JÖNKÖPING UNIVERSITY
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How Covid-19 and working from home have affected agile software development

This thesis has been executed at the School of Engineering in Jönköping within the area of Computer science. The authors take full responsibility for opinions, conclusions and findings presented.

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Abstract

Due to Covid-19, there has been a rise of uncertainties around the world. One of the uncertainties is how teams and individuals of these teams in agile software development has been affected. The goal of this paper is to see how Covid-19 has affected these people that are WFH (Working from home).

In order to collect data for the research paper, a survey of qualitative and quantitative responses and semi-structured qualitative interviews are used. In total there were 17 respondents to the survey and two interviews were conducted.

The findings of the research show that there have been increased numbers of meetings and they have also gone to a more online setting compared to before. Goals in general have been slightly harder to reach to the extent where communication has been slower. Higher focus has been established by the workers leading to productivity has been improved both from the individual perspective and the team perspective. The majority also would like to continue to work from home going into the future and going to the office is not mandatory but instead optional.

Keywords: Agile software development, Covid-19, WFH, Working from home

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1. Introduction

In 2001, 17 people gathered to explore a new approach to software development. From this meeting the manifesto of agile software development was introduced and the way of working changed in project groups and teams around the world (Beck, et.al., 2001). The values and principles of agile were the new things for companies to follow.

At the beginning of 2020, Covid-19 changed the basis for most businesses. Software companies were impacted by the limitations of face-to-face interactions and meetings. Instead, these things are done over the web and virtually. One of the key assets of agile software development is its focus on collaborative work (da Camara, Marinho, Sampaio, & Cadete, 2020). For instance, pair programming which is a part of agile software development to ensure quality control directly (Kude, Mithas, Schmidt, & Heinzl, 2019), this way it might affect the positive teamwork behaviors that are needed. Also, scrum is a popular method within agile that works in sprints to solve problems within the development team (Schwaber & Beedle, 2002).

During the pandemic it became a lot harder to have physical meetings with the team and customers. The pandemic also affected the clients and end-users that are involved in the development of the product that is being made (da Camara, Marinho, Sampaio, & Cadete, 2020). In the same study, however, it showed that teams provided better code when they were WFH (Working from home). Also, understanding the requirements of the project, and sharing the knowledge within the team helped them to improve. However, some teams that are already WFH home on a regular basis might not be as affected as teams that are used to not working remotely and this can create problems over time. Cooperation between co-workers is a fundamental part of a well-working software development team and has been this way for a long time (Edmondson, 1999). If this is taken away by working remotely this can create a big problem for companies that are not used to working this way. It can be a vital point to have members in a software development team trust each other and give constructive criticism when needed.

1.1 Problem statement

From the introduction of the manifesto in 2001, there have been researchers who believe agile both have benefits and limitations with how the methods work in projects, with the benefits being a collaboration with customers, work processes, pair programming, and the focus of the current work (Dybå & Dingsøyr, 2008). Dybå and Dingsøyr continue that the limitations per se have been that the lean development technique has not worked well. Pair programming has been inefficient and there has been a lack of attention to design and architecture. There is also research that implies agile development methods to be more suitable for smaller rather than larger projects (Cohen, Lindvall, & Costa, 2004). Due to the circumstances of Covid-19, there have been some challenges with agile, some of the issues being work from home, fewer meetings with clients, and an increase in cost and time (Hassan, 2021).

This study will focus on how agile software development teams and the individuals of these teams have been affected due to the prevailing circumstances of Covid-19. How their work changed from before Covid-19 and if there have been any limitations with the switch WFH or has it been no problem adapting to these circumstances. It will also focus on how the companies and project groups that are using agile software development intentions after Covid-19 are. If the companies plan to stay on course the way they have done the past year or to get back to how things were set up before the pandemic.

1.2 Purpose and research questions

In the previous section the problem around agile software development and why it is important were discussed. By getting a broader perspective and understanding around this topic of how WFH is operating in today's society. The goal of this paper is to investigate how Covid-19 has affected people that are working from home with agile software development. The interest of this research is to see what differences there are from before and during Covid-19 in agile software development. From the companies that we are investigating, what will be the future going forward with agile. Consequently, these are the questions that the study aims to answer in this research to get more information about this area.

RQ1: What are the benefits and disadvantages when applying agile software development to teams and developers working in an office?

This question focuses on both the benefits and disadvantages of working with agile software development teams and developers before Covid-19, this way we can measure the differences between before Covid-19 and during.

RQ2: In what ways has agile software development changed as a result of teams and individuals working from home?

This research question relies on how working from home has affected teams and individuals working on a project, has it worked as usual or has there been any consequences to adapt to moving to an environment that is from home.

RQ3: What does the future hold for agile software development teams?

For this research question, we want to investigate how agile software development teams are planning to work in the future. If they are going to stay on course with what they have done the past year due to the circumstances or shift back to the way they worked before Covid-19.

1.3 Scope and limitations

This research will contain companies that work with agile methods. The research will investigate how teams and individuals did work before Covid-19 and how they have been affected by the circumstances when working with agile. The research will not go into detail on what all the specific agile methods are.

Due to Covid-19, there is no comparative data between how it has gone with teams and individuals in project teams. This is a new research area that does not have enough collected data. Therefore, this study will answer the research questions with help of qualitative survey and interviews, where the data can be compared and analyzed. The idea is to collect qualitative data from several teams and individuals so the answers to

the questions become credible. If the collected data is trustworthy, it makes the result better for this research.

1.4 Disposition

- Chapter 2 – Method and implementation

  Method and implementation address the different ways of collecting data for the study

- Chapter 3 – Theoretical framework

  A short description of the agile software development and roles of some methods will be presented here. This will be continued with the already known benefits and limitations of agile and some information about what teams' thoughts are going forward. Lastly, the effect of working remotely in agile and known facts about how Covid-19 has impacted WFH will be presented.

- Chapter 4 – Results

  Results of the data that has been collected will be presented in this chapter.

- Chapter 5 – Discussion

  Both the results of the data will be discussed as well as the methods that has been used.

- Chapter 6 – Conclusion and Further Research

  The conclusion of the research that has been done will be shown in this section as well as what types of further research can be done.

2. Method and implementation

In order to answer the three research questions, the methodology is a quantitative and qualitative survey and involves qualitative semi-structured interviews. There is considerable value for combining quantitative and qualitative methods (Bryman, 2006). The two methods will complete each other because the quantitative survey questionnaire will be a preparation for the qualitative semi-structured interviews questionnaire. This will provide balance for the research result (Johnson, Onwuegbuzie, & Turner, 2007).

For research methods, a survey has been chosen as the main source of research. By doing a survey, it provides a compilation of how many participated in the research. It can illustrate a statistical form on questions that are in numeric options. The survey is an online survey with the use of a Google Form document, where previous knowledge in how to operate with Google Form exists, and it is easier to handle the collected data in an excel file. The approach has been chosen to scale the responses to questions in the survey. Due to the fact that everyone who is answering has an internet connection, they can by themselves choose a time to fill out the form when it fits them the best.

2.1 Data collection

Mixing survey methods and interview techniques are evolved in response to the observed limitations of both quantitative and qualitative designs. It will provide the research opportunities to understand and answer the question of "how" and "why" (Caruth, 2013). These methods will be described further below. The companies that did participate in the survey and interviews was contacted via mail.

2.1.1 Survey

The main purpose of this research method is to collect data from a survey and access data quickly. Participants can choose their own time when it suits them the best. Therefore, it is attempted to assist and support educational researchers in making informed choices and decisions (Minnaar & Heystek, 2013).

The benefits of online survey are that data that is collected can be used straight away for analysis and by having the questionnaires go to an electronic file, another stage of data entry is not necessary and this will diminish time to finish the research project (Van Selma

& Jankowski, 2006). Another benefit is that the online surveys can be anonymous, this will help us get more participants that would not want to participate if it was not in fact anonymous. But due to the fact it is anonymous, a problem can occur if participants do the survey more than one time and this will affect the results that will be collected.

The survey is made to measure how Covid-19 has affected the employee's work environment and effort in agile team/teams compared to pre-Covid-19, these impact questions are shown in Table 1. Metadata questions which are shown in Table 2 will help the research draw comparisons and conclusions in the results section.

The questions are designed into four categories; *Likert Scale*, *Open-ended question*, *Closed-ended question* and *Single-choice.*

- *Likert Scale*

The asymmetric Likert scale will be a six-level scale which is used in the research that forces an answer from the participants and does not offer a neutral standpoint. This way the data that is being collected will gather more information about how the participants really think and stand for that specific question.

- *Open-ended question*

The questions that are open-ended questions are designed to give participants more freedom for an explanation and their way of thought on that specific topic.

- *Closed-ended question*

Closed-ended questions are questions in which the response will be a "*yes*" and "*no*" answer.

- *Single-choice*

The single-choice question allows the respondents to select one answer from 0-7 alternative.

