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Improving team performance working on global software development projects using agile methods

A case study of team performance in GSD, Sweden

Master's thesis in Management and Economics of Innovation

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Abstract

As globally distributed software development (GSD) is rapidly growing in recent years and in the pandemic situation that has recently happened, the topic of studying team performance of team members working on GSD cannot be much more relevant. Companies and teams all over the world face new challenges by combining distributed software development and agile methodologies due to its business benefits. In order to improve team performance working on GSD using agile methods, organizations should be able to influence every team member to proactively participate in such developments which leads to the question of what are the critical factors that influence team performance working on GSD using agile methods. Our study intends to explore existing challenges by reviewing present literature and empirically explore factors related to improving team performance by looking at what they think influences team performance in their new workways, specifically in an agile environment working on GSD.

In this paper we are to present findings on critical success factors by exploring present literature to investigate the identified success factors that improve team performance working on GSD using agile methods, for which we conduct qualitative and quantitative analysis. Using a mixed model approach, this study was divided into 3 stages namely: Literature review, survey, and interviews to further investigate the present scenario of teams working on GSD in Sweden. Our results indicate that success factors not limited to but include training teams to be self-organized, coaching agile practices, sharing adequate project knowledge and documents etc. play an imperative role in improving team performance working on GSD using agile methods. In addition, we propose a framework/model that is entirely built on the team's potential. As agile GSD is a trending topic in information and software technology, we hope to contribute to a better understanding of challenges and success factors of teams working on agile GSD.

Keywords: Team performance, Global Software Development (GSD), Agile methods, Virtual team

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1 Introduction

1.1 Background

Throughout the last decade, working in distance and with different members across the globe has become more evident and especially now when COVID-19 has struck. The COVID-19 pandemic has forced the world to embark on a work from home experiment, which turns out to be a new post pandemic reality because of its flexible/agile working lifestyle. As many traditional companies like twitter, google etc. are going to continue this style of working after the pandemic even when they have had a history of showing up at the office to work (Thomas L, 2021). Though telework/telecommuting was invented about 50 years ago, thanks to the rapid spread and implementation of new information and communications technology (ICT) has enabled distributed teams, regardless of location, to work flexibly, albeit leading to many changes in the organization (Geister S, Konradt U, & Hertel G, 2006). According to the Society of HR management (2012), approximately 66% of Multinational companies use virtual teams to operate efficiently. However, according to research conducted by CNBC in March 2021, several large companies are not willing to give-up on their large real estates and these companies will still want their employees to be in the office for a few days a week (Thomas L, 2021). Though virtual teams have other advantages such as saving expenses from travelling and office set-up, they have faced various challenges related to performance (Holmström et al., 2006). Moreover, According to Cousins K C et al. (2007), various studies on virtual teams indicate that it is difficult to gain trust if there is no prior relationship built between team members. Albeit, trust may be built over time, it is fragile and difficult to maintain virtually. Therefore, the best managerial practice for companies to hire best talents globally and organize teams to include both in-office and remote workers is that hybrid teams pose significant challenges.

Hybrid team is a working model that encompasses the concept of allowing employees to work flexibly and choose what suits them best in terms of productivity. In other words, a hybrid team is a combination of employees from office and remote providing flexibility to the employees to work from anywhere (Cousins K C, Robey, D, & Zigurs I, 2007). This simply means that some people commute to work while others work from home. As hybrid teams are going to be more and more popular by the end of the COVID-19 pandemic, employees would get to choose when and where they work depending on their personal preferences. One of the many advantages as mentioned above is adding great talents from the global market to the workforce that may not be available locally. Secondly, by selecting when and where to work, employees can decide a time when they are most productive during the day, thereby eventually improving performance of the work. Another incentive of working in hybrid teams is that work will be based on results produced rather than the number of hours spent working. However, there are some downturns for managers who are running hybrid teams. Hiring/offshoring intellectual talents to accomplish a certain common task increases the complexity of strategic flexibilities such as communication gaps, coordination, cultural and time differences. One of many other challenges is developing and maintaining agility in such distributed structures as one of the fundamental practices of adopting agile is face-to-face conversations (Dikert, 2016). The need for these distributed hybrid teams to be agile is increasing because they are being managed from a strategic focus rather than a cost focus to enhance the performance of these teams (Sarker S & Sarker S, 2009) mainly because the last couple of years agile methodology has increased its popularity among system and software development professionals. Developing a new system in an agile way brings many advantages as stakeholders are invited to review outcomes regularly and at a much earlier stage.

Currently as every business needs an online presence to reach larger audiences and provide customer accessibility, integrating software is an inevitable module of business today (Olanrewaju T et al., 2020). Most software development organizations are globalizing in order to develop software through access to larger groups of talent pools and reap maximum financial profits for both organizations and employees. This phenomenon of software development is known as global

software development (GSD) (Holmström et al, 2006). The concept of mixing distributed software development and agile methods has been relatively new for organizations looking for new methods to serve customers. As a majority of the software development organizations have adopted this concept of global software development projects (GSD) to reap various economic and financial benefits.). These software development organizations are combining agile methods and distributed software development that assist them to deliver fast and high-quality products that satisfy the requirements of customers without anticipating the challenges posed by such requirement changes to the organizational culture.

As of today, agile methodologies, like scrum, have gained a lot of attention as it allows teams to focus on delivering software development based on iterative and incremental techniques. Though these agile developments have shown improvements in developing frequent testable solutions and increasing flexibility for change during the project life cycle, there are multiple challenges in agile software development in the GSD environment which includes ineffective coordination, insufficient communication, and managerial challenges such as client-vendor requirement conflicts and cultural differences. (Khan M et al., 2021).

From a global perspective, both researchers and industry practitioners in the area of global software development (GSD) have shown keen interest in understanding the social and technological dynamics within such teams (Piccoli G, Powell A & Ives B, 2004). This master thesis project tries to contribute to ongoing research on identifying the important role of various factors ranging from sharing knowledge and building trust through communication to team empowerment and managerial control on the performance of GSD teams.

1.2 Research Topic

This master thesis project was conducted in collaboration with GoVentures AB. As a facilitator of new innovative business ideas, GoVentures AB creates and nurtures unique ideas all the way to a successful business. Using digital technology, they solve global challenges in a sustainable way considering environmental, cultural, and social values. GoVentures vision is simply to contribute to a better world.

GoVentures AB plans to launch a new set of innovative tools to be used by system development professionals for enhancing the performance and predictability of agile development projects in a distributed environment. The tools include an AI-powered planning and management tool for agile development, an infrastructure enabling efficient communications within and between development teams and with users and stakeholders.

1.3 Research Questions

In this thesis project, we will be answering the following research questions:

- **RQ1**: Which factors influence the performance of the teams working on GSD projects using agile methods and which of these factors are perceived as more critical than the others?
- **RQ2**: How do these factors influence the performance of the teams working on GSD projects using agile methods?
- **RQ3**: How could the understanding of the critical factors be used to improve team performance working on GSD projects using agile methods?

Though transforming agile practices in GSD environments could potentially lead to many challenges and viewpoints to use as many research questions as possible, we have chosen these three questions because we believe they serve the best interests of GoVentures which are likely to provide actionable and feasible insights to develop solutions.

2 Theory

The theory on which our thesis is built upon comes from two different areas of research. First, we start by focusing on research pertaining to teams since a large part of the predictability and performance in distributed agile projects relate to teams and how they work and in turn affect the performance. The second area of study was the process of agile methods since it is a part of the performance and predictability of the teams and has been proven to affect these. Another reason for choosing these two areas is to ensure that we have all the factors needed and to have a clear picture of the bridge that lies between them and how they can complement each other and to focus on what knowledge we can attain from them. Teams have challenges but so does the process of agile methods and herein we find the factors which are important to our research.

2.1 Types of teams

When considering team performance factors related to the teams, we have chosen to consider different types of teams within product development who all share similarities with each other but also where in the theory of team performance factors does not deviate depending on type of team. This approach is considered to have a broader scope of theory. We have considered different types of teams namely: Virtual teams, Hybrid teams and Distributed teams.

Virtual teams A virtual team is a team made up of members who all work in a virtual environment which is maintained by IT and software. The context here is global aka from different parts of the world and the purpose is to achieve success in the common projects they have (McConnell E, 2011)

Hybrid team: In hybrid teams the workers have the flexibility to choose where to work from and this is done to increase productivity. In other words, the hybrid team is made up of people working from office and remotely this to provide team members with flexibility to work from anywhere (Cousins K C, Robey D, & Zigurs I, 2007).

Distributed teams: The term distributed teams refer to a team where the members are all located in different locations from one another. Team members working from home, co-working spaces or even a coffee shop wherein all of them are working far from each other. For example, you can be a design leader working in Russia managing an engineer in Germany (Hertel G, Kerr N L, Scheffler M, Geister S & Messé L A, 2000)

Virtual teams are sometimes called remote teams and there is small difference between virtual teams or distributed teams but on the larger aspect they are the same. The small difference might be because of the level of technological support provided to the teams. In other words, virtual teams are distributed geographically whereas distributed teams are distributed locally in the same geographical area differing in access to better technological support (Fiol C M et al., 2005). However, virtual teams are a more commonly used name to describe these teams. Hybrid teams have a local presence as well however since the team is also working remotely, we see similarity to virtual teams. All in all, we have concluded that the general theory of either of these teams are applicable for use. However, the name of the team we have chosen to use for this study is **Hybrid teams.**

Hybrid teams are faced with multiple challenges which hinders them from performing to its full potential. Since each member of the team is limited to email, chat etc., face to face communication is not possible, it requires more planning and management tools for agile development and building a

collaborative culture. Trust is very important for a shared vision and in collaboration but also in engagement. However, due to the lack of face-to-face communication this is hard to solve since face-to-face communication creates trust (Bakken R, 2021). Some of the other challenges might be such as the decision making in the group, the effectiveness of the decisions and the time needed to make these decisions are all affected (Baltes et al., 2002; Hollingshead et al., 1995). It has also been shown that the level of work-satisfaction, cohesion of the group is lower (Baltes et al., 2002; Warkentin et al., 1997).There are also challenges regarding the process variable such as motivation and trust (Hertel et al., 2004),(Jarvenpaa et al., 1999). There are also common challenges faced by hybrid teams due to the changing work environment, implementation of new communication technology and organizational transformation have forced team members to adapt to these changes. The changes involve such things as how cooperative work is managed and how it is performed independent of time and space. There are multiple advantages for the organizations in terms of getting a hold of experienced engineers far away, providing flexibility to team members, and saving expenses by improving team performance using agile methods.

2.2 Distributed teams & global software development teams working in agile methods.

The use of agile software development has nowadays become a popular approach in creating new software systems for commercial use. The context of software engineering is also changing, taking on increased complexity and are influenced by factors such as in pursuit of cost efficiencies, improved product quality and network infrastructure and speed to market. Agile Software Development has gained significant attention due to its flexible approach to managing the requirement volatility and emphasis on extensive collaboration between customers and developers (Holmström et al, 2006). According to observation there is an increased number of GSD (global software development) project managers that are seriously considering introducing agile practices (Agile Manifesto, 2021). Since there is an increase of interest to use agile practices in GSD projects, researchers and practitioners consider it worth their time to investigate the relevant experiences reported in the different literature to understand how agile practices can be implemented effectively in GSD projects. The Investigation is only on agile practices related to software project management.

Scrum, which is an agile method, is being frequently used in GSD to leverage the benefits of the two methods. Agile methods promise benefits such as tight collaboration between people, interactions between people rather than focus on process and tools and constant delivery of product, effective communication via face-to-face interactions (F. U. 2017, April 20). However, Agile methods assume that the project context enables close communication between team members. Indeed, one of the principles behind the Agile Manifesto is that face-to-face conversation is the most efficient and effective method of sharing information in a development team (Agile Manifesto, 2021). The reason why the twelve principles of agile were not used rigorously was due to the virtual context where for example face to face conversation is not possible for teams while working in GSD (Herbsleb J D, 2007). Some of the reasons are that" GSD typically involves stakeholders located in different time zones and geographic locations, from different national and organizational cultures, using different and, at times, unreliable technologies to collaborate" (Holmstrom et al, 2006). Such time differences, geographical and socio-cultural distances can result in significant communication, coordination and managerial challenges that need to be overcome for the benefits of GSD to be realized. There are several challenges when it comes to communication when applying agile practices in a distributed team & GSD and are as follows:

1) How could daily communication be arranged effectively?
2) when having different agile practices? Which of the communication practices and media are suitable?
3) In agile methods informal communication is important but how can this be encouraged?

