. These advantages, according to the informants, are as follows:

1- Continuous measurement of the project status brings the customer closer to the project and thus increases the level of commitment to the project. Commitment is important for providing feedback about the product.

2- Continuous measurement helps in detecting deviations and not least the causes of these deviations; this in turn reduces the level of uncertainty about how the project will evolve, particularly in terms of the remaining tasks and functionalities. The scope of the work in each increment is limited and therefore the achievement of results after each increment can be easily measured; this facilities decision making on whether the project is heading in the right direction or not. In extreme cases, the customer will still have certain working functionalities even if the decision to halt the project is taken.

3- Continuous measurement allows for better knowledge sharing and a better trust level between the parties.

4- Perhaps more significantly, the measurement of success is performed jointly. That is, achieving a consensus about whether an iteration or a delivery is a success or a failure is based on a negotiated argument. This facilitates the consideration of a subjectivist view for the measurement of success.

Secondly, in agile projects, there is a stronger focus and greater emphasis on ensuring customer satisfaction. This customer satisfaction is measured in terms of how quickly the project

delivered value. Delivering within the budget seems to be a less significant criterion in measuring success. Customer satisfaction is a broad term. From the interview results, we believe that the following conditions should be met to achieve this level of satisfaction:

1- Customers feel themselves to be involved in the process through continuous feedback and prioritization of features.

2- The customer has control over the project.

3- The customer obtains value for money and is able to see that each iteration is a step towards value creation.

The other findings are also in line with the project management body of knowledge. For instance, in agile projects as well, every stakeholder has a different perspective of success. From the customer's viewpoint, the success criterion is the value received for the money invested. The technical staff is happy if everything works nicely, there are no serious bugs and they learnt something new. The management is happy if the company gains more customers or keeps its existing ones. The developer's perspective of success is to deliver the complete features within the time and less emphasis is placed other success criteria. Some respondents believe that success criteria are about finishing user stories/features within the time and budget, while others think that delivering on time is more important than finishing within the budget. These findings suggest that it is important to clarify and define the project success criteria as a joint effort between supplier and customer organizations before start-up. Therefore, it is a recommended practice to define the expected success criteria up front. To deliver business value to the customer, it is very important for the supplier and the customer to define the criteria for success at the start of the project. These criteria should be realistic, meaning that they need to be achievable and measureable. Different stakeholders should be asked to define clearly what, in their opinion, the end result of the project should be. Hussein [29] conducted an empirical study on 145 participants from different industries and pointed out the causes of changes in success criteria in Norway. Among other reasons, he pointed out the "lack of alignment of success criteria during the initiation phase" as an important reason for ultimately failing to achieve success. He suggested that project success criteria should be defined during the initiation phase and used as a reference frame for the life cycle of the development [29].

## 5. Discussion and analysis

In this section, we intend to discuss the findings outlined in the previous chapter. As the findings suggest, there are two interrelated differences between the way in which success or

failure is measured in agile projects and the way in which it is measured in waterfall-based projects. One of the differences is related to the frequency of measurement and the other is related to the focus of this measurement. It is also observed that a higher frequency of assessment influences customer satisfaction positively.

**1) Continuous assessment of status**. This is perhaps the most fundamental difference that we observed in the findings. Continuous assessment and evaluation of the project status jointly with the client offer several advantages. We shall present the significance of these findings in light of the project management literature on related topics.

- Greater commitment. The importance of commitment (organizational commitment and commitment of the project organization) to project success is widely considered to be an important success factor [47],[49]. Fowler and Horan identified a combination of top management commitment and project team commitment as a force driving the successful development of IS projects [50]. Pinto and Prescott identified top management support as a critical success factor and suggested its dominance in the planning phase of the project life cycle [51]. McLeod and MacDonell (2011) emphasized the importance of top management commitment in projects as it plays various roles in the organization, for example influencing attitudes, creating a positive context for change, overseeing the development of the project and ensuring the availability of resources [52].
- A higher level of trust and a better sense of control. Trust is defined as the willingness to assume [53]. It is a complex concept because it is multi-layered, multi-disciplinary and multi-dimensional and changes over time [54]. Trust has an impact on decision making because decisions are made in light of the level of trust and the perceived risk [53]. Trust and control coevolve [55]; nevertheless, the challenge is to find the right mixture of the two because total control can lead project participants to feel that they are not trusted and can have consequences of a moral hazard nature [56]. Trust is perceived as an enabler of knowledge-sharing behaviors [57]. According to Lewis, interpersonal trust enables the quality of communication. In the project performance, the impact of trust can also be observed in its role in uncertainty management [58]. According to Atkinson et al., trust generates more open communication and therefore more accurate risk assessment [56].
- Reduced task uncertainty. Task uncertainty includes several variations or forms, such as difficulty (having difficult tasks ahead), interdependence between tasks and newness

of tasks (never been attempted before) [59]. According to the author, these forms of task uncertainty have a negative impact on the level of perceived success or failure of projects. Continuous measurement helps in detecting the difficult tasks lying ahead. The scope of the work in each increment is limited and therefore the achievement of results after each increment can be easily measured; this facilities decision making on whether the project is heading in the right direction or not. In extreme cases, the customer will still have certain working functionalities even if the decision to halt the project is taken.

- Considers the subjectivist view. This entails recognizing that different stakeholders in the same project might have different evaluations of the project. McLeod et al. studied several IS projects and concluded that project outcomes are interpreted differently from different stakeholder perspectives, and also potentially at different times, and are constructed through subjective processes of sense making [52]. Joint sessions of assessment therefore provide a better atmosphere for discussing these different and subjective views before reaching final conclusions about the outcome.

**2) A stronger focus on the impact on the customer**. This involves meeting specifications, satisfying customer needs and providing a return on investment for the customer. These are measured using a combination of objective measures, such as the number of functions delivered and time to delivery; they are also measured subjectively in terms of the sense of commitment, sense of better control, trust, sense of task certainty and ability to express subjective opinions.

## 6. Conclusions

The project success criteria from the supplier perspective in projects that use agile-based approaches are not significantly different from the success criteria used in projects that are based on waterfall models. The assessment of success or failure is based on criteria that typically fall into either the *project management success* category, such as delivering on time, on budget and according to specifications, or the *project success* category, such as customer satisfaction, providing value to the customer, having an impact on business in the supplier organization, creating new opportunities in terms of new contracts, learning and sustaining the supplier's business.

The paper, however, identified two fundamental differences that distinguish the perception of success in agile projects from that in waterfall projects. Firstly, in agile projects, the evaluation

is carried out on a regular basis after each increment. This regular and continuous measurement of success offers several advantages, including:

1) Greater commitment and involvement from the customer;
2) A higher level of mutual trust between the supplier and the customer, which leads to better knowledge sharing;
3) Reduced task uncertainty, which provides more predictability about the direction of the project and better grounds for change control;
4) Room to consider multiple and subjective assessments by various stakeholders to achieve a consensus about the state of the project.

Secondly, there is a strong emphasis on customer satisfaction. Customer satisfaction is measured in terms of how quickly the customer obtains value from the project. The continuous assessment of success after each iteration also has a significant, positive impact on the way in which the customer evaluates the project outcome.

Our final conclusion is that this study demonstrates the importance and consequences of continuous and regular assessment of project status, regardless of the type of approach followed in the project. This continuous assessment increases the level of commitment, mutual trust, knowledge sharing and predictability and provides the stakeholders with opportunities to express their subjective and changing views on the project status. All these factors contribute positively to the overall satisfaction with the project.

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