Table 1: *Survey questionnaire - impact questions.*

No.	Covid-19 WFH Impact Questions	Reference	Type of question	RQ1	RQ2	RQ3
1	Has there been any team changes or changes to your individual work?	(da Camara et al., 2020, p. 14-15)	Closed-ended		☑	
2	If you answered yes in the previous question, what changes has been made and why?	own question	Open-ended		☑	
3	How many days a week did you work from home before the pandemic?	(Hassan, 2021, p. 68)	Single-choice	☑		
4	How many days a week did you work from home from the start of the pandemic to July 2020(when things began to be stable)?	(Hassan, 2021, p. 68)	Single-choice		☑	
5	How many days a week do you work from home since July 2020 - now?	(Hassan, 2021, p. 68)	Single-choice		☑	
6	What impact has Covid-19 had on the productivity on the team/teams performance?	(Hassan, 2021, p. 67)	Likert scale		☑	
7	Why do you believe the productivity has changed within the team?	own question	Open-ended	☑	☑	
8	What impact has Covid-19 had on the productivity on your individual performance?	(Hassan, 2021, p. 67)	Likert scale		☑	
9	Why do you believe the productivity has changed on your individual perspective?	own question	Open-ended	☑	☑	
10	In what way has meetings with client representatives been any different since before Covid-19?	(Hassan, 2021, p. 60)	Open-ended	☑	☑	
11	Has there been any changes of achieving the goals that has been set up by the team/teams?	(da Camara et al., 2020, p. 7)	Likert scale		☑	
12	Why do you believe that achieving the goals has changed?	own question	Open-ended		☑	
13	When the pandemic is over would you want to continue the way you worked during the pandemic?	own question	Closed-ended			☑
14	When the pandemic is over, what does the future hold for the team/teams you are working in?	own question	Open-ended			☑

Table 2: *Survey questionnaire - metadata questions.*

No.	Meta Data Questions
1	How old are you?
2	Which company are you apart of?
3	What is your role in the agile software development team/teams?
4	What type of agile software development are you working with? (Example: Scrum, XP, DSDM, etc.)

2.1.2 Interviews

Qualitative interviews are being used to get more knowledge about how the work of the participants from the survey has changed during Covid-19. Also, data will be collected to answer how the future looks for the team/teams going forward therefore the interviews can be linked directly to answer our three research questions.

The first reason interviews were chosen is that some answers that are given might be unclear and need to be better formulated. Secondly is that participants can express themselves more in detail in interviews compared to survey questions, even though they are open-ended questions, interviews will allow participants to explain their answers in a different way. The third reason is that the participants that have done the survey might have done it together, interviews will allow the participants to be more independent in their answers and not be affected by others.

In interviews, there are three different types (Alshenqeeti, 2014). Structured interviews where all the questions during the interview are in the same place for every participant and are set beforehand which leads to no follow-up questions from the questionnaire to the interviewee. Unstructured interviews are contrary to structured interviews. No questions beforehand are prepared and the conversation is more open and relaxed. Semi-Structured interviews have similarities to structured interviews where the questionnaire comes prepared with questions but the order of the questions does not matter and it also allows for follow-up questions and keeping an open conversation based on the answers of the participants.

This research has chosen to do semi-structured interviews due to the importance of follow-up questions to the participants. This way, the participants can give more in-depth answers that will benefit the research of this paper compared to the other techniques. The interview question that is being asked to participants are shown in Table 3.

Table 3: *Interview questionnaire - impact questions.*

No.	Covid-19 WFH Impact Questions	Reference	RQ1	RQ2	RQ3
1	What do you think about the meeting structure when it is online compared to face-to-face?	(Dybå & Dingsøyr, 2008, p. 848)	☑	☑	
2	How has the prodcutivity in the meetings changed compared to before?	(Hassan, 2021, p. 60)	☑	☑	
3	Do you believe that companies working with agile from home will go back to working in the office or stay at home after the restrictions are upheld?	own question			☑
4	Why do you believe that Covid-19 has affected your team/teams for the better or for the worse in the long run?	own question			☑
5	Compared to before does a project take more or less time to finish?	(Hassan, 2021, p. 65)	☑	☑	
6	How has not having face-to-face interactions with colleagues affected people's work rate and satisfaction?	own question		☑	
7	How hard was the transition from working in the office to working from home?	(Hassan, 2021, p. 37)		☑	
8	Do you think that different roles in your team/teams have been affected differently due to WFH?	own question		☑	
9	Has the cost of the projects changed while WFH?	(Hassan, 2021, p. 65)		☑	
10	Has the team/teams been more successful in a WFH environment compared to before Covid-19?	own question	☑	☑	

2.2 Data analysis

This section will contain information on how the survey and interviews are analyzed in order to get the most out of our questionnaires to be able to present sufficient results.

2.2.1 Survey analysis

The process of analyzing survey is divided into three categories, preparation, organization, and result (Elo, o.a., 2014). In the article, they describe the importance of each category to improve the trustworthiness of the analysis. As illustrated in Figure 1, it represents the steps to analyze the quantitative and qualitative data.
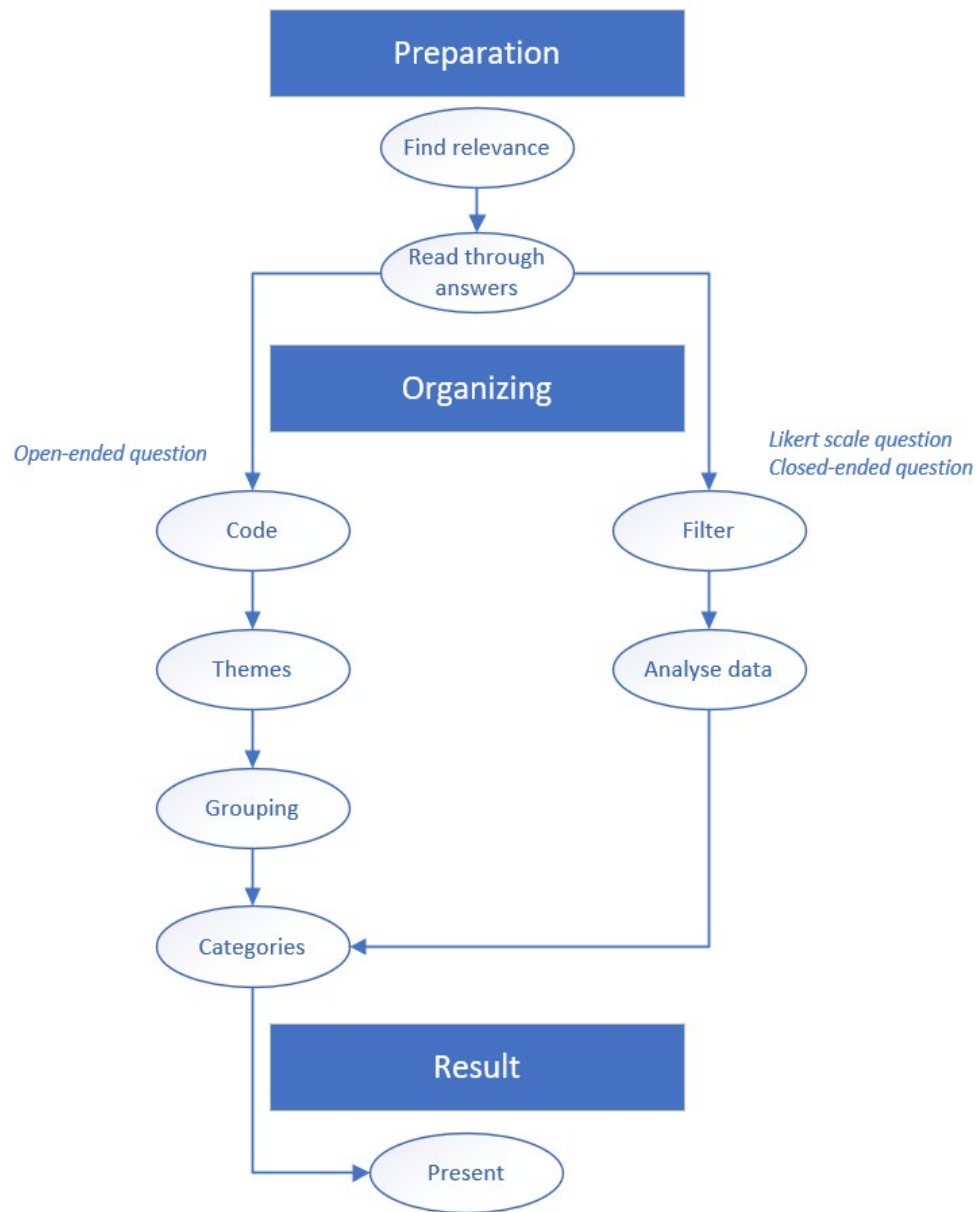
Figure 1: *Process of analyzing survey (Elo & Kyngäs, 2008).*

- *Preparation*

As is shown in Table 1, the preparation was first to find relevance to each survey question by referring it to research articles and RQ. Further, questions developed by authors have been added to the survey, which is relevant to *RQ1*, *RQ2,* and *RQ3*. The questionnaire is the unit, which is supposed to be analyzed. In preparation, a major part is to read through the collected data and understand the data before moving on to the next category *Organization.*

- *Organizing*

The organization is the stage of filtering and it includes coding and creating categories. Depending on if the question is an open-ended question or a Likert scale question/closed-ended question, there are different ways to analyze them.

- The quantitative Likert scale and closed-ended question will be analyzed as ordinal data, presented as a bar graph or a pie chart showing the agreement level and the frequency in a figure.
- The requirements to questions that are open-ended are to filter out the answers in addition to delivering and identify the result (Jackson & Trochim, 2002). The procedure starts again with reading through the text and writing down all the necessary aspects of the content (Hsieh & Shannon, 2005). After having done that part the code is divided into themes where the code has the same content. It follows up with grouping the themes into categories and presenting an overview over the categories.