4) How could the risk for misunderstandings, e.g., regarding requirements, be minimized?
5) To ensure open communication in teams trust needs to be built and kept but how would this be done? (Mockus A & Herbsleb J, 2001)

Another challenge might be the cultural challenge when introducing agile methods. They can change the hierarchy since developers will be given more power in autonomy and decision making and they might not be used to it when they implement agile (Fowler M, 2004).

There is some belief from authors, “that if agile is to thrive over the next 10 years, then it not only has to work in a distributed environment, but it has to work well in order to deliver the most value to an organization” (Khan S U & Niazi M, 2012). Agile methods follow the process of iterative and incremental software engineering methods. Agile development is a lightweight software development process that provides the opportunities to manage the dynamic behavior of system development requirements (Niazi et al, 2016). GSD offers multiple advantages for both client and vendor organizations in terms of low cost, early product delivery and high-quality product (Herbsleb J D, 2007),(Holmstrom et al, 2006),(Khan S U & Niazi M, 2012) , (Paasivaara et al, 2008).

In comparison to the traditional methods used, the scrum method showed an improvement in visibility of the project activities, better stakeholder collaboration, team awareness, trust and lastly a shared understanding. Of the different challenges that GSD faced such as Coordination, communication, and managerial challenges. The studies focus was in using scrum practices to solve the GSD coordination challenges.

Limited consideration has been given to develop the framework and standards for scaling agile techniques in the GSD environment, which has resulted in the limited success of agile projects (Paasivaara M & Lassenius C, 2016). Various studies have discussed the scaling of agile process in collocated (single site) and large-scale software development contexts (Paasivaara et al, 2008), (Basavaraj M & Lassenius C, 2016). However, currently the majority of organizations are adopting the GSD paradigm (Khan et al, 2017), (Niazi et al, 2016).

Before the start of the agile process in the GSD environment it is important that there is an understanding of the critical factors since this will assist the practitioner to address key areas in the GSD environment. In addition, identified success factors from reviewing literature have also been categorized into the context of client-vendor organizations. The main reason behind the client-vendor categorization is to highlight the significance of each factor for both the client and vendor GSD organizations (Khan et al, 2017), (Niazi et al, 2016).

2.3 Team related factors that influence performance from a general perspective.

2.3.1 Motivation

The first factor found to influence team performance was motivation and has been shown to increase performance. Motivation does not only affect the individual performance but also the teams (Karau S J & Williams K D, 1993) (Karau S J & Williams K D, 2001). This supported the notion that it is an important parameter and one that we must take into consideration. When looking into motivation, it is further divided into four different areas according to the VIST model mentioned by (Hertel G, 2002).

Valence is the importance of having goals individually and as a team (Lipnack J & Stamps J, 1997). According to research, it has effects on motivation when goals are unclear. However, how much of an effect on performance is not clear. We find the research relevant and believe the study regarding the VIST model by (Hertel G, 2002) gives a better overview of motivation.

Valence is when the individual or team can see that the performance, they put in will lead to the expected outcome they expect. Here they must also prefer attaining the outcome. An example is if one wants time but gets money instead. They might not value the offer of more money (Robert et al, 2001).

There are 3 ways to look at expectancy in valence:

1) Effort→ Performance expectancy: The assessment and probability that the effort put in leads to the desired performance increase.

2) Performance→ Outcome expectancy: The assessment and probability that the successful performance will bring about the expected outcome.

3) The outcome which has been attained is valued by the person or team.

Instrumentality: Is how an individual perceives their contributions individually and to the team (Hertel et al, 2003),(Hertel et al, 2000),(Kerr N L & Bruun S E, 1983). According to studies and research it is found that how contributions are perceived by the individual affects both the motivation and performance of the individual. Clear framing of task assignment and feedback on goals but also having communicating relationships on tasks and contributions between team members increase performance however the question is how much of an increase and how much of an increase do individuals perceive it has.

Self-efficacy: The definition of self-efficiency is the perception of the capability in fulfilling tasks according to social-cognitive theory (Bandura A, 1986). According to (Staples D S, Hulland J S & Higgins C A, 1999)**.** Research has shown that perceived self-efficacy has a correlation with performance, and it can be further enhanced by feedback and training. According to (Bandura A, 1977a),(Bandura A, 1977b) the formal definition of self-efficiency is one's personal estimation of one's capabilities of executing tasks such as organizing and fulfilling goals through actions. Bandura also tried to get an understanding of the way in how one can assess the strength, generality and level of self-efficacy based on the context and activities. The level is dependent on the specific task and its difficulty. An example of this is the difficulty in spelling different words with increased difficulty. when taking a look at generality it is the capability of transferring the self-efficacy belief from one activity and to another such as drawing to painting. How is the perceived strength of self-efficacy well measured based on the certainty the individual has in performing the task. The way one measures the factors such as generality, strength and level is through a questionnaire that specifies a given task with varying difficulty but also captures the confidence degree by a measure of 0-100%. When measuring self-efficacy, the focus is on the personal qualities and not on psychological or physical. self-efficacy beliefs also differ depending on the function and domain example beliefs of biking to beliefs of lion Taming, but they are also sensitive to the context such as loud environment or silent as an example (Zimmerman B J, 2000).

Trust: Acts as a vital parameter for effective interaction in virtual teams' success. Since virtual teams work independently across time, space and organizational boundaries, team members need to trust the capabilities, motives, and skills of other members for a team to be successful. Based on trust, a member's behavior is relatively constrained which develops into interaction patterns. These patterns affect the ways members share and interpret information leading to problems related to maintaining trust. Usually when members are unfamiliar with one and other, then the potential to develop such constraints which results in conflicts and misinterpretation. Rita Mulcahy states that teams which might not be able to meet face-to-face will see side effects such as conflict, less productivity and other effects to project schedule and cost (Smal A, & Jõgeva E, 2017). In order for teams to develop and establish trust, members should value and invest in maintaining relationships with fellow team

members. Sharing sensitive information and relying on other members in times of need would be easier when trust is established. But when trust is an issue, a team member living up to his capabilities would be harder to prove. Therefore, once trust is established, then a sense of teamwork is achieved.

Trust in general is defined as the willingness to depend or rely on a process, individuals, group, or event in whom we can have confidence/faith (Clark & Payne, 1997). According to the VIST model trust can be separated into two parts: perceived trust in the electronic system and team members relating to impersonal trust. According to studies trust has been defined as an important part to successful teamwork however how does this relate to team performance and how critical is it to team performance? a way to enhance trust has been described as having informal communication such as face to face meetings.

2.3.2 Communication

As organizations are facing unprecedented change in the external environment requiring flexible structures, they are used to having teams working virtually to provide human resource flexibility and speed to complete projects in such demanding environments. Virtual teams create significant communication issues for both leaders and members of the team as they require a structure to support communication that promotes speed, nimbleness, and competitiveness. Though several organizations have found a way to turn virtual teams and agility to make use of human resources and knowledge, many organizations have not managed to use them effectively and creatively.

Communication is one of the main tools for achieving success in project managers work and it is researched that project managers spend about 75% of their work time communicating and delegating tasks to team members (Andreoni J & Justin M Rao, 2011). Albeit miscommunications and associated challenges can delay the project resulting in increasing the number of working hours spent and it is agreed that the communication aspect is one the main challenges that project members face during managing projects. Therefore, one of the prerequisites for virtual teams to be successfully implemented is that there are competent managers who understand the challenges to communicate effectively and solve communication related conflicts. The areas that this thesis aims at are types of communication problems that contribute to challenges in virtual teams.

Though there are many challenges related to communication, some of the significant challenges global distributed teams face while working with work processes has been highlighted by Suchan J & Hayzak G (2001) and they are as follows:

1) **Failure to communicate contextual information**: As all team members working virtually depend on electronic communication links such as phones, laptops, mobiles etc. to support their interaction. This makes it hard for teams to accomplish rich enough information to be transferred instead it also requires teams to over communicate to make sure complete information is conveyed.

2) **Failure to communicate information evenly**: Since the information shared among the team is through a media, the links to this media poses issues related to reliability and capability of handling numerous data transfer and other work-related activities like meetings, coaching etc. Therefore, teams located in a weak infrastructural area are prone to face problems like incomplete information required for project completion. The consequence of this challenge is followed by other challenges which make it hard for teams to interact and in turn leads to trust issues due to gaps in communication. Other communication challenges that cause failure to communicate information evenly are as follows:

- Differences in salience of information to individuals.
- Differences in speed of access to information.

Moreover, these causes of the problems also related to physical distribution of team members often working in from different locations and different time-zones, cultural diversity, communication technology used the information load and lack of language competences.

2.3.3 Leadership

The topic of leadership in managing virtual teams has discovered that leaders make a critical difference in managing a team by setting ground rules for team members. And very often said, no particular leadership style is suitably the best for a virtual team. Virtual teams are made up of members working in a cross-functional way where they have highly interdependent tasks and share responsibility for team outcomes. When deploying the virtual team in an organization it requires team-based innovation on some level to leverage and integrate the diverse expertise (e.g., organizational/functional/regional expertise) and to generate an innovative product, process, or business strategy (Malhotra et al, 2007). Global team leaders highlight the importance of knowledge in such areas as team building, conflict resolution, trust building, and coaching to build effective collaboration in global virtual teams (Binder, 2009). Virtual leaders work constantly on coming up with more creative solutions (Kayworth & Leidner, 2000). Managers on the other hand should carefully analyze how each type of issue might impact their own projects and teams and determine how best to adapt their leadership style to mitigate the potential impact of that issue.

2.3.4 Feedback

Feedback is information which is given to a team or individual and it is done so that they might use it in a positive manner to increase their performance (Earley et al, 1990),(Kluger A N, & Denisi A, 1996). There are different forms of feedback which are a part of different aspects (Balcazar et al, 1986).

First aspect

Feedback related to outcome.
Outcome feedback is information concerning performance outcomes. Process feedback is information on how to perform the work or job.

Second aspect

Feedback can be given on different levels either on team level or individual.
When it comes to team level it can either be team level feedback or individual feedback but given on a team level feedback.

The third aspect

Source of feedback
Feedback can be given by the lowest level members of the team Bottom-up or by leaders and managers Top-down or by members giving each other feedback or through a combination of all of these Multi feedback.

The fourth aspect

Is the use of feedback to either evaluate or develop reason?
It is very important to be able to differentiate the forms of feedback since the assumption of each form of feedback and mechanism leads to how feedback enhances performance.

When looking at performance increase by team-level or individual-team performance the latter showed more performance increase than the team feedback did (Burgio et al, 1990) (Goltzet al, 1989). The effects of feedback related to outcome is that it leads to an increase in effort and a domino effect on performance (Kluger A N, & DeNisi A, 1996), (Locke E A & Latham G P, 1990).

Less study has been done on Process feedback in comparison to outcome feedback (Earley et al, 1990), (McLeod P L, & Liker J K, 1992). A combination of outcome feedback and explanatory

feedback gives a higher degree of performance improvement than outcome feedback alone (Korsgaard M A, & Diddams M, 1996).

When looking at individual process feedback in comparison to process team feedback it was found to contain more information not only regarding behaviors, strategies and actions regarding to the task but also interpersonal behaviors but also teamwork and the motivation of team members motivational feedback in this case.

There is a belief that team process feedback improves task solving by enhancing interpersonal processes (Dominick P G, Reilly R R & McGourty J W, 1997).

There is a chance that team process feedback focuses the team members attention on other variables such as communication, motivation, and cooperation and in turn improving these processes and is according to Hackman crucial for team performance.

Team process feedback has been shown to promote interpersonal processes. However, it has not been confirmed if this enhances team performance (Druskat V U & Wolff S B, 1999) and (Dominick P G, Reilly R R & McGourty J W, 1997).

3 Research Methodology

3.1 Research Approach

As research approaches are decided on what needs to be answered, it is important to always refer back to the research questions mentioned in section 1.2. Referring to research questions helped us to understand what type of data is necessary for the success and quality of results. Thus, the framework used for conducting research is a mixed methods research and the nature of our study is that of an exploratory study. We chose to conduct an exploratory study not only because this study strives to explore the relevance of critical success factors with currency ways of remote working but also to find new critical success factors that improve team performance working on GSD using agile methods. As such we chose to start exploring previous data, which is made up by literature reviews to get a good understanding of the subject and basic understanding of our research questions. Once we achieved this, we started exploring the primary data and this was in 2 stages. As our research deals with both qualitative and quantitative data, we recognized that mixed method research would help us bridge the gap between qualitative and quantitative research. A mixed method as a research design would help us pragmatically describe and develop techniques that are closer to what researchers practice to evaluate and understand complex phenomena of our social world (Johnson R B & Onwuegbuzie A J, 2004). Moreover, Mixed methods are considered to strengthen the validity and reliability of data particularly when human attitudes and behaviors are involved in the research process (Abowitz D A, & Toole T M, 2010). One of the fundamental reasons to choose this research approach was because we had research questions that required both qualitative and quantitative data to be answered. Moreover, most previous research carried out in this area collected both qualitative and quantitative data to provide strong evidence to their results.

This research approach was divided into two main stages namely: data collection and data analysis. The first stage in data collection was to create a survey where the teams working on global software development using agile methods, selected by GoVentures, will answer some questions relating to RQ1. This was done to create a broader understanding of the research question by input from the GSD teams but also help us answer RQ1. The study design approach to formulate survey questions was to start by identifying primary research related to the topic. Initial searches were made using keywords such as “challenges in GSD”, “Issues faced in agile methods”, “success factors in GSD”, “GSD using agile methods”. We used these search results to identify a set of relevant papers that

match our areas of interest. Based on the preliminary search results, we selected 68 papers that seemed relevant based on the topic. We conducted interviews for the purpose of understanding the influence of critical factors on team performance working on GSD using agile methods and answering RQ2.

Lastly, the survey and the interview outcome were analyzed to finalize our findings and results from the study and further literature reviews were conducted in order to help us answer the last RQ3. The survey and interview questions will be made with the help of Fitzpatrick (2013) to create questions that pinpoint the answers to our research questions.

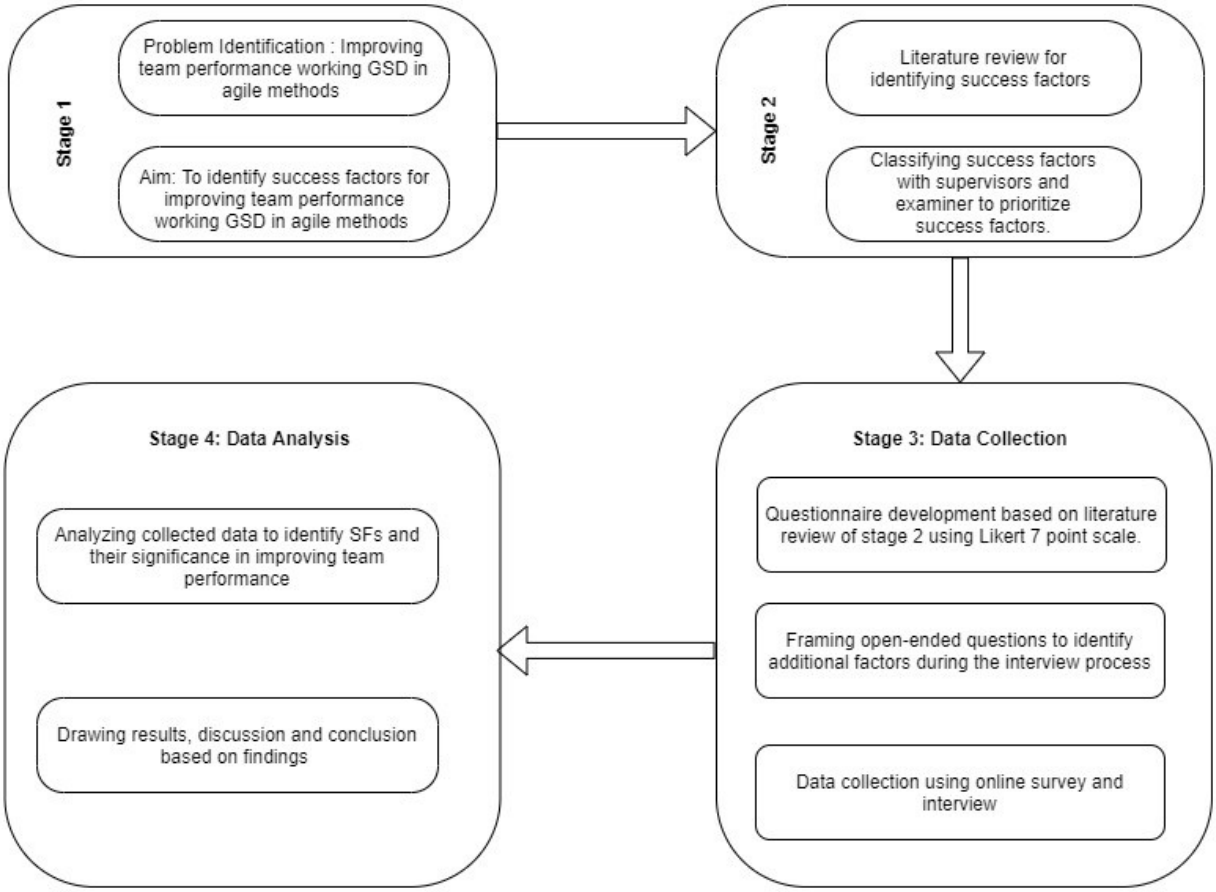

Figure 1: Schematic diagram of research approach

3.2 Survey

To create the survey, we started by researching what previous literature reviews have concluded about which factors are important but also open up for additional factors to be added by the survey participants. The shape of the survey is that of a digital google form where the participants fill in the questions through selecting and writing. An overview of the answers from the survey was made to understand the RQ1. The questions in the survey were related to RQ1 and the survey was sent out to 50 potential participants working on GSD using agile methods. We decided to conduct a questionnaire-based online survey because it offers some advantages such as:

1. It is easier to collect data from industry practitioners and freelancers located in different locations.
2. The survey can be created, distributed, and administered effectively.
3. Conducting an online survey is cost-efficient.

3.2.1 Survey creation

Based on RQ1 and the focus of the project, we defined four keywords to guide our preliminary search and collect primary data for developing fundamental understanding of the challenges and issues related to team performance working on global software developments using agile methods. The keywords used to guide our inclusion/exclusion decision are success factors in GSD, challenges in agile process in GSD, scaling agile methods in GSD, Performance management in GSD. We chose to exclude different agile practices, limitations, and benefits of agile practices in general to focus on formulating survey questions related to factors affecting team performance.

After evaluating the articles considered based on keywords, we identified factors that most frequently occurred. The idea behind identifying critical factors to answer RQ1 is primarily to find the key areas that an organization can focus to improve team performance to achieve targets and business goals. But since critical factors might differ between organizations, and individuals' perspective and experience over time, we ought to find out the most critical factor among the identified factors in the current working scenario by conducting a survey. Moreover, this survey also serves as a platform to explain the intent of the project and possibly attract participants to take part in our interviews. Moreover, we categorized the identified critical factors based on four main domains after carefully mapping, understanding, and discussing their impact on team performance with founders of GoVentures and our examiner.

We selected relevant papers based on keywords as mentioned above and refined our searches by using a tollgate approach which includes phases to include and exclude suitable papers. During the first phase, 68 articles were extracted after searching for articles using relevant keywords. The second phase of the approach was performed based on reading the introduction and conclusion of the selected papers, which resulted in shortlisting 23 articles. The final phase of the approach was based on reading the full text of the selected articles. Finally, we selected 9 articles using other quality assessments such as understandability, results, and implications to frame survey questions to answer RQ1.

The 9 articles used for creating survey is as follows:

1. Addressing Communication, Coordination and Cultural Issues in Global Software Development Projects. (Khan, M. N. A et al., 2021).

2. A fuzzy analytical hierarchy process to prioritize the success factors of requirement change management in global software development. Journal of Software: Evolution and Process. (Akbar M A et al., 2021).

3. Analytic hierarchy process-based prioritization and taxonomy of success factors for scaling agile methods in global software development. (Shameem et al., 2020).

4. Success factors influencing requirements change management process in global software development. (Akbar M A et al., 2019).

5. Systematic literature review on agile practices in global software development. Information and Software Technology. (Vallon R et al., 2018).

6. Prioritizing challenges of agile process in distributed software development environment using analytic hierarchy process. Journal of Software: Evolution and Process. (Shameem M et al., 2018).

7. Challenges and success factors for large-scale agile transformations: A systematic literature review. Journal of Systems and Software. (Dikert K et al., 2016).

8. Tools to support global software development processes: a survey. (Portillo-Rodriguez J et al., 2010)

9. The impact of agile practices on communication in software development. (Pikkarainen M et al., 2008)

3.2.2 Participant selection

After deciding on creating a questionnaire survey on google forms and identifying critical factors that affect team performance working on GSD in agile methods, we selected on how the questions will be answered and which questions required mandatory answering. Participants from various companies of various size and representing different industries all from Goventures network were approached to participate in the survey.

Participants were invited to respond to our questionnaire survey through GoVentures contacts. We had some criteria for respondents who participated in our survey, and they are as follows:

- The first selection criteria for the participants is that they must be from a GSD team that is a combination of employees from office and remote providing flexibility to the employees to work from anywhere and when they work remotely, they interact with other members by using mail, phone, or software to contact each other. (Cousins K C et al., 2007).

- The other selection criteria is that the team is a product development team which means they are made up by people tasked in developing new features or creating information systems and organizational processes. (Corporate Finance Institute, 2020).

3.2.3 Data collection

The purpose of the survey was to gather reliable information related to relevance of critical factors with regards to current ways of remote working and to find the most critical success factors among the identified critical factors from the literature review. The link to the survey as seen in Appendix C had questions about the relevance (using Likert scale) and criticality (ranking) which helped the participants to reflect on their own experiences while answering the survey. The software used to collect all data was Google forms where a short introduction was included in the beginning and questions separated into categories were made. The link to the form was sent through email with a greeting and a short introduction. Data was then stored in google docs, which was easily transferred to Microsoft Excel to further sort the data collected and visualize relevant information based on role and experience. A total of 35 participants responded to our survey. Although Bell et al. (2018) did not mention the minimum number of respondents to validate qualitative data, instead highlighted quality, and detail. Therefore, the collected data was not only used to compare and contrast with previous studies but also measure relevance and criticality of the factors that influence team performance working on GSD using agile methods in the current scenario.

3.2.4 Data analysis

When looking at the surveys and its analysis we followed the frequency analysis approach. This was done so that we would be able to analyze the collected data using the created survey and since the

survey is made of quantitative data this method is the most suitable for this purpose (Hosking J R M & Wallis J R, 2005).

The frequency in the survey was then tallied and summarized in a table so that each success factor would give a clear picture of its ranking. The classification of the responses was divided into three parts namely: Negative which includes (Strongly Disagree (SD), Moderately Disagree (MD), Slightly Disagree (D)), Positive which includes (Strongly Agree (SA), Moderately Agree (MA), Slightly Agree (A)) and lastly Neutral. Besides the Frequency analysis approach, we have also used the method of splitting the data based on roles in this case (Team member, Team leader, Manager) and experience this to get a deeper understanding of if experience and role might affect the choice of success factor for team performance and to see if there is another dimension to the analysis and if other interpretations of the data could be made.