- *Result*

By the survey questionnaire, the result is to present our findings to answer *RQ1, RQ2, and RQ3.* Also, the result will provide us with content to create the interview questionnaire.

2.2.2 Interviews analysis

Since all questions to the interviews are open-ended questions, the procedure to analyze the content of interviews will be presented by five steps (Gibson & O'Connor, 2003). This is shown in Figure 2.

```
┌─────────────────────────────┐
│  Listen through interviews  │
│  and transcribe the         │
│  interviews                 │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│   Generate data to codes    │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│       Codes to themes       │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│  Grouping and categories    │
│  the themes by research     │
│  topics                     │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│           Result            │
└─────────────────────────────┘
```
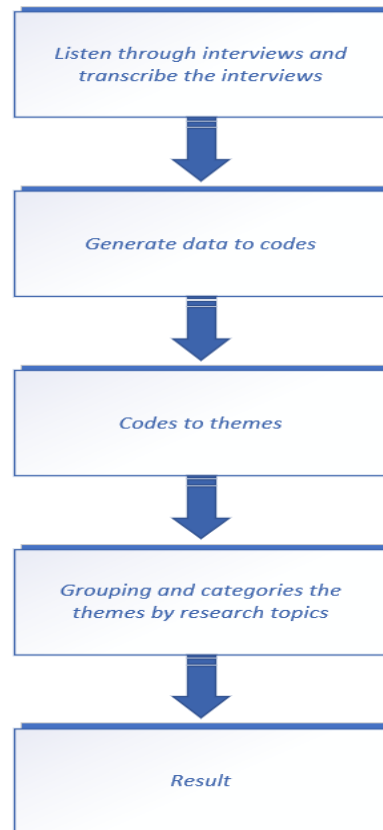
Figure 2: *The procedure to analyzing interviews (Gibson & O'Connor, 2003).*

● *Step 1: Listen through interviews and transcribe the interviews.*

All interviews were recorded so that all interviews could be listened through several times and be written down word for word in order to be able to have a transcribed version of the gathered data.

- *Step 2: Generate data to codes.*

Thereafter, when the transcribed version of the data was done, the next step was to start generating the data into code. The coding made it possible to quantify how often specific themes are addressed in a text, and the frequency of themes could then be compared and correlated (Kvale, 2007).

- *Step 3: Codes to themes.*

When all data has been generated to code step 3 was to continue to divide the code into themes that are important for answering the research questions and discuss the themes which are the goals of the data analysis process.

- *Step 4: Grouping and categories the themes by research topics.*

In step 4, it is important to group and categories the different themes and make it relevant to the research. By this, the result could present the content of the interview as grouped categories in *step 5*.

- *Step 5: Results*

The results from the interviews will be presented from what previous step 4 did, by grouping and categorizing the themes.

2.3 Validity and reliability

The research questions of this paper are answered in both the survey section and in the interview section. Both methods are used to get a good look from the individual and the team/team's angle.

From the survey there were a total of 17 respondents and two interviews were conducted. The participants who were interviewed also took part in the survey. In our study, 17 individuals are an acceptable sample size for discovering patterns and providing adequate data.

The survey has been answered by numerous individuals in different companies to get description to the research questions. The semi-structed interviews are designed to get more detailed and resolved answers (Barriball & While, 1994). The interviews were done to have an open discussion why the respondents answered as they did and get more knowledge from the two participants. But also, for asking follow-up question that could be presented in the result for our study.

The questionnaires have been constructed to capture metadata. The metadata are descripted data that can be organized and sorted to search on the summarized data easier. The purpose is to evaluate, gain, use, and facilitate the search of resources (Duval, 2001). From this, conclusions can be drawn and compared if the answers that are given have any similarities if the metadata falls into the same category. Some metadata are more important than other metadata in our research. The role that individuals have and the type of agile software development method they are doing both have a significant impact on our research, although this can vary a lot depending on what a specific person is working with.

2.4 Considerations

There is one main consideration in this research which is ethics because numerous individuals from different companies are asked a number of questions both in the survey and in interviews. There are four different research ethic principles that are being followed in this study: the information requirement, the consent requirement, the confidential requirement and the utilization requirement (Vetenskapsrådet, 2002).

The information requirement instructs that the participants are well informed what the purpose of the study is and be informed that participation is voluntary and they have the right to cancel the participation if desired. The consent requirement instructs that it is required to have the consent of the participants before collecting any data. The confidential requirement instructs that all data that is collected in the study is secured and does not allow unauthorized access. Lastly the utilization requirement instructs that data that is collected will only be used for which the participants have been informed and given consent to.

The participants are informed of the above ethical consideration when handed the survey and the interview questionnaire from the authors.

3. Theoretical framework

The theoretical framework establishes the foundation of the research and helps us to acquire the foundational knowledge of the scope in the research and the appropriate validation of the findings.

This section will present relevant information and research about agile software development, its roles, and the effects it may or may not have on individuals that are working from home or remote. This research has a lot of underlying information about our research questions and this will help us draw conclusions later in the research when our results are presented.

3.1 Agile Software Development

Agile software development is a way of dealing, creating, and developing solutions in different environments. With this method, teams are structured and organized to reach the same goal. The teams, which are working with agile, are self-organizing and cross-functional teams. The approach of agile teams is to have close collaboration and near communication. The agile manifesto was created with four core values and twelve principles.

The four core values in agile manifesto.

- Individuals and interactions over processes and tools.
- Working software over comprehensive documentation.
- Customer collaboration over contract negotiation.
- Responding to change over following a plan.

The twelve principles in agile manifesto.

1. Customer satisfaction by early and continuous delivery of valuable software.
2. Welcome changing requirements, even in late development.
3. Deliver working software frequently (weeks rather than months).
4. Close, daily cooperation between business people and developers.
5. Projects are built around motivated individuals, who should be trusted.
6. Face-to-face conversations is the best form of communication (co-location).
7. Working software is the primary measure of progress.
8. Sustainable development, able to maintain a constant pace.
9. Continuous attention to technical excellence and good design.
10. Simplicity – the art of maximizing the amount of work not done – is essential.
11. Best architectures, requirements, and designs emerge from self-organizing teams.
12. Regularly, the team reflects on how to become more effective, and adjusts accordingly.

The principles and values of agile software development were formed as a way to help teams break the cycle of process inflation and to focus on simple techniques for reaching their goals (Martin, Newkirk, & Koss, 2003).

3.1.1 Benefits and limitations

Agile software development is widely used in many technology organizations, but every organization is different from one another, and some organizations will benefit more from working with agile than other organizations might do. Teams and individuals of these teams have their own perceptions of the benefits and limitations of agile software development.

Two major advantages of agile software development are customer satisfaction and their interactions with teams that are working with their project. In a study where customers were asked questions after the project was finished, they argued that the way the team was working on the project was very easy to follow due to weekly meetings. If any uncertainties or changes would arise these were easily fixed just because of the constant communication (Rover, Ullerich, Scheel, Wegter, & Whipple, 2014).The

study continues that these were the effects of Scrum where the main focus is customers, product quality, teamwork, and iterative development. When working in agile software development the software/project is developed over several iterations and after each iteration, it is delivered to the customer for their feedback and to discover errors and problems that may occur later on. Every one of these iterations is defined with analysis, implementation, design, and testing (Sharma, Sarkar, & Gupta, 2012). As a result of all these iterations and the communication with the customers, the risk of the development is diminished. When looking at the work quality the developers feel more productive while using pair programming and are more pleased by the environment (Mannaro, Melis, & Marchesi, 2004).

By implementing agile in large-scale software development leads to advantages in one part but also issues in another part. Using smaller teams leads to more control over the whole project but can be seen as issues in the planning from the management side (Petersen & Wohlin, 2009).

Sometimes the communication with the customer is not always clear and productive. If the customer's feedback is unclear and not comprehensive the process might not go the way the customer wants and this leads to a problem and a disadvantage. Another vital point is that if the customer is not happy with the work and changes the requirements, a lot of resources and time will go to fix these issues (Sharma, Sarkar, & Gupta, 2012). The discussion touched upon the subject of how some developers found that they were more productive when using pair programming but everyone has their own understanding and some argue that pair programming is not productive but instead depleted when only working that way (Ilieva, Ivanov, & Stefanova, 2004). There is also a study showing that when working in agile the team members need to be highly competent, have prior experience, and an awareness of the business to succeed with such a thing (Merisalo-Rantanen, Tuunanen, & Rossi, 2005).

Table 4: *The benefits and limitations of agile software development (Petersen &*
Wohlin, 2009).

No.	Benefits
1.	Customer Satisfaction.
2.	Interactions with teams.
3.	Weekly meetings lead to that uncertainties are easily fixed.
4.	Constant communication.
5.	Constant Customer feedback.
6.	Several iterations.

No.	Limitations
1.	Smaller teams lead to issues in management side.
2.	Communication with customer can lack productivity and clearness.
3.	Customer might change requirements a lot, resources and time will go to fix the new requirements.
4.	Members need prior experience and know the business.
5.	Competence is needed.
6.	Pair programming is not productive in the long run.

3.2 Roles in Agile software development

There are a lot of agile software development methods. Each contains different roles within it. Roles define different responsibilities in the team/teams to make the project complete in the end.

Our study focuses of the roles from three agile methods: Extreme Programming (XP), Scrum and Dynamic System Development Method (DSDM). Table 5 shows the different roles that within each method.