3.3 Interview Data

RQ2 demands access to qualitative data, we conducted interviews that were more like a discussion and a reflection of their experience. The purpose of the interview is to get a deeper understanding of the factors affecting team performance. The interview was conducted in a semi-structured manner. With the help of previous research we did when reviewing literature, we created interview questions by following a semi-structured interview guide and the questions were informal. Hence the interview shape followed the suggestions from 'The mom test' by Fitzpatrick (2013). Some of the participants who shared their mail-IDs were selected from the survey and all in all we wanted to interview somewhere around 10-15 members where interviews consist of team members, team leaders and managers. This was done to ensure that we got all factors related to every level of hierarchy in the management. The first part of the interview focused on the briefing about the intent of the interview and the master thesis. An estimate of 1-2 hours was allocated for the interview depending on the availability of team members/leaders. The purpose of the interviews was to go more in depth and truly understand the experiences and problems related to team performance and answer the RQ2. Lastly, some of the questions were shaped or changed based on the reflection from the first few interviewees with the possibility of collecting even more relevant data.

Due to the recent Covid situation with no physical contact, we limited our interactions with the interviewees to virtual meetings in combination with the survey. The virtual meeting was done through either ZOOM/MICROSOFT TEAMS or phone calls.

3.3.1 Data Collection

Participants for interviews were volunteers who responded to our survey. All the participants were industry practitioners from different organizations namely: CEVT, Vector, AstraZeneca but working on GSD in agile methods. We interviewed 5 participants out of which 1 was a manager and the others were team members. The interviews were semi-structured as it increased the flexibility to ask spontaneous questions as and when interesting insights emerged during the interview process. However, the interview guide had also one last option at the end where the interviewees were asked if they have anything else they have which they consider important for the success of the team. This final question was in case we somehow missed something relevant we would be able to address it at the end. By doing it this way we were able to categorize the data in relation to the categories we have created and simplify the process of understanding and analyzing the interviews. Moreover, the semi-structured interview approach was an appropriate interview approach to collect valid information (Bell et al., 2018). All interviews differed in time, but the length of all interviews were within 60 to 90 minutes. The intended information was collected by recording the interviews over zoom and transcribing them for reliability purposes. The recorded data will be deleted after the submission of our master thesis report as promised to our interviewees.

3.3.2 Data analysis

The interviews with the participant were recorded and transcribed. This was done to ensure concrete analysis of the interviews but also for reflection purposes. The transcription was done similarly to the methods of (Campell et al., 2013) where the coding process is done in units of analysis. This method means that one identifies a portion of the text and then codes it. This is then called a unit of analysis, this captures the context and meaning of what the participant said (Campell et al., 2013). An example of this is when an interviewee says: some trust in our company is built through informal meetings online. This or part of this text can then be identified as a unit of analysis the coding then relates to Trust. An overview of the process seen below in figure 2. The reason the chosen method was used is that there are issues which could arise when a unit of analysis is not given naturally, and this creates a need for a subjective interpretation from the interviewer. Sometimes referred to as issues of Unitization (Krippendorff, 1995) an example of this can be when two interviewers want to use the same code for a paragraph or sentence but the definitions of the text to be analyzed might not be the same (Campell et al., 2013). This might create problems and in terms of reliability due to the authors meaning the same thing, but the expression might be different.

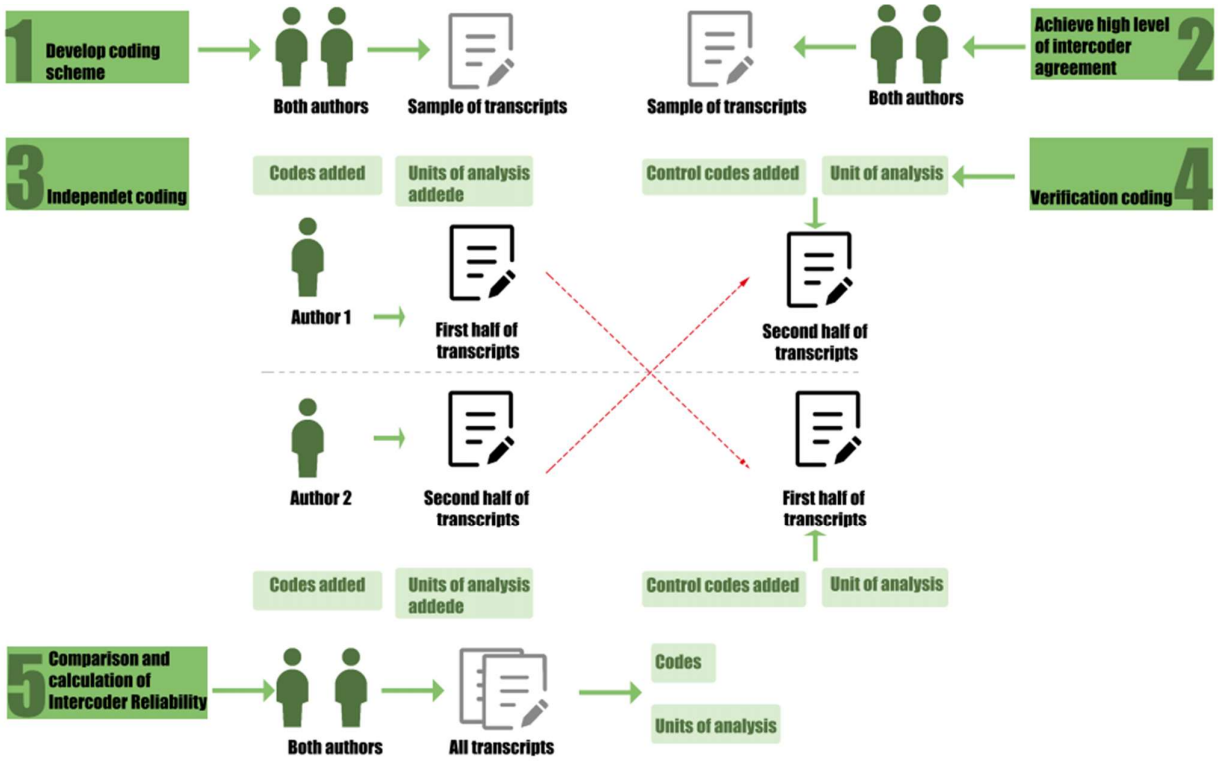

Figure 2: Interview coding process

Furthermore, all questions were formulated in such a way that it was open for the interviewees for judgment whether it was good or bad. Such as what is the preferred way of doing something in comparison to how they do it now and if they saw any challenges in their daily work relating to the factors, we provided based on the theory these were built upon. This in turn added to the analysis when combined with the survey we had for a better understanding of the factors.

4 Results

In this section we will state the result from the survey and interviews we have conducted. The focus here is to state what were the results from the survey but also what the interviews mentioned about the ranked critical factor for team performance. By answering both the RQ1 & RQ2, the identified critical factors will relate to addressing the coordination, communication and managerial challenges faced by teams working on GSD using agile methods.

4.1 Survey - Factors influencing performance in GSD teams using agile methods.

There were 2 purposes for this survey, one to find out which factors were critical, and the second purpose was to find out which of these were more important than the other factor within the same category. The results of the survey is built upon the answers from 35 respondents, of whom 19 of the 35 were Managers in a team and the other 16 were responses from team members. with experience levels based on the number of years ranging from (0-2),(3-5),(6-9) and lastly (10+). One interesting point to note is that we had no young managers in the experience level of (0-2) years.

4.1.1 Important factors

Table 1 below shows the different categories which were focused on and the 21 different factors within each category. Besides this we also see how the ratings are for the different factors where they either are Positive ((SA)Strongly Agree, (MA)Moderately Agree, (A) slightly Agree) or Negative ((SD)Strongly Disagree, (MD)Moderately Disagree, (D) Slightly Disagree) and lastly N(Neutral). Table 1 also shows the combined responses of both managers and team members, and we can already see that some of the factors have scored more than others and might be more important for team performance. Table 1 shows that all factors are important factors based on the empirical data we have collected.

When looking at Table 1 we see that a few factors stand out more than the others and this is very interesting from a result perspective. The following factors stand out from table 1 due to the large number of participants selecting it as important to a higher degree within each category. The factors standing out from table 1:

- Training to strengthen trust.
- Training teams to be self-organized.
- continuous knowledge sharing.
- open to improve based on feedback.
- proper communication tools.
- sharing project knowledge and documents.
- agile process training and awareness

CF No	Critical factors and its categories	Positive			Negative			Neutral
		SA	MA	A	SD	MD	D	
Category 1: Management related CFs		Responses from 35 participants						
CF1	managing cultural differences	8	5	14	0	1	1	6
CF2	training to strengthen trust	11	16	6	0	0	0	2
CF3	continuous organizational support	9	9	8	0	0	1	8
CF4	Client-vendor relationship	11	6	9	0	3	0	6
CF5	training teams to be self-organized	13	13	8	0	0	0	1
CF6	Agile process training and awareness building	12	16	4	0	0	1	2
Category 2: Team- related CFs								
CF7	Continuous knowledge sharing	28	6	1	0	0	0	0
CF8	Having experienced software developer	13	11	8	0	1	1	1
CF9	Ability to self-organize	16	10	8	0	0	0	1
CF10	Defined role and responsibility	6	12	9	0	3	1	4
CF11	High level trust	22	11	1	0	0	0	1
CF12	Open to improve based on feedback	26	6	2	0	0	1	0
CF13	Utilize cultural differences	1	9	13	1	3	0	8
Category 3: Technology related CFs								
CF14	Proper communication software tool	20	9	5	0	0	1	0
CF15	Easy tracking of activities	11	15	7	0	0	1	1
CF16	Sharing project knowledge and documents	20	8	6	0	0	0	1
CF17	Frequent customer involvement	12	11	5	0	2	2	2
Category 4: Process related CFs								
CF18	Well defined project scope and requirement	18	9	4	1	0	1	2
CF19	Sufficient project documents	8	14	9	0	0	2	2
CF20	Continuous agile coaching	9	8	9	0	0	3	6
CF21	Frequent customer feedback	8	12	8	1	0	1	5

Table 1: Identified CFs in the questionnaire survey based on responses.

4.1.2 Ranking

To be able to focus more on the results we also looked at how the participants have ranked the factors. The participants ranking them makes it easier for us to choose the top 3 factors in each category to dive deeper into. When looking at the result from the ranking we see that the initial results we have from table 1 are found here but also some which were not that explicit in table 1. Table 2 shows the most important factors for team performance based on responses from participants.

CF No	Critical factors and its categories	Rank 1	Rank 2	Rank 3
Category 1: Management related CFs		Responses from 35 participants		
CF3	continuous organizational support	11	3	4
CF5	training teams to be self-organized	4	13	13
CF6	Agile process training and awareness building	5	4	13
Category 2: Team- related CFs				
CF7	Continuous knowledge sharing	13	7	5
CF9	Ability to self-organize	1	10	9
CF11	High level trust	8	8	8
Category 3: Technology related CFs				
CF14	Proper communication software tool	12	5	9
CF16	Sharing project knowledge and documents	6	13	9
CF15	Easy tracking of activities	11	10	10
Category 4: Process related CFs				
CF18	Well defined project scope and requirement	21	1	5
CF19	Sufficient project documents	5	15	9
CF20	Continuous agile coaching	6	7	11

Table 2: Prioritizing of critical factors that influence team performance

4.2 Role and experience

When splitting the data based on role and experience, we found some interesting results. We see that Managers & Team members have chosen some factors differently because of their role and experience. Table 3 shows the final ranking of each factor within their respective category, and this was done by evaluating the number of responses each factor had on the ranking in table 2.

CF No	Critical factors and its categories	Managers	Team members
Category 1: Management related CFs		Responses from 35 participants	
CF3	continuous organizational support	Rank 1	Rank 2
CF5	training teams to be self-organized	Rank 2	Rank 1
CF6	Agile process training and awareness building	Rank3	Rank 3
Category 2: Team- related CFs			
CF7	Continuous knowledge sharing	Rank 1	Rank 1
CF9	Ability to self-organize	Rank 3	Rank 3
CF11	High level trust	Rank 2	Rank 2
Category 3: Technology related CFs			
CF14	Proper communication software tool	Rank 3	Rank 1
CF16	Sharing project knowledge and documents	Rank 1	Rank 3
CF15	Easy tracking of activities	Rank 2	Rank 2
Category 4: Process related CFs			
CF18	Well defined project scope and requirement	Rank 1	Rank 1
CF19	Sufficient project documents	Rank 2	Rank 2
CF20	Continuous agile coaching	Rank 3	Rank 3

Table 3: Prioritizing of critical factors that influence team performance by Managers & Team members

We also see that when doing a comparison in Table 3 for managers & team members we see that some factors which are ranked higher by team members are ranked lower by managers. We also see that some factors within the categories are ranked the same such as Category 2 team related factors and category 4 Process related factors. However the following factors are not ranked the same.

In category 1 (Management related factors), we can see that continuous organizational support is ranked higher than the manager when compared to team members' rankings. Whereas training teams to be self-organized was ranked higher by team members when compared to managers' rankings.

In category 3 (Technology related factors) proper communication tools. When looking at proper communication tools we see that here the managers have ranked it as a 3 where team members on the other hand have ranked it as a 1. The same can be said about Sharing project knowledge and documents where managers have ranked it as a 3 but team members have ranked it as 1.

The charts in **Appendix A** also show how managers and team members with different experiences have rated the 12 factors.

4.3 Interview results

Our interviews with our interviewees made it explicit that ranked factors are absolutely crucial for improved team performance. When we asked questions related to some of the ranking factors like "Continuous organizational support in software development", "Training teams to be self-organized", "Provide agile process training and awareness within the team" and "Well defined project scope and requirement", we noticed that the above-mentioned factors were interrelated to one another. Transcribing comments from interviews helped us understand the dependency of factors on each

other. For example: the level of trust between team members influenced the way they communicated. Therefore, based on the conducted interviews, the below mentioned are considered to be the most important factors that influence and improve team performance working on GSD in agile methods.

4.3.1 Educating managers to practice agile processes virtually

Managers seem to play a significant role in making a team perform up to its optimal level as they have the authority and power to encourage team members to adopt new ways of remote working. Results from interviews highlighted the need to educate management on agile practices. Right education on agile ensured that managers still saw employees as people working for the organization to achieve set reasonable objectives rather than overcompensating remote workers with unrealistic expectations. Training also helped managers to implement consistent agile practices across the organizations that can be visible and improved over time. Moreover, as mentioned by one of the interviewees, training will educate managers to evaluate team performance of remote workers differently from the way they assess while working in a collocated place.

4.3.2 Organizational support in improving team performance

Organizational support is important when facilitating the needs of the teams and the processes the teams need to solve the right challenges that hinder their team performance. As one of the interviewees said, “Sometimes problems might not be due to agile approaches but rather because of following old ways of working”, collaborative and supportive ways of working have constantly been challenged. Teams face problems related to such transformation. Consequently, teams are demoralized and demotivated when facing these challenges. Large changes in ways of working such as completely switching to a digitized workplace requires organizational support. Management commitment described by one of our interviewees is paying a lot of attention to the chosen agile practices and constantly assessing the practices work. However, expectations should be clearly communicated to the teams and assuring the teams that change is the right thing to do.

4.3.3 Training teams to be self-organized

When asked in the interviews all of the interviewees agreed that being self-organized is important and it gives somewhat freedom to the team members in choosing what work they can do. Moreover, agile principles of allowing teams to be self-organized helped teams to create and develop their own ways of working to improve their speed and quality of work. When asked if the interviewees felt that they could decide what work they could choose to do one of them said “yeah sometimes I can focus on one thing I find more important or interesting”. This indicates that there is some freedom in choosing their own task, but it also shifts depending on the work and sudden changes within the organization and requirements from the customers. However, not all interviewees were aware of the freedom to choose tasks because they pretty much felt like doing the same thing every time or the same old project.

4.3.4 Trust

Being ranked as the second most important within its category, trust affects the interaction between team members and as such this was not unexpected and when asking the interviewees, they all said that when trust was lacking, it affected their engagement and motivation to improve team performance. When asked if they have a solution on how to improve the team performance, one participant suggested that one solution to enhancing trust would be to “On the after work we typically play some online games and compete to get to learn from each other in different ways and I think that is a good way of building trust.”

4.3.5 Communication & transparency

Intensive communication was emphasized many times to be one of the most critical SF by a number of studies. It was seen to be important that communicating to every team member and keeping everyone updated helped every team member to be proactive about their activities related to the project. It was also recommended that working in an agile way has made communication highly visible on many communication channels and even over-communicated. One of interviewees summarizes the viewpoint on over-communication: “Repeat your communication through mail after a meeting to be sure that your teams understand a new method or process”.

Workshops, coaching sessions, and online discussions are examples of different communication formats suggested by our interviews to improve communication, trust, and transparency. Daily scrum meetings of 15 minutes were scheduled everyday with the scrum master just to discuss problems and stumbling blocks faced by team members while working on the project. Problems not necessarily related to work, were also addressed to just build a sense of concern among the team. Another approach in communicating the new way of working was that managers explained and encouraged agile ways of remote working in an extensive series of one-on-one discussions. A manager particularly used these sessions to evaluate the personality aspects of team members as it was seen to be a key aspect for achieving effective communication and collaboration during agile ways of working remotely. Few team members explicitly mentioned the need for a clear message of expectations as it helped remove confusion and made teams understand the purpose that was served.

Enabling transparency during communicating was reported to be important and even highlighted as a critical parameter for success of communication. Interviewees repeatedly mentioned that bias to sharing information with everyone was critical in their ability to adapt on a daily basis to ensure their success in a team. Transparency in some companies was achieved by sharing both successes and challenges, actively reflecting on the feedback, using project management tools to display project status publicly, and by holding meetings to introduce new team members as and when they joined. By sharing experiences and status of each team members’ performance, the organization made sure that everyone was moving in the same direction.

Creating and communicating positive experiences in the beginning highlighted that the agile ways of remote working spread effectively through positive word-of-mouth. Following agile methods assisted by making any benefits publicly visible and celebrating even the small victories made it easier for the management to appreciate team success and efforts. When good results were shown by a team it created interest in others, and enthusiasm to try the new way of working that could be adapted.

4.3.6 Communication tools

When looking at the ranking we see that communication tools are ranked very high. However, this is not an unexpected ranking since the nature of the work done by the interviewees is to be done online and far from each other. We see that having tools that solves the issue of being far from each other is an important Success factor for team performance. When doing the interviews some participants were satisfied with their tool set and thought that there was not much improvement to be made as one mentioned he said that they had all the tools needed and started reciting tools such as Microsoft teams, Jira, SharePoint etc. However, another participant said that Jira was good, however complicated. However, it was also noted that the level in which they were working was different where one was using all the features of the tool and the other used limited features. There were also some differences to the tools needed depending on the work being done. The result from the survey and the interviews shows that awareness of the environment and the work being done is critical for communication tools to enhance the team performance because adequate tools might not cover all the areas needed for the increase in team performance.

4.3.7 Agile mindset & coaching

When teams understood agile values, they also understood how agile practices influenced their performance and felt motivated. Some responses indicated that experienced coaches and scrum masters being a part of the team made a huge difference in practicing agile methods seamlessly. Many interviewees expressed their need for social events as it would benefit the adoption by helping to build an agile mindset. A few interviewees even described the transformation being driven by a series of events where team members received information and had the possibility to contribute to shaping the new way of working. One interviewee described how the corporate agile awareness and teaching event was designed to be fun and engaging, which made people more enthusiastic in applying the agile practices. Various social activities were recommended as valuable tools for improving bonding within teams. Though there were of personal preference, the importance of creating personal bonding was highly anticipated for teams to work harmoniously to be an effective team.

5 Discussion

In this section all of our findings from the survey and interviews are put in relation to the theories relating to team performance and agile practices. First part of the discussion focuses on the results and the theory relating to the results which intends to address RQ1 and RQ2. While trying to answer RQ1 and RQ2, we also consider the relevance of the factors in regard to the current scenario and the criticality of the factors to evaluate their importance. The second part of the discussion will focus on addressing the challenges, namely: communication, coordination, and managerial challenges, faced by industry practitioners by contributing to the existing theory and finding practical implications to improve team performance working on GSD using agile methods and in turn answer RQ3. Below are the stated research questions we intend to answer:

- **RQ1**: Which factors influence the performance of the teams working on GSD projects using agile methods and which of these factors are perceived as more critical than the others?
- **RQ2**: How do these factors influence the performance of the teams working on GSD projects using agile methods?
- **RQ3**: How could the understanding of the critical factors be used to improve team performance working on GSD projects using agile methods?

5.1 Assessment of critical factors

As mentioned before, studies within virtual/distributed/hybrid teams and agile methods have not been sufficient to understand which factors are critical for influencing team performance in GSD working with agile methods but also how these influences the work. Therefore, the study was performed to explore what these critical factors might be and their implications on the work done.

5.1.1 What is critical when influencing team performance in GSD teams using agile methods ?

The findings in this thesis show that the 21 factors which we had in the beginning of our research were important factors however these factors were not all critical according to the rating and this resulted in 12 critical factors of which were the most important ones. We also found out that the factors not among the 12 are not considered important by the participants but the degree to which the participants feel they have an impact on team performance is less than the 12 critical factors. Furthermore, the participants selected some factors also in preference to what their current role and experience was; younger participants selected factors to which they believe they and the team might

need to increase team performance and similarly for more experienced ones with other roles. It is shown that role and experience are very important in choosing factors and that being able to prepare a setting to where role and experience are accounted for might actually be a very good means of combating the lack of team performance due to role or experience. We also found that some critical factors have relations to one another such as the ability to self-organize and training teams to be self-organized from table 2 even if they are in different categories.

Based on our understanding, one needs to have a complete understanding of the environment to be aware of all the critical factors needed to improve team performance. The combination of the two different areas such as GSD and agile yielded all critical factors and that some factors are interrelated to some extent. we see that understanding the interrelation might actually be important to know more about the factors importance and role in being a critical factor. We also see that an understanding of the environment is important when looking for factors and might yield different factors depending on the environment such as GSD with agile has yielded these factors.

Our result findings indicate that not all factors have the same criticality, importance, or degree. This is interesting since this proves that not all participants have the same needs. These needs change depending on the role one has and also the level of experience affects the degree to what the participant believes to be critical related to challenges such as communication, coordination, and management. For the team performance in a GSD environment using agile methods, the survey results showed where some are rated more critical than others and that the theory is not sufficient enough to explain the degree of criticality the participant believes it to have.

5.1.2 How do these factors influence the performance of the teams working on GSD projects using agile methods?

To deepen our understanding about critical factors and their influencing on team performance in GSD teams using agile methods. We start by looking at the results and combine our result with the theory to try and get a better understanding of the critical factors and research question 2.

5.1.2.1 supporting agile process

Organizational support is critical and sometimes problems are not always known and might appear as something else in this case having organizational support becomes important. Furthermore, to facilitate all of the activities needed for an effective team and to make the team performance work at a higher level it is important that the organization supports the team. The importance of global leaders in this setting is crucial for team performance. When deploying the virtual team in an organization it requires team-based innovation on some level to leverage and integrate the diverse expertise (e.g., organizational/functional/regional expertise). Highlighting the needs of the teams is another area which is very crucial since the needs of the individuals affect the needs of the teams hence it requires organizations focus on what type of needs there are for the teams. Global team leaders highlight the importance of knowledge in such areas as team building, conflict resolution, trust building, and coaching to build effective collaboration in global virtual teams (Binder, 2009). Management commitment in supporting the team is very important but also informing the teams on what is to change and how so that correct support is given, and the right issues are solved. This in turn paves the road for a successful team. Furthermore, agile methods should be taught and followed up by scrum masters and managers should help establish the agile practices. These practices however are ideal when working at a physical location. However, when looking at working on distance we see that even if the methods are followed problems arise which affect the agile work ways. An understanding of both agile in combination with work on distance is needed from managers to be able to implement it correctly. This is shown by one of the participants who mentions a lack of understanding of agile and work on distance by managers. Theory deepened our understanding that the need for agile methods is true however the degree to which some parts of agile works need further engagement such as engagement from managers and the aspects of communication related to agile. Interviews

highlighted the need to educate management on agile practices. Right education on agile ensured that managers still saw employees as people working for the organization to achieve set reasonable objectives rather than overcompensating remote workers with unrealistic expectations. One of the interviewees also mentioned training will educate managers to evaluate team performance of remote workers differently from the way they assess while working in a collocated place.