Table 5: *Agile Software Development Roles (Beck, 2000), (Rubin, 2012), (Richards, 2013).*

Agile Software Development Roles			
Roles	*XP*	*SCRUM*	*DSDM*
Business Advisor	-	-	☑
Business Ambassador	-	-	☑
Business Analyst	-	-	☑
Business Sponsor	-	-	☑
Business Visionary	-	-	☑
Coach / Scrum Master	☑	☑	☑
Customer	☑	-	-
Product Owner	-	☑	-
Programmer	☑	-	-
Project Manager	-	-	☑
Solution Developer	-	-	☑
Solution Tester	-	-	☑
Team Leader	-	-	☑
Team Member	-	☑	-
Technical Advisor	-	-	☑
Technical Coordinator	-	-	☑
Tracker	☑	-	-
Workshop Facilitator	-	-	☑

3.2.1 Roles in Extreme Programming

Extreme programming is based on values of simplicity, communication, feedback, and courage. It will bring the whole team together in presence of simple practice, feedback to activate the team and see where the teams are and adapt the work to their situation (Lindstrom & Jeffries, 2004). The process XP consists of is *Exploration*, *Planning*, *Iterations to Release*, *Productionizing, Maintenance, and Death.*

In XP there are roles with different responsibilities during the working process and its practices (Beck, 2000). Programmers are a fundamental piece to XP. This is because in XP the programmer does not only write tests and keeps the program code simple. Communication with other programmers and team members is a key aspect. If the program is up and running but there have been some misses in the communication part the project is not done. Customers write the stories and functional tests and set the implementation priority for the requirements. Testers help the customer to write

functional tests and also to run these tests regularly as well as broadcast the test results. Tracker traces the estimates and each iteration in the process and gives feedback to the team. The manager makes the final decisions and is a vital component when communicating with the project team.

3.2.2 Roles in Scrum

The main component in Scrum is its sprints that can vary from 1-4 weeks. The sprint itself includes sprint planning, daily Scrum, sprint review, and sprint retrospective. Every sprint starts with planning where the team decides what they are going to achieve for the sprint and this is an occurring event until the project is finished. The daily Scrums are a short summary of the team's work during that day and it is a good way to get the most of how the progress has been done for the daily tasks. Both the sprint review and the sprint retrospective are done at the end of each sprint where the review is more towards the product and the retrospective is more towards the individuals and the team's process.

In Scrum, there are three different main roles that need to be addressed. The product owner is the one that assures that decisions regarding the economy for the project are beneficial and these decisions are an ongoing process during the release, sprints, and for the product backlog (Rubin, 2012, p. 165-172). But that person also has different roles in the whole project such as participating in the planning process, overseeing the backlog with estimations and prioritizing the backlog tasks, making sure that the acceptance criteria are met, and collaborating with both the development team and the stakeholders.

The Scrum Master is a leader within the Scrum team but is mostly there to assist and to help the team (Rubin, 2012, p. 185-189). The roles that a Scrum master provides in a team are important for its success. When the project group experiences outside conflicts the Scrum master is there to shield the team so they can stay focused on the main tasks of the project. Any hurdles that might occur during the project is the Scrum master's duty to eradicate. To be a good Scrum master the person should be able to understand the issues the team needs to discuss to create some sort of a solution. The person should also be a very collaborative person meaning they should be able to work with the team members, product owner, and even persons who might not be involved with Scrum.

Development team members are the ones that handle the tasks that are assigned for the project, they should also report the progress of their work on the sprints and control the quality of the product (Rubin, 2012, p. 195-197).

3.2.3 Roles in Dynamic Systems Development Method

DSDM focuses on the project lifecycle with five phases and supports its philosophy with eight principles. It aims to deliver the right product at the right time. One of the key techniques in DSDM is that it uses iterations as a timebox and the duration can be from a few days up to a few weeks (Richards, 2013).

In DSDM there are thirteen roles with a set of responsibilities. The roles can be categorized into three categories, Project Level, Solution Development Team, and Supporting Roles. At the Project level, the Product Owner, Manager, Technical Coordinator, and Business Visionary are responsible for overseeing the whole project and making sure the project is in the right direction and can be delivered to the customer. The Solution Development Team, Business Analyst, Business Ambassador, Solution Developer, Solution Tester, and Team Leader are those who are doing the whole project work and have different responsibilities to cover all tasks that need to be handled.

3.3 Effect of remote working on the practice of agile teams

By moving to remote working it will affect people and companies in different ways. If people for example have been working remotely and/or from home before Covid-19, they will understand the significance of working this way full-time. For those who precisely had changed an office to working remotely, there will probably be a bigger difference.

The importance of agile teams who have people working remotely are collaboration platforms, communications tools and other online tools (Deshpande, Sharp, Barroca, & Gregory, 2016). Depending on which role in a team the person has, remote working can affect differently and as the twelve principles of agile says, it can be harder to achieve principle *3*, *4* and *6* when working remotely. Besides, people who have self-discipline

may not be affected by the performance of working remotely, but in a way, it can affect well-being and satisfaction.

When development team or teams going in to remote working, it requires a different solution for how they are used to work in the office. Cockburn (Cockburn, 2002) highlights different team scenarios that can be seen as remote teams. *Multi-site development*, which are larger teams who works in fewer locations and each location are a complete development group. *Offshore development*, when team are split between remote sites (other countries). *Distributed development*, when team is spread across different location but with fewer people per location. What Cockburn points out is the importance of communication tools within remote teams and the high cost of teams "idea transfers". Specially in distributed development where each person spends a lot of time on phones, chats and email communication.

In (Sharp, Barroca, Deshpande, Gregory, & Taylor, 2016) the authors present a result of how the remote working in agile teams have worked out. Where it has been successes and challenges by working remotely. There are challenges by the trust and team building of colleagues, where the face-to-face interaction is a part in this situation. The team need to find the best collaborative platforms that fits the teams who works both remotely and on site. For the remote workers, there is a potential disadvantage that they can be isolated or excluded from knowledge at the office. Also, some may feel that they struggle in the online meetings. The potential advantage for remote workers is that they can focus on their task to be more efficient and deliver higher productivity in their work. Where it is no distraction or informal communication from others co-workers.

More WFH opportunities will help close the gap between men and women in terms of hours worked and salaries in the workplace due to the fact that WFH is more likely to be used as a way to efficiently organize those types of activities in a way that benefits the firm than as a way to meet private needs (Arntz, Sarra, & Berlingieri, 2019).

3.4 Covid-19 and the impact of WFH

Due to Covid-19 a lot of people in offices, schools, organizations, etc. have switched from working on-site to working from home. This has generated a new playing field to explore in the future for a lot of companies. But how well has it panned out to be and is it efficient. Adapting from a workspace to working from home can be very difficult and

this could lead to a negative point of view. Many who are unable to work independently or are unable to maintain effective relationships with colleagues can be less effective in a WFH situation (Bolisani, Scarso, Ipsen, Kirchner, & Hansen, 2020).

On the other side, working from home reduces the amount of tension you face and this will lead to that job productivity will naturally improve when stress is not perceived as a burden (Purwanto et al., 2020). Workers will be able to complete the task more easily this way. Job satisfaction can increase when someone can complete tasks more quickly and efficiently. If you are able to complete the task successfully that has been set up for a day, you will undoubtedly be more enthusiastic the next day. Even though there are both advantages and disadvantages with WFH during Covid-19 the impact may be very individual and personal. Persons with children might be impacted negatively due to a potential risk of a battle between work and needs from the family (Arntz, Sarra, & Berlingieri, 2020). Nonetheless, these risks can go away as schools open up again on a regular basis and these persons that struggled might benefit from WFH experience.

3.4.1 Teams post Covid-19

Covid-19 has left a lot of uncertainties within agile software development teams with a shift in the work environment. But how will it look after Covid-19 does not have a major impact on people's lives and they are allowed to go back to their offices again.

A conclusion is that tech workers, in particular, are going to continue WFH and use collaborated tools for the future (Mancl & Fraser, 2020). In the same article, the authors discussed that especially high-performing teams will continue their way of work in a good fashion but teams that depend on face-to-face interactions will most likely not perform as well. Another aspect that is worth mentioning is how teams performed before they were forced to work from home. If a team struggled before Covid-19, they will most likely suffer when returning back to the offices if they managed to cope working from home for an extended period of time. When returning it will be fresh air again for a lot of people in these teams and problems that were buried could result in technical as well as social problems (Kude, 2020). Teams that have strived under this period of time are expected to continue to do so in the future as well.

4. Results

In this chapter our results from our research will be presented. In order to answer our three research questions both the survey questions which were presented in 2.1.1 and the interview questions which were presented in 2.1.2 will be analyzed. The eight different categories *Weekly schedule, Meetings, Goals, Goals assessment and method, Work changes*, *Team productivity* and *Individual productivity, Productivity assessment and roles* will help answer the RQ1 and RQ2. The three different categories, *Desire of WFH, Office at home* and *Combining working environments* will help us answer RQ3. In total there are eleven categories which are related to the steps which are presented in 2.2.1 and 2.2.2 where surveys and interviews are analyzed. The categories are also related to the survey questionnaire in Table 1 and the interview questionnaire in Table 3.

Some of the questions in both the survey and the interviews touch upon the findings in more than one research question therefore this will be presented at the same time in the results.