Agile methods promise benefits of handling requirements changes throughout the development lifecycle; extensive collaboration between customers and developers; and early and frequent delivery of products (Abrahamsson et al, 2002). However, the challenges are not so much the agile method in itself but the implementation of the agile method. This is expressed in the interviews where some stated that having a scrum master would give motivation and influence their work while others also stated that having social events would benefit adoption of agile but also build the mindset. We see here that it is not enough with the methods being available but a follow up ensuring the implementation with a good mindset and presence of agile coaches are critical for increasing team performance using agile.

5.1.2.2 Trust teams to be self-organized

Being self-organized means being able to make some decisions but also take ownership of the work one does and evolve with the work. Self-efficacy is when one believes that one is capable of doing the work one is motivated and this in turn increases team performance (Bandura A, 1977a), (Bandura A, 1977b). One interviewee mentioned how he was able to switch to something he found more interesting to work with and that this affected his motivation. Being able to self-organize in turn affects self-efficacy since both of this affect team performance. Having more decision making and change in the work one intends to do helps with improving the performance of the team since the team members can support one another in evolving tasks but also can get the benefit of a motivational task. Self-efficacy and self-organization tie well in with one another and the interviewees mention that they would prefer some decision making and change in the tasks they were given. Theory states that trust affects the team performance however it is not mentioned on how one should build trust when working virtually. Furthermore, Rita Mulcahy states that teams which might not be able to meet face-to-face will see side effects such as conflict, less productivity and other effects to project schedule and cost (Smal A & Jõgeva E, 2017). This might be true however we also see that there is proof from participants that there are solutions which might prevent the side effects Rita mentions. What also affects self-organized teams is trust and for teams to build trust they need to invest in their relationships with other members and not only have meetings about work. One interviewee mentioned that to build trust one can only be talking about work or doing work related activities to build trust, but one might do activities like playing games where they compete and learn about one another in a different setting. This shows that to build trust when working remotely we must embrace other methods and activities which will help build trust even when one is not able to meet face to face.

5.1.2.3 Communication

Communication is an important factor according to theory and Communication is one of the main tools for achieving success in project managers work and it is researched that project managers spend about 75% of their work time communicating and delegating tasks to team members (Andreoni J & Justin M Rao, 2011). A lot of the theory talks about issues in how to handle sharing information and how to effectively communicate this information and according to the interview it is true that the theory holds. For example, we have the following challenges from theory: Failure to communicate contextual information, Failure to communicate information evenly, Differences in salience of information to individuals, Differences in speed of access to information these are all confirmed through the interviews. However, we also emphasized on the notion of repetition and the quality in which information is spread through the organization in a virtual environment. The reason for this is that during our interviews we found out that this is a good way of ensuring that the team knows what has been said during the meeting and do not miss vital information. But it is also a way of repeating what

has already been said in other words over-communication. Lastly, we have the idea of Transparency to which the theory does not focus on according to the interviews. Interviewees repeatedly mentioned that bias to sharing information with everyone was critical in their ability to adapt on a daily basis to ensure their success in a team. This shows that there are more elements to which communication must be evaluated for greater team performance. A suggestion on how to approach the problem was achieved by sharing both successes and challenges, actively reflecting on the feedback, using project management tools to display project status publicly, and by holding meetings to introduce new team members as and when they joined. Furthermore, we have the tools used for communication which shows that yes communication is important but so are the tools we might need to facilitate the communication and that focus of theory should in some way support this area as well and show in what way we should evaluate the tools. First the degree to which a tool works affects the team performance when it comes to communication. but another participant also mentioned that sometimes the complexity of the tools might hinder in its usages and decrease team performance. Lastly, we also have the area of the tools usage which might also be needed for consideration since the environment might change and different parts of the tool might be more important. All in all theory supports the notion of tools being needed however participants from the interview show that there is a balance needed between area of effect, complexity and function of tools when considering tools for communication.

5.2 Contribution

This study contributes to the topics of managing GSD using agile methods in two ways. Firstly, the result of this study contributes to previous studies by further investigating and highlighting certain critical factors that influence team performance working on GSD using agile methods. For example: Training teams to be self-organized, communication tools and custom agile principles. Secondly, Agile methods which seem to have problems with communication, coordination and managerial problems that are associated with GSD are addressed (Dikert et al., 2016) by suggesting a model that could potentially be used to adopt business agility in GSD teams based on team's potential. Additionally, this part of the section will be answering RQ3 "How could the understanding of the critical factors be used to improve team performance working on GSD projects using agile methods?"

5.2.1 Theoretical Contribution

This study adds to existing studies within success factors influencing team performance working on GSD using agile methods such as Dikert K, Paasivaara M, & Lassenius C (2016), Moe N B, & Šmite D (2008) and Holmström et al (2006) by studying the challenges and issues faced by teams working on GSD using agile methods.

The indication that certain critical factors play an important part in improving team performance working on GSD using agile methods add to support previous studies such as (Dikert et al, 2016) and (Vallon el at., 2018) which found out critical factors like communication, management support etc. that improve team performance working on GSD using agile methods. However this study also indicates that these critical factors are still important in a hybrid team setting i.e. teams located locally even after eliminating geographical and temporal challenges. Communication being one of the most important factors that influences collaboration and coordination would also be in-line with previous empirical studies that causes communication issues in GSD (Rashid N, & Khan S U, 2018). For instance, a study by (Minssen H, 2006) emphasizes the demand for communication to challenge coordination issues of team working.

In accordance with the literature in this field, we have found that team performance is primarily driven by a common purpose of developing software based on the demands of the customer. While (Dikert et al., 2016) focuses on scaling agile practices in GSD, our study focuses on problems faced while teams working on GSD using agile methods. An interesting aspect found to be true is that challenges faced while working in agile methods were the same and the success factors such as maintaining

good control over communication and other related factors that influenced the team performance were complex.

While considering GSD using agile methods, most articles consider challenges related to temporal distances. In the article by Holmström et al (2006), one major disadvantage of being separated by temporal distances is that the number of overlapping hours is reduced, and the result is bringing a feeling of being felt out and lagging behind which makes people unmotivated (Holmström et al., 2006). Whereas our study did not include examining temporal distance as we were confined to one particular time zone. We found out that teams working from the same time zone often were willing to meet their teammates to get along and build strong relationships. This highlighted the need for socializing even in improving team performance as we humans always tend to feel so generally. Introducing virtual parties and team building activities seems to play a big part in building a team to improve their performance while working in agile ways.

Furthermore, as mentioned above, what is also interesting to see is that critical factors relating to agile methods have a lower importance than the critical factor relating to team factors as stated in the theory for teams. Firstly, team members mentioned that there is a need for managers to train the team to be self-organized. One of the approaches mentioned in section 5.1.2.1 could be where managers can teach teams to self-reflect on themselves by setting goals periodically, and receiving feedback based on their performance. However, managers helping teams to be self-organized can transfer the responsibility of making consensus-based decision making to the team members which would strengthen their collaborative skills. This can possibly be one of the most significant critical factors to improve team performance working on GSD using agile methods. Secondly, agile practices mentions that close collaboration with customers and customer inclusion throughout the software development is one of the important principles in GSD. But our results indicate that this aspect is not very crucial for improving team performance. Since customers/clients happen to be located in the geographical area and eliminate temporal differences, this factor of setting developer- customer requirement and developing close collaboration is no longer a critical factor to improve team performance working on GSD using agile methods. Thirdly, our study indicates that role and experience plays a crucial role in evaluating criticality of factors affecting team performance. We identified that as team members gain experience or shift roles, they perceive factors to differ in terms of criticality.

5.2.2 Practical Contribution - Introducing custom agile methods suitable to the team's potential.

As mentioned previously by Holmström et al (2006), having agile software development frameworks like scrum, XP etc. usually designed for a small group who are physically collocated that has evidenced considerable success seems to be a suitable approach to study team performance in GSD. Moreover, interview results helped us understand the need for a system for teams to over-communicate and strengthen coordination and trust by understanding each other's capabilities. Considering having a model that can help teams based on their requirement, we propose a framework for agile software development in GSD that comprises three domains, namely: Humans, Technology, and Information in relation to have previously highlighted GSD challenges such as communication, coordination, and management. The framework includes 3 key concepts that shape the way teams work in an effective manner. The 3 key concepts are as follows:

1) **Shared Management System:** A system that can be commonly shared by everyone involved (i.e., team members, team manager/leader and customers) in the project. This system would help everyone track, share, and access every information required for project completion. This would also help create specific plans and strategies related to executing a particular project. This system would help humans to use technology for sharing information to address GSD challenges. When we asked our interviewees to provide a list of the best practices that can be implemented, using a single

software tool that would make it easier to address all the above-mentioned GSD challenges was prioritized. Some features that a software tool should address is as follows:

- Communication: Working on GSD projects often has several hurdles in communicating. Reminding ourselves that face-to-face communication is the best communication medium. But since this is completely eliminated, software tools should provide features that help team members mutually share informal information to keep others informed about their status. As organizations considered to be innovative and creative, require members to be collaborative and supportive in such dynamic and complex environments.

- Knowledge management: Software development teams usually produce a significant amount of knowledge in their daily work hours. Software tools that can help developers share every important knowledge produced to support and stimulate creative activities and tackle problems knowledge sharing and management is highly valued.

- Tracking and coordination: Tracking features that allow to track list of activities and events that are important for developing software to know the criticality of the development process is often anticipated by team members. However, there are many other tracking types depending on importance to what to track. For example: Certain projects need to track bugs to test software functionality. Therefore, tools that support coordination and tracking would help improve team performance in GSD.

2) **Cultural orientation:** As cultural differences between team members bring in a complex dimension of challenges such as attitude towards hierarchy, motivation, sense of time, need for structure, work ethics, communication styles and interpretation of information (Holmström et al, 2006). These issues often lead to confusion making it hard for teams to collaborate and share a sense of working towards a common goal. Therefore, having management-orientated cultural sessions, where in all these cultural issues are discussed, could help team members be aware of their role to strengthen or weaken the team performance and be aware of their role in serving the purpose in the organization. Being conscious and mindful about such issues and constantly working towards resolving them along with team members would help teams to build a sense of trust (Conchúir et al, 2009). Management teaching teams to work on improving themselves and training them to be self-organized to tackle such challenges would help every team member to consciously engage in the consensus decision-making process. Moreover, in this approach, teams would not be hesitant to take the lead and make mistakes. Teams would develop a sense of belongingness where every team member knows every other team member's strength and capabilities, improving their performance and maintaining a healthy work-life balance.

3) **Agile philosophy:** Agile philosophy according to agile software manifesto (Beck et al, 2001) says, “Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done” (Beck et al, 2001). Such agile practices have highlighted the importance of incorporating a mindset of being adaptive to any given situation rather than prescribing an exact way of working. There were a number of comments from the interviews mentioning the benefits of coaching teams to apply agile methods in practice. Agile coaching helps teams to focus on understanding the principles of agile software manifesto helping team members to reflect on their own actions while working in a project. As agile practices are mostly iterative and learnt better by doing, teams should soon focus on building a great remote team culture of their own that includes agile ways of working. One way of finding a great team culture that fits every team members’ way of working is to build team activities that increase communication, engagement, and motivation.

Communication is an essential part of software development; it has become even more critical in GSD as communication has changed from the ideal face-to-face conversation. Socializing remotely is seen to be a necessity, no matter if it is a manager, new team member or team leader, everyone can play an important part engaging team members in bringing some laughter and joy to meetings

through some fun activities. Playing some online games that need creative involvement or talking about personal experiences about a common task (for example: attending lectures from home for a year now) might create a sense of connection and find common grounds of interest. According to research conducted by workplace expert Jennifer Moss, the easiest way to infuse joy and happiness into your daily work life is by spending 1/6th of your meeting time on relationship-building. Showing care and concern about others well-being improves engagement as it appreciates and acknowledges one's time spent together.

6 Reflections on methodology

Our research has yielded some insights regarding critical factors in an agile GSD set-up that can be used by employers for practical implications. As many employers are likely to think of shifting to remote work, employees and managers have to deal with such a paradigm shift to hybrid work schedules, where some people will be in the office while others work remotely. Educating managers ahead of this to take care of the situation and motivate employees to stay engaged towards achieving designated goals seems to be a necessity. Based on a survey conducted by Cognizant center for the future of work (CFoW), out of 4000 executives all over the world, nearly half the respondents expect COVID-19 pandemic to shift workforce from traditional and non-digital work environments to fully digitized environment (B Pring & E Davis, 2020, p23). The same report also highlights a constant rise in issues related to trust and ethics indicating a need for redesigning the workplace as just one of the milestones towards achieving digitizing business practices (appendix B: Photo). Therefore, we consider our analytical findings to serve as fruitful insights for further research for unfolding a digital workplace. The conclusions we have are made by presenting a literature review by analyzing literature articles, conducting a questionnaire survey, and interviewing industry practitioners to describe the challenges and potential success factors that influence team performance working on GSD in agile methods. The following conclusions have been made based on our research.

6.1 Survey

The study found out that the way we have created a survey based on the literature helps us to understand the criticality of each factor and its influence in improving team performance working on GSD using agile methods. This survey also clarified how managers/team members think depending on their experience and what was more or less critical for them. Furthermore, we also found out that combining different theoretical literature regarding the environment in a workplace such as in this instance teams working in GSD and agile will yield new critical factors and might give a better understanding of the team performance within the team.

6.2 Interview

The interview questions have resulted in a new way of understanding the gaps and challenges while working remotely which seemed to contrast with agile ways of working in a physically collocated office ex: communication tools. The shape of the questions has also opened up for a deeper understanding of challenges faced in companies using GSD and agile. The interviews have also yielded new factors such as transparency within the company. The usage of the interview questions has also led to some practical applications such as using our interview-questionnaire in organizations to find similar issues and potential solutions that fits teams.

6.3 Limitations

Our preference or rationality might have influenced the selection of secondary data, as most of the listed critical factors are extracted from literature studies. This may also potentially have a threat to

validate this study as the researchers of the selected articles may be biased and could have extracted wrong data. However, feedback from respondents from the survey revealed that the selected success factors were indeed considered to be critical factors that influence their team performance working on GSD in agile methods. Moreover, we have conducted semi-structured interviews with industry practitioners to externally validate the results of the study. In this research study, all the participants were from Sweden and therefore, it would not be reasonable to generalize the results with respect to teams working in other regions of the world.

7 Further research

The identified secondary studies are from only 9 literature articles and the identified critical factors are from those researchers perceived and interpreted to be the most important. The most selected critical factors are continuous management approaches, training teams to be self-organized, well-defined project scope and requirement and continuous knowledge sharing. Organizations need to shift their approach on managing teams globally distributed to improve team performance by addressing issues related to coordination. We believe, based on the survey and the interviews, that experience also plays an important role in deciding to what degree the critical factors are important. But also, the effect and requirements it has on the teams depending on the composition of team members who are experienced or have a lack of experience. Moreover, transparency in corporate communication is likely to be underseen which causes inadequacy to engage all team members. Therefore, considering transparency as a critical factor to improve team performance and can be seen as an integrating factor to engage through communicating vision and purpose. Paying much attention to psychological safety such as trust issues in a hybrid team set-up could improve team effectiveness and team dynamics.

We believe that these findings will potentially serve as a reference article to help tackle challenges related to team performance working on GSD in agile methods. Moreover, categorization of critical factors will help future studies to focus on a particular category of the success factors to improve team performance working on GSD in agile methods. Shifting responsibilities to teams by eliminating micro-managing would help teams to build resilience and strengthen dependence among team members to make consensus-based decisions. Studying team performance of different teams and then comparing different teams from different domains would help us understand more about what and how factors influence team performance working on GSD using agile methods.

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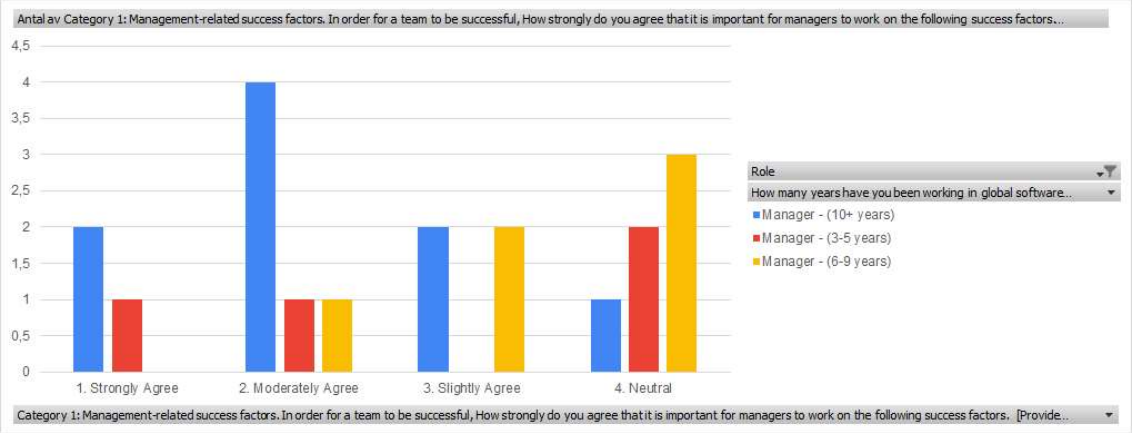
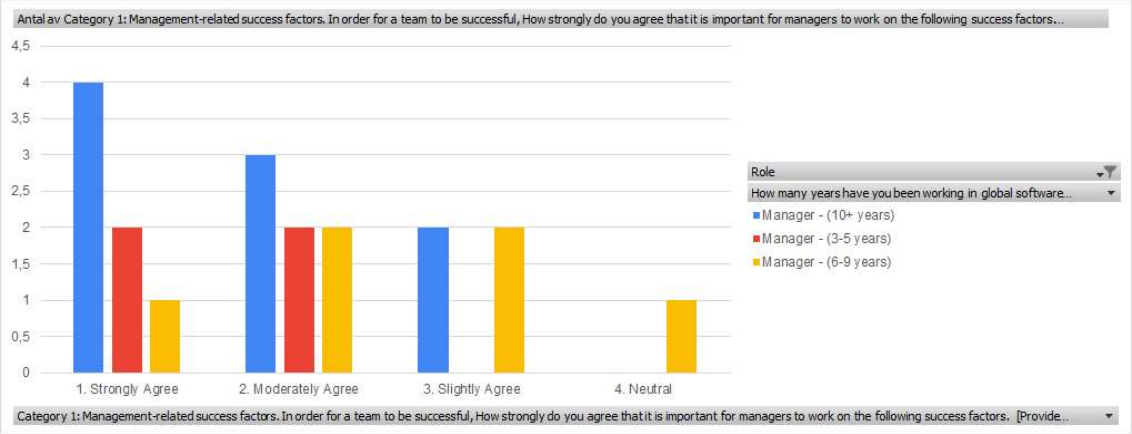
8 APPENDIX A

Managers

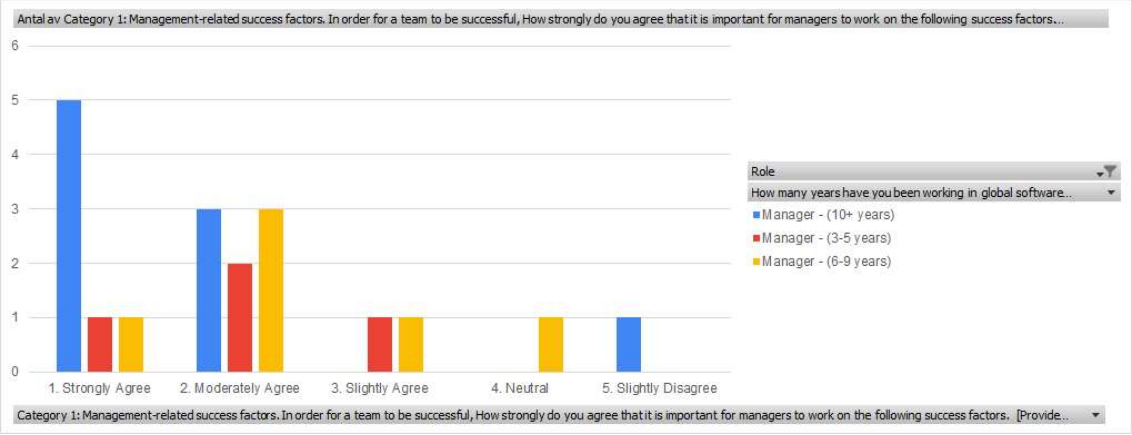
Category 1: Management-related success factors. In order for a team to be successful, How strongly do you agree that it is important for managers to work on the following success factors.



1.1 [Provide continuous support in software development]

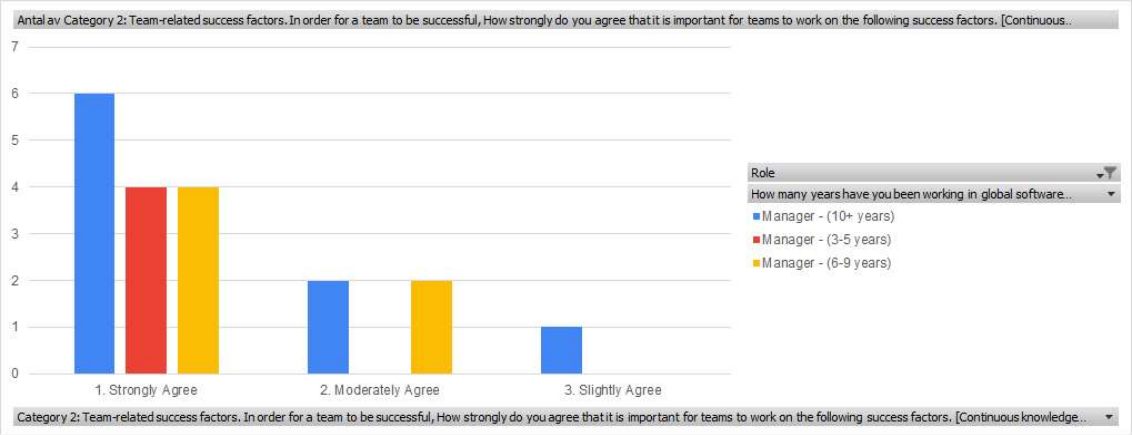


1.2 [Provide training for the team to be self-organized]

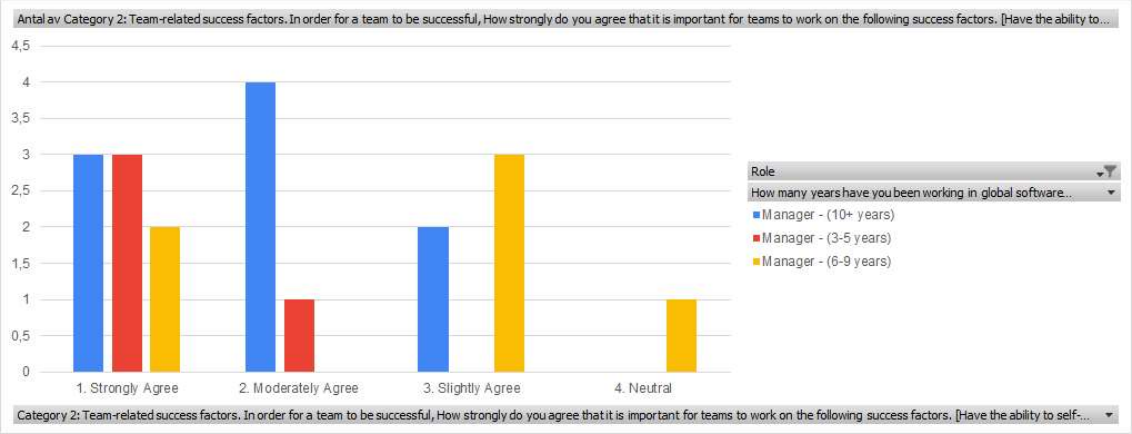


1.3 [Provide agile process training and awareness within the team]