A total of 17 respondents answered the survey that were sent out and a total of two interviews were conducted. In the survey twelve was working with scrum, five with XP and two with DSDM. Those who participated in the interviews also took part in the survey. In the interviews that were conducted one of them was a scrum master and the other interviewee was a developer.

Metadata that has affected the results will only be commented in the sections where these have occurred.

4.1 Effects of switching to WFH

In this section both RQ1 and RQ2 will be answered and analyzed. As described in the result header even though RQ1 and RQ2 are separate questions, they both touch upon the same subject and many questions that are being answered by the participants in the survey as well as the interviews contain results that affect both of these research questions.

- *RQ1: What are the benefits and disadvantages when applying agile software development to teams and developers working in an office?*
- *RQ2: In what ways has agile software development changed as a result of teams and individuals working from home?*

4.1.1 Weekly schedule

In this section the results that will be presented will apply how the weekly schedule for individuals working with agile software development has changed over the course of Covid-19. The benefit of doing it on a weekly basis is that it normalizes the data regardless of sprint durations. This is an important part of the research to see if the individuals that have worked from home at the rate that they have been affected, therefore the answers from the other questions in the survey and the interviews will be valid. This will help us answer RQ1 and RQ2. All the answers that are given are average estimates.

Figure 3, Figure 4 and Figure 5 shows where the respondents have worked from before the pandemic happened, to the start of the pandemic and where things began to be stable. Before Covid-19 most of the respondents worked in the office. When the pandemic struck these numbers shifted to most of the respondent WFH. This carried on even when things began to be stable around July 2020.
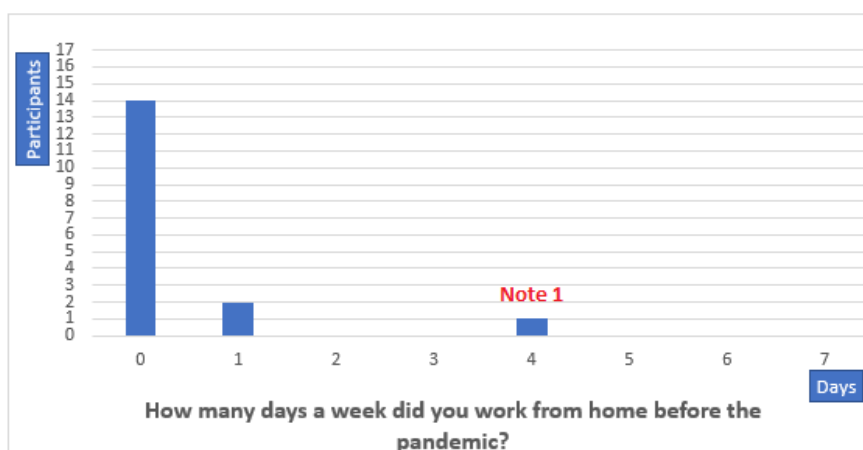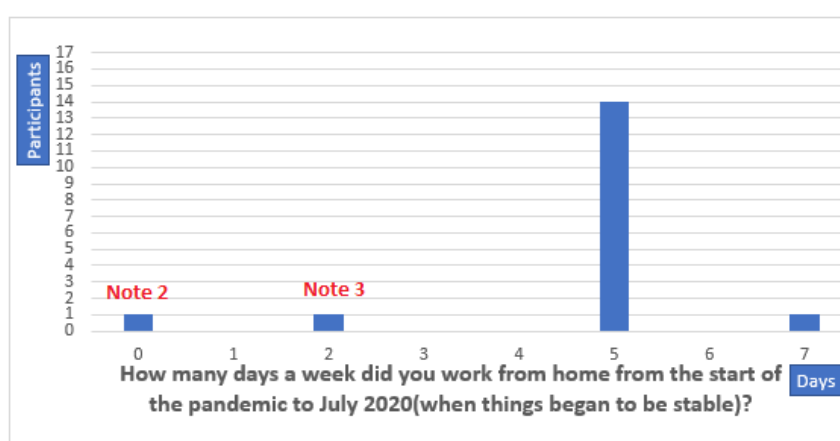
Figure 3*: WFH before the pandemic.*
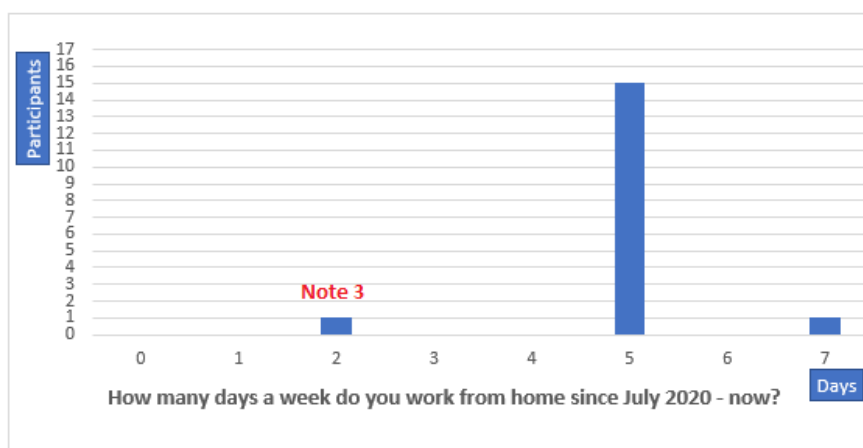

Figure 4: *WFH start of Covid-19 - July 2020*

Figure 5: *WFH July 2020 - May 2021.*

Note 1: The respondent who answered that they worked four days at home before the pandemic stated that it was because of the customer this participant had. The customer did not require the respondent to be onsite to work therefore the respondent has answered that they worked four days a week from home.

Note 2: The respondent who did not work from home at all from the beginning of the pandemic did not participate in an interview and no metadata could tell why this individual answered this way.

Note 3: The respondent who did answer they worked from home two days in both Figure 4 and Figure 5 stated that the customer demanded onsite work some days a week.

4.1.2 Meetings

The section will provide insight on how the meeting side of things have changed from when switching to WFH compared to working in an office and what the differences are. This will help us answer RQ1 and RQ2.

When the switch to WFH happened, some participants noticed the difference is that there are more meetings when WFH now compared to when it was in the office. Some participants that worked with Scrum responded that in the beginning the structure of the meetings was not so good, but as time went on it became better and better while some created an agenda that was actually followed in certain meetings, especially in daily Scrum meetings. However, in other meetings besides daily Scrum, some participants felt like they did not know why they were there. Others say the most noticeable changes in comparison to what it is now is that there is more coffee talk in the office and remaining on the topic is easier when it is online. Everyone is usually aware that a meeting is ongoing. If someone has a meeting that finishes at a certain time, most people will have another meeting that begins at that specific time, which is respected more often now compared to before.

Even though the majority observed that some changes had been made when switching to online meetings there were also participants that felt there had been no switch in the structure and the productivity of these meetings. Lastly some respondents thought that

over online meetings it was harder to express what their thoughts were and had a hard time adapting to these new circumstances.

From the open-ended question *"In what way has meetings with client representatives been any different since before Covid-19?"* A pie-chart was created from the results in the survey to illustrate how the division between the 17 respondents in this question looked like. This is shown in Figure 6.
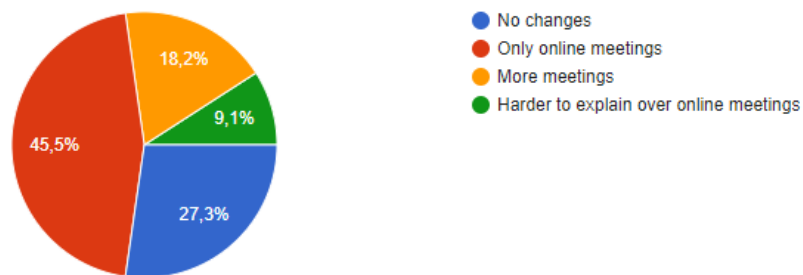

Figure 6*: Changes and meetings*

Distribution of answers: *No changes: 3/11, Only online meetings: 5/11, More meetings: 2/11, Harder to explain over online meetings: 1/11*

4.1.3 Goals

This section will provide understanding if there have been any changes in achieving team goals that have been set up by the team/teams. This will help us answer RQ2.

Even though the majority feels that it has become slightly harder to accomplish the goals of the teams, some participants feel the opposite way and argue that for software developers, WFH is ideal. This is shown in Figure 7.
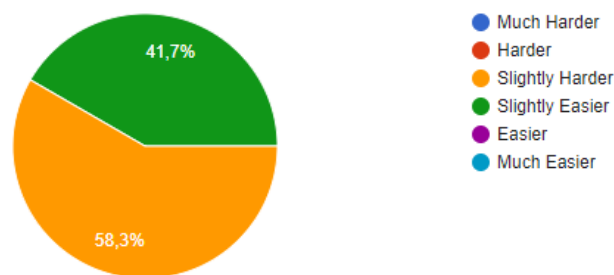

Figure 7: *Achieving team goals*

Distribution of answers: *Slightly Easier: 7/17, Slightly Harder: 10/17*

The changes from participants that thought it was harder to reach the goals that had been set up by the teams has different factors. Firstly, some participants think that working from home limits the productivity of work. Secondly, communication is a little slower, and getting an answer through either email or other video conferencing platforms (Teams, Skype, Zoom; etc.) takes somewhat longer than just asking someone in the office. Thirdly, when everybody works from home, there is a sense that things are a little more casual and that there is less regulation. There are also participants who say that they have just now started to settle in with working from home and the goals criteria that has been set by the teams. That in the beginning of the transition it was hard to fulfill the needs of the goals because of the environmental change but it has become better and better as time has gone by.

Although, one of the interviewees who was a Scrum master observed that there is less synchronization and alignment within the team and with other stakeholders. Other respondents observed that members engage more individually now compared to before.

4.1.4 Goals assessment and method

This section will present the result on changes of achieving team goals in the three methods. This will help us answer RQ1 and RQ2.

Mapping through what the participant have answered and which method they are using, following result can be presented. All five participants who works with XP feels that there has been slightly harder to achieve team goals while WFH. But participants who work with Scrum and DSDM have divided opinions about how they have achieved their team goals while WFH. This is shown in Figure 8.
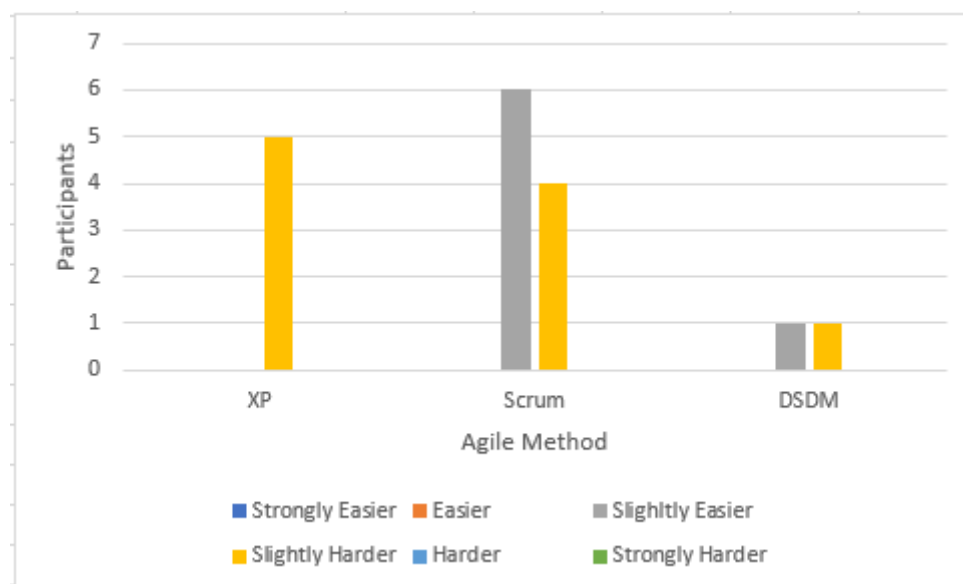

Figure 8: *Achieving team goals in different method.*

4.1.5 Work changes

This section will present the result on what the changes have been to the team/teams and for the individual work. This will help us answer RQ1 and RQ2.

The result in the survey shows that the work changes are very evenly split by the respondents. Even though a slight majority find that there have not been any major changes to their individual work or the team's work. This is presented in Figure 9.

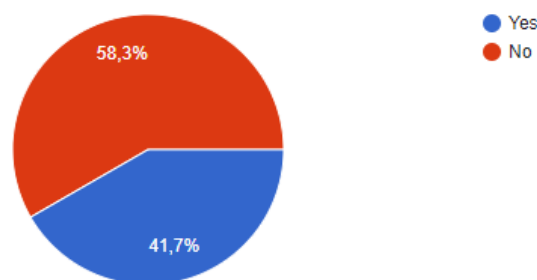Has there been any team changes or changes to your individual work?

Figure 9: *Changes in working practice.*

Distribution of answers: *Yes: 7/17, No: 10/17*

There were seven participants who have answered that there have been changes to their individual work and their team's work. Firstly, some of these participants observed that there has been less pair programming than before. This has not been the most optimal because the work that they are doing involves a lot of pair programming and this has become a difficulty while WFH. Secondly is that the transition to intro/mentoring assignments is caused by the onboarding of new team members. In addition, planning was changed to include simplified introductory activities to make onboarding new team members easier. Thirdly some respondents observed that because of retrospective, there are biweekly modifications to the workflow which were not the case before. Lastly three respondents stated that they have moved on to a different team which resulted in changes to the individual work and the team's work. This is not something that has been affected due to the switch of WFH and still would have been changed even if the work were in the office.

4.1.6 Team productivity

This section will present the result on what the productivity have been to the team performance. This will help us answer RQ1 and RQ2.

The findings in the survey shows that the majority of the people that are now WFH feels that the productivity within the team has been improved compared to before. This is shown in Figure 10.
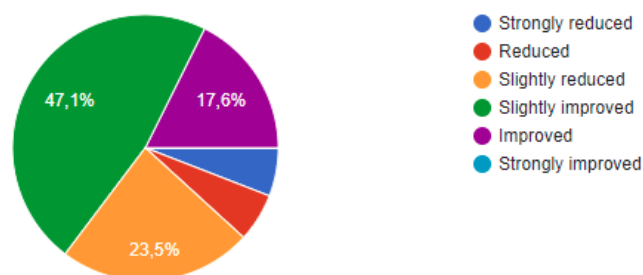

Figure 10: *Impact of Covid-19 on team's productivity.*

Distribution of answers: *Strongly reduced: 1/17, Reduced: 1/17, Slightly reduced: 4/17, Slightly improved: 8/17, Improved: 3/17*

Firstly six out of 17 respondents pointed out that some team members are more productive working from home than in an office. Secondly is that the focus is much higher when comparing WFH and pre Covid-19 in the office because of less distraction from other employees. Thirdly some respondents observed that people can plan their days in a variety of ways, and most people appreciate this flexibility. Fourthly one interviewee brought up that at their company employees can book coffee breaks together so that they still can get a non-work conversation with someone, which can be important for some people's productivity in the long run.

While some respondents were positive to the team/team's productivity there were respondents that also felt the other way around. Some respondents thought that because there was no in-person interaction it was less fun to work and this affected their productivity in a negative way. Others observed that home distractions were not ideal and this led to a lack of discipline which resulted in more time to plan out the days.

Lastly was that the communication was a lot harder than in the office, that the conferencing platforms were not reaching its potential between the workers.

4.1.7 Individual productivity

This section will present the result on what the productivity have been to the individual performance. This will help us answer RQ1 and RQ2

The findings in the survey shows that the majority of the people that are now WFH feels that the individual productivity has been improved compared to before. This is shown in Figure 11.

What impact has Covid-19 had on the productivity on your individual performance?
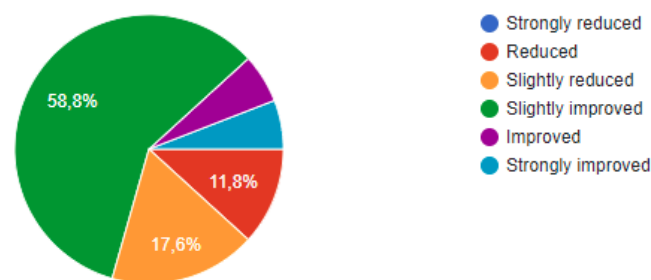

Figure 11: *Impact of Covid-19 on individual work productivity.*

Distribution of answers: *Reduced: 2/17, Slightly reduced: 3/17, Slightly improved: 10/17, Improved: 1/17, Strongly improved: 1/17*

Some respondents observed that working from home reduces distractions, which leads to an increase in productivity, and they work more than they should without intending to do so when the home has become the office. Before Covid-19, working days were over as soon as they left the office. Most of the respondents that thought their individual productivity had improved said that overall the focus in the working hours had improved immensely. That not having coffee breaks with other employees every other hour helped them in the long run to finish the assignments they had been assigned.

Two respondents that answered that their productivity had decreased addressed that they did not feel relaxed working at the same location where they spend their free time. Other respondents indicated that the disadvantages include a lack of natural collaboration and a lack of room for fast questions when they needed help.

4.1.8 Productivity assessment and roles

This section will present the result on what the productivity have been depending on if the respondent is a team leader or a developer. This will help us answer RQ1 and RQ2.

The findings in the survey shows that team leaders have divided opinions about the work in team productivity, but the majority feels that their individual productivity have been reduced. For those who are developers, the majority feels that their team and individual productivity has been improved. This is shown in Figure 12.
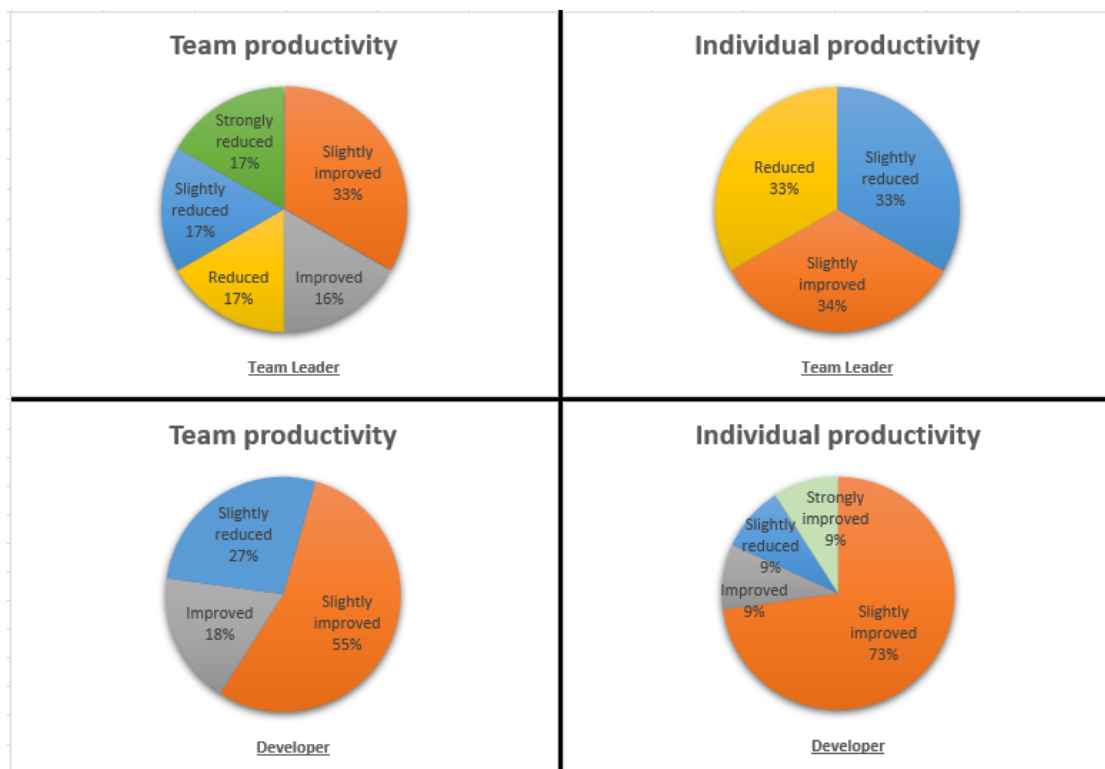
Figure 12: *Team and individual productivity depending on role.*

Distribution of answers by *Team leader*:

Team productivity: *Strongly reduced: 1/6, Reduced: 1/6, Slightly reduced: 1/6, Slightly improved: 2/6, Improved: 1/6*

Individual productivity: *Reduced: 2/6, Slightly reduced: 2/6, Slightly improved: 2/6*

Distribution of answers by *Developer*:

Team productivity: *Slightly reduced: 3/11, Slightly improved: 6/11, Improved: 2/11*

Individual productivity: *Slightly reduced: 1/11, Slightly improved: 8/11, Improved: 1/11, Strongly improved: 1/11*

4.2 The future for agile software development

In this section RQ3 will be answered and analyzed of what the future holds for agile software development teams.

- *RQ3: What does the future hold for agile software development teams?*

4.2.1 Desire of WFH

Most participants feel like they would want to continue to work the way they have done over the course of the pandemic when an office environment is established again. This is shown in Figure 13.

When the pandemic is over would you want to continue the way you worked during the pandemic?
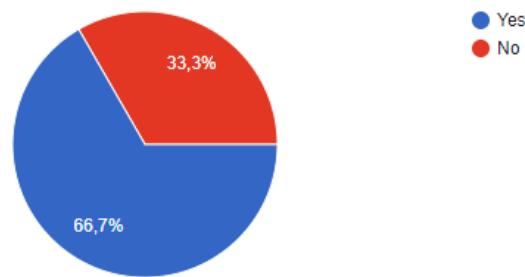
Figure 13: *Desire to continue working from home (WFH).*

Distribution of answers: *Yes: 11/17, No: 6/17*

From the interviews that were conducted the interviewees stated that they enjoy WFH so much that it is difficult to return to the workplace. One of the interviewees continued that many of the colleagues of this person feel the same way. Furthermore, a reason that the interviewee and the colleagues felt this way was because there was more freedom at home. Some complained about not interacting with other colleagues on a regular basis was a problem. But lately to able to have small chit-chats, co-workers have started to schedule coffee breaks with other employees over video conferencing platform.

4.2.2 Office at home

Some respondents also have their own setups at home, like an office where they enjoy working. As a result, this equates how colleagues perceived working from home in the past and how they perceive it now. Furthermore, both interviewees mentioned that the companies where they are working also recognizes and acknowledges the possibilities of WFH compared to before. Previously the corporate culture was that employees would not get so much work done at home. Since it is a new reality, the companies now realize the employees are doing something at home and it would be difficult to return to the old way of working fully.

4.2.3 Combining working environments

Combining work at home and at the workplace will lead to more freedom of choice where to work and the result of our study shows that many respondents enjoy that freedom. As a result of our respondents answers, the future of WFH in agile software development looks encouraging.

5. Discussion

The purpose of this research was to see how WFH due to Covid-19 has affected agile software development teams, the individuals of these teams and also what the future holds for agile software development. This was made through answering the three research questions:

- *RQ1: What are the benefits and disadvantages when applying agile software development to teams and developers working in an office?*
- *RQ2: In what ways has agile software development changed as a result of teams and individuals working from home?*
- *RQ3: What does the future hold for agile software development teams?*

5.1 Result Discussion

Reflecting over the results of the research questions, a clear advantage of communication in the office was the constant communication between coworkers which has been difficult when WFH. But at the same time some respondents say that the productivity has gone up due to less distractions from coworkers. Going forward a balance between communication and disruption must be found to get the best of both sides.

When going back to the theoretical framework and how the agile approach has worked remotely one effect was that every person is different and self-discipline is important. Looking at the results of our research the person that answered they have not noticed any major difference by WFH compared to in the office may have been more disciplined then those who answered the opposite. But there are other factors than discipline as why the respondent have answered the way they have done. Disturbance at home has been and will be a problem going into the future just because every person does not have the same prerequisites.

As brought up in section 3.3 when switching to WFH from an office environment there might be difficulties when switching if these employees have not been working remotely or at home before. In the results a respondent brought up that in the beginning of the transition it was hard to fulfill the needs of the goals that was required from the company but as time went on it became better and better.

Also, in section 3.4 it is discussed that employees can be affected negatively when they are unable to maintain an effective relationship with colleagues which has been difficult when WFH. Looking at the result several respondents brought up that their productivity has been decreased just because they do not have any interaction with other colleagues anymore. However, other respondents in a different company said that they now can book coffee breaks together with other employees to be able to have that interaction with other employees which has helped them in the productivity part.

Respondents also said that when WFH there has been less regulation and work is a little bit more casual. In section 3.4 it is brought up that WFH reduces the amount of tension the employees face and this will lead to the productivity being higher which is align with our results where the majority say that the team as well as the individual productivity has been improved.

When looking at section 3.1.1 in the theoretical framework a known limitation was that pair programming was not productive in the long run. In the results some respondents said that because of WFH their work had been affected, because it involved a lot of pair programming. Which means beforehand it was an advantage working this way. Some respondents observed that there are biweekly modifications to the workflow because of retrospective, which were not the case before making it a disadvantage in the office. When onboarding new team members, the planning has changed to simplify activities for them. The respondents that mentioned this did not say if these changes to the new members had been for the better or for the worse, a follow up question for this comment to get more information would have been ideal.

As declared in section 3.3 a disadvantage WFH or remotely is that they can struggle in online meetings which is also mentioned by the respondents of our study. That in online meetings some respondents have trouble expressing themselves compared to an face-to-face meeting.

Going forward into the future the results show that the companies recognizes the possibilities of WFH because they can see that employees actually get something done at home. This could lead to that the gap between the genders in hours worked and salaries can be decreased which is brought up in section 3.3.

Looking through the methods the participants worked with, only two participants worked with DSDM. The results would have been more reliable if there had been more respondents working with this method.

5.2 Method Discussion

Looking at the structure of the meeting questions in the survey questionnaire, they could have been clearer. Questions about how the meetings were set up and how productive these were before the switch to WFH happened would produce a much more understandable result. This way a comparison for the meetings could be set up from before the pandemic and during the pandemic. Also, assumptions were drawn that the meetings that were being held before the pandemic were at work while meetings pre Covid-19 could have been online.

Some respondents observed that there were communication problems that affected the goals that had been set up. An observation could have been made of what type of video conferencing platforms they were using that affected their work negatively. If those who were affected used the same platform or if this were the case of all of the variations of platforms that could have been used.

The outlier in section 4.1.1 (Note 2) that worked from home zero days a week when the pandemic struck needs to be addressed. There is no data as to why this participant did this and no conclusion can be drawn from that. The questionnaire should have been clearer and a follow up question in the survey where the respondent could address why they answered in a certain way would help the result. It was assumed that the respondents worked five days a week in the survey. Some individuals may have worked part time which in this case could have had an impact on the results. The other outliers in section 4.1.1 (Note 1, Note 3) were interview participants who were asked the question as to why they responded in this way, making these outliers valid and not affecting the results in a negative way.

Another aspect worth discussing is the work changes that had been made. The questionnaire could have been more informative where conclusions could be drawn if these changes were negative or positive. From there metadata with what roles and which software development method this person used could have increased the validity and reliability of the results.

When looking at the productivity part it can be looked at very individually. Just because everyone does not have the same prerequisites. While in an office environment most of the people have their own personal space making it equal for everyone. Even though the metadata showed that the productivity was different when comparing the roles, this could have been a coincidence. The majority also feels that productivity has been increased but at the same time the goals have been harder to reach. More informative questions could have been asked by the questionnaire as to how the productivity and the goals differ in the sense that the respondents answered the way they did. A conclusion could be made that the respondents think that they are more productive than they actually are.

In the interview questionnaire questions about what the cost of the project and how long a project took were very dependent on what type of customer they had. This was not an effect of WFH and Covid-19 therefore this is not brought up in the results chapter.

The questionnaire could have been different when observing what the future holds for the agile software development teams. Looking at the results most of the respondents would like to continue to WFH even if an office environment is established. This could be due to the fact that these teams were very successful under their period of time at home. If this was the fact other teams that were not as successful maybe would have answered differently.

6. Conclusions and Further Research

6.1 Conclusions

The most well-known model for efficient software development is the agile approach. But even though it is the most common, agile software development has to deal with new challenges as a result of the pandemic. The results of our study show that the majority of the participants shifted from an office environment to a working from home environment.

The participants have reported an increased number of meetings and they have also gone to a more online setting compared to before. Team goals in general have been slightly harder to reach to the extent where communication has been slower when someone needs a hand. In the office environment it is much easier to get a hold of someone because they are in the same building. The video conferencing platforms have to an extent been a problem and have failed to replace the in-office communication experience.

Productivity has been improved both from the individual perspective and the team perspective. In the WFH (working from home) context, the principal reason for improved productivity is that individuals achieve a higher focus on completing work-related tasks than in the office. The flexibility of setting up a day by themselves has also been a boost for the workers.

Due to the similarities between goals being more difficult to achieve and productivity being higher, it is possible to conclude that the respondents believe they are more efficient than they are.

Despite the negative sides of the pandemic, maybe a new and better way of work in agile software development has risen. When going to the office is not a demand but is instead an option, this can lead to more freedom of choice where to work. The results of our study clearly show that most of the respondents have been enjoying working from home and would like to continue this way going into the future.

6.2 Further Research

In this section we will discuss the follow of further research: post-Covid-19 established changes; Video conferencing; Business synchronization; Security aspect.

- *Post-Covid-19 established changes*

When observing future research one suggestion would actually be how agile software development has changed since Covid-19. Here the researchers can use our results to see if it has any similarities.

- *Video conferencing*

If any video conferencing platforms have any implications on the communication between the workers and if any conclusions from this can be drawn. In order to do that research, there are aspect that authors need to think about as follow: different platforms, increased sample size and time and change. Different platforms need to be collected from different companies that are using different video conferencing platforms. Then conclusions can be drawn to compare if different platforms works better than others.

- *Business synchronization*

Something worth looking into is how the business synchronization alignment with team members and stakeholders has worked out, see if there have been improvements or reduction to the work from before and after the pandemic started.

- *Security aspect*

Lastly, something that is not included in this research is the security aspect when people are WFH. How have they dealt with document security or other security aspects that are important for the company.

7. References

Alshenqeeti, H. (2014). Interviewing as a data collection method: A critical review. *English linguistics research 3.1*, 39-45.

Arntz, M., Sarra, B. Y., & Berlingieri, F. (2019). Working from home: Heterogeneous effects on hours worked and wages. *ZEW-Centre for European Economic Research Discussion Paper 19-015*.

Arntz, M., Sarra, B. Y., & Berlingieri, F. (2020). Working from home and Covid-19: The chances and risks for gender gaps. *Intereconomics 55.6*, 381-386.

Barriball, L. K., & While, A. (1994). Collecting data using a semi-structured interview: a discussion paper. *Journal of Advanced Nursing-Institutional Subscription 19.2*, 328-335.

Beck, K. (2000). *Extreme programming explained: embrace change.* addison-wesley professional.

Beck, K., Beedle, M., Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., . . . Thomas, D. (2001). *Manifesto for Agile Software Development.* Journal Article. Retrieved from http://www.agilemanifesto.org

Bolisani, E., Scarso, E., Ipsen, C., Kirchner, K., & Hansen, J. P. (2020). Working from home during COVID-19 pandemic: Lessons learned and issues. *Management & Marketing. Challenges for the Knowledge Society 15.1*, 458-476.

Bryman, A. (2006). Integrating quantitative and qualitative research: how is it done? *Qualitative research 6.1*, 97-113.

Caruth, G. (2013). Demystifying mixed methods research design: A review of the literature. *Online Submission 3.2*, 112-122.

Cockburn, A. (2002). Agile software development. The Agile software development series.

Cohen, D., Lindvall, M., & Costa, P. (2004). An introduction to agile methods. *Adv. Comput., 62.03*, 1-66.

da Camara, R., Marinho, M., Sampaio, S., & Cadete, S. (2020). How do Agile Software Startups deal with uncertainties by Covid-19 pandemic. *arXiv preprint arXiv:2006.13715*.

Deshpande, A., Sharp, H., Barroca, L., & Gregory, P. (2016). Remote working and collaboration in agile teams. *In: International Conference on Information Systems, 11-14 Dec 2016, Dublin, Ireland*.

Duval, E. (2001). Metadata standards: What, who & why. *Journal of universal computer science 7.7*, 591-601.

Dybå, T., & Dingsøyr, T. (2008). Empirical studies of agile software development: A systematic review. *Information and software technology 50.9-10*, 833-859.

Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative science quarterly 44.2*, 350-383.

Elo, S., & Kyngäs, H. (2008). The qualitative content analysis process. *Journal of advanced nursing 62.1*, 107-115.

Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K., & Kyngäs, H. (2014). Qualitative content analysis: A focus on trustworthiness. *SAGE open 4.1*, 2158244014522633.

Gibson, N., & O'Connor, H. (2003). A step-by-step guide to qualitative data analysis. *A journal of aboriginal and indigenous community health 1.1*, 62-90.

Hassan, S. A. (2021). *Agile Project Development Issues During COVID-19.* Lean and Agile Software Development: 5th International Conference, LASD 2021, Virtual Event, January 23, 2021: Proceedings (Vol. 408, p 59) Springer Nature.

Hsieh, H.-F., & Shannon, S. (2005). Three approaches to qualitative content analysis. *Qualitative health research 15.9*, 1277-1288.

Ilieva, S., Ivanov, P., & Stefanova, E. (2004). Analyses of an agile methodology implementation. *In Proceedings. 30th Euromicro Conference, 2004*, 326-333.

Jackson, K., & Trochim, W. M. (2002). Concept mapping as an alternative approach for the analysis of open-ended survey responses. *Organizational research methods 5.4*, 307-336.

Johnson, B., Onwuegbuzie, A., & Turner, L. (2007). Toward a definition of mixed methods research. *Journal of mixed methods research 1.2*, 112-133.

Kude, T. (2020). Agile software development teams during and after Covid-19.

Kude, T., Mithas, S., Schmidt, C., & Heinzl, A. (2019). How pair programming influences team performance: The role of backup behavior, shared mental models, and task novelty. *Information Systems Research 30.4*, 1145-1163.

Kvale, S. (2007). Analyzing interviews. *Doing interviews*, 102-120.

Lindstrom, L., & Jeffries, R. (2004). Extreme programming and agile software development methodologies. *Information systems management, 21.3*, 41-52.

Mancl, D., & Fraser, S. (2020). COVID-19's influence on the future of agile. *In International Conference on Agile Software Development*(Springer, Cham), 309-316.

Mannaro, K., Melis, M., & Marchesi, M. (2004). Empirical analysis on the satisfaction of IT employees comparing XP practices with other software development methodologies. *In International conference on extreme programming and agile processes in software engineering*, 166-174. Springer, Berlin, Heidelberg.

Martin, R., Newkirk, J., & Koss, R. (2003). *Agile Software Development, Principles, Patterns, and Practices (Vol. 2).* Upper Saddle River, NJ: Prentice Hall.

Merisalo-Rantanen, H., Tuunanen, T., & Rossi, M. (2005). Is extreme programming just old wine in new bottles: A comparison of two cases. *Journal of Database Management (JDM), 16.4*, 41-61.

Minnaar, L., & Heystek, J. (2013). Online surveys as data collection instruments in education research: A feasible option? *South African Journal of Higher Education, 27.1*, 162-183.

Petersen, K., & Wohlin, C. (2009). A comparison of issues and advantages in agile and incremental development between state of the art and an industrial case. *Journal of systems and software, 82.9*, 1479-1490.

Purwanto, A., Asbari, M., Fahlevi, M., Mufid, A., Agistiawati, E., Cahyono, Y., & Suryani, P. (2020). Impact of work from home (WFH) on Indonesian teachers performance during the Covid-19 pandemic: An exploratory study. *International Journal of Advanced Science and Technology 29.5*, 6235-6244.

Richards, K. (2013). Agile Project Management: Integrating DSDM into an Existing PRINCE2 Environment. s.l.: Best management practice-KRC.

Rover, D., Ullerich, C., Scheel, R., Wegter, J., & Whipple, C. (2014). Advantages of agile methodologies for software and product development in a capstone design project. *In 2014 IEEE Frontiers in Education Conference (FIE) Proceedings*, 1-9.

Rubin, K. (2012). *Essential Scrum: A practical guide to the most popular Agile process.* Addison-Wesley.

Schwaber, K., & Beedle, M. (2002). *Agile Software Development with Scrum* (Vol. 1). Upper Saddle River: Prentice Hall.

Sharma, S., Sarkar, D., & Gupta, D. (2012). Agile processes and methodologies: A conceptual study. *International journal on computer science and Engineering 4.5*, 892.

Sharp, H., Barroca, L., Deshpande, A., Gregory, P., & Taylor, K. (2016). Remote working in an Agile team.

Van Selma, M., & Jankowski, N. (2006). Conducting online surveys. *Quality and quantity 40.3*, 435-456.

Vetenskapsrådet. (2002). Forskningsetiska principer inom humanistisksamhällsvetenskaplig forskning. *Stockholm: Vetenskapsrådet*.