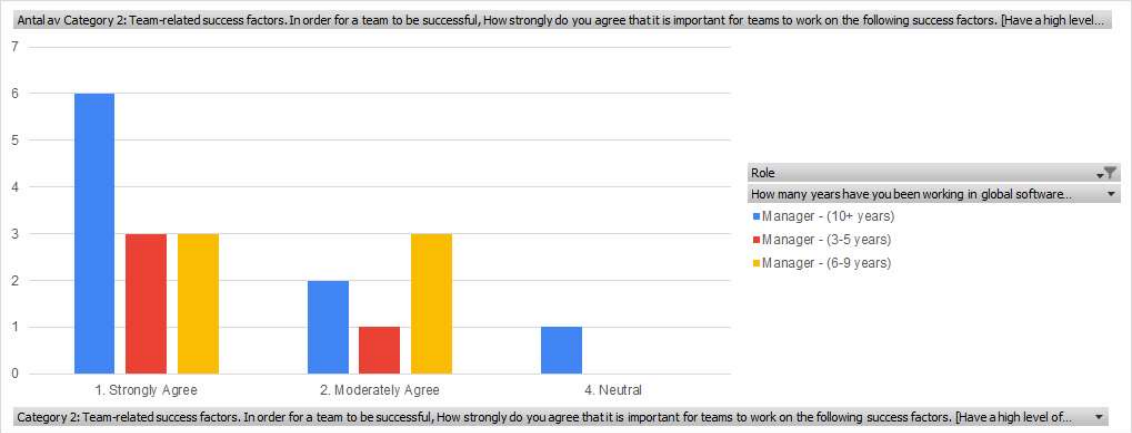
Category 2: Team-related success factors. In order for a team to be successful, How strongly do you agree that it is important for teams to work on the following success factors.



2.1 [Continuous knowledge sharing among the team]

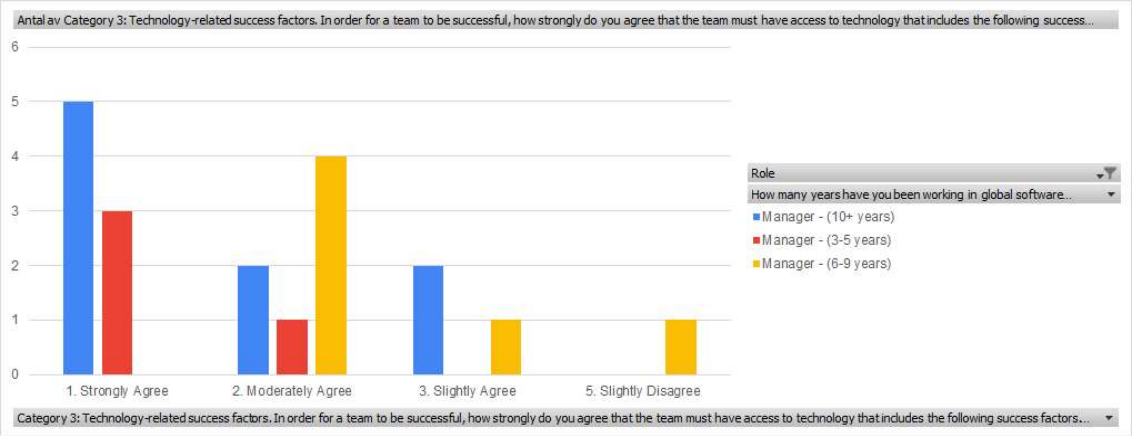


2.2 [Have the ability to self-organize within the team]

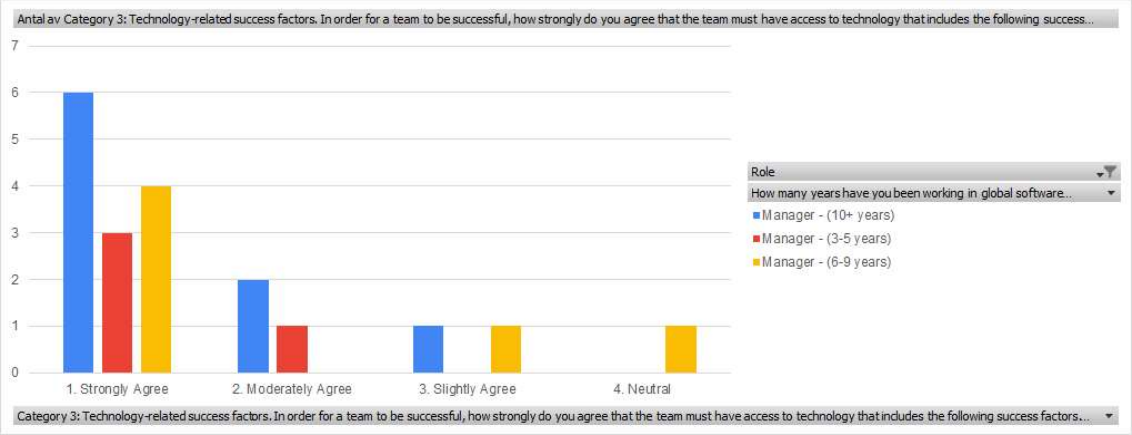


2.3 [Have a high level of trust among team members]

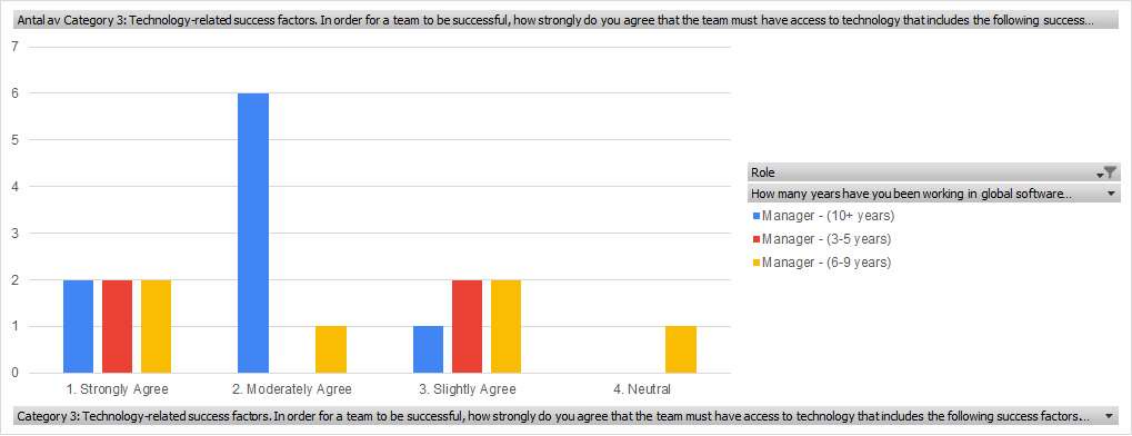
Category 3:Technology-related success factors. In order for a team to be successful, how strongly do you agree that the team must have access to technology that includes the following success factors.



3.1 [Proper communication software tools]

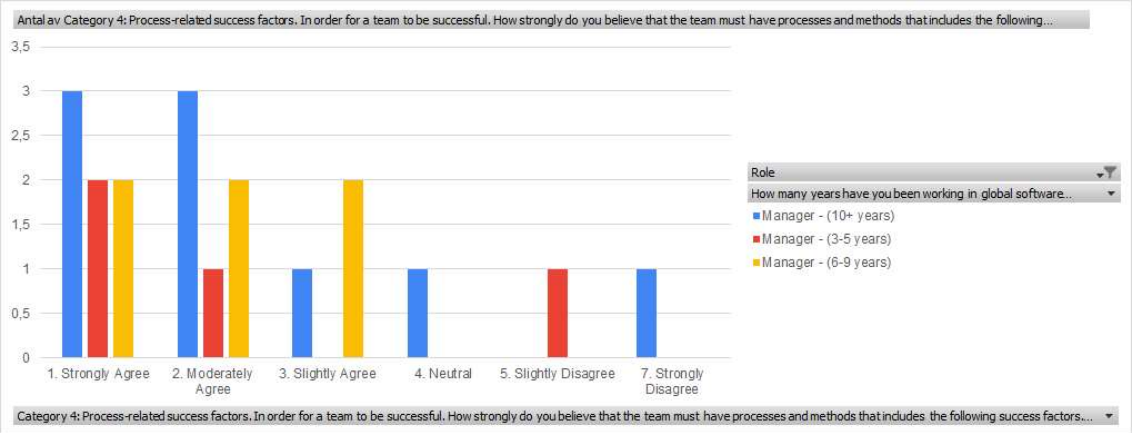


3.2 [Storing and sharing project knowledge]

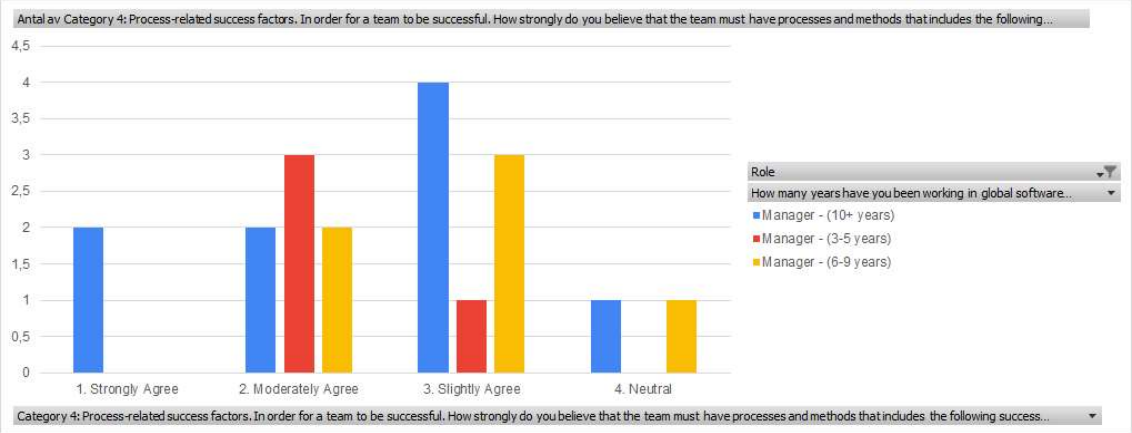


3.3 [Easy tracking of all activities in the project]

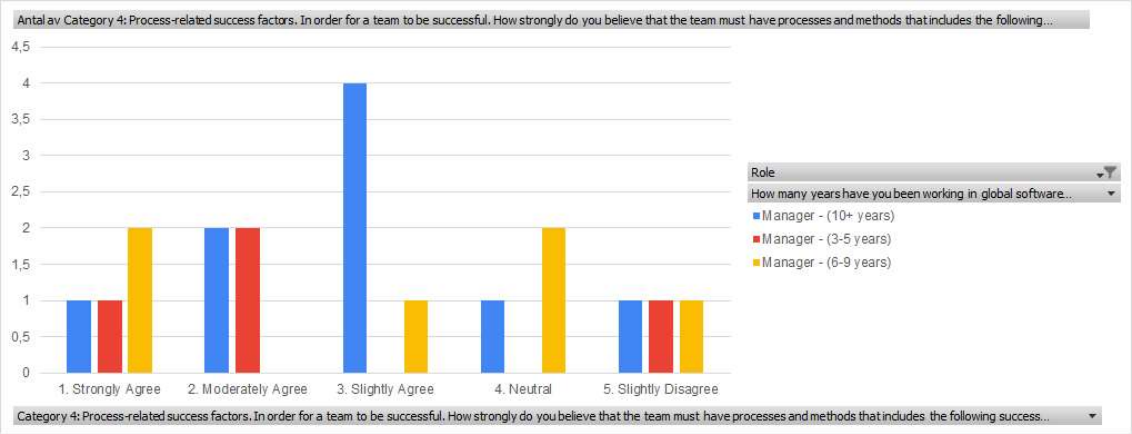
Category 4:Process-related success factors. In order for a team to be successful. How strongly do you believe that the team must have processes and methods that include the following success factors?



4.1 [Well defined project scope and requirements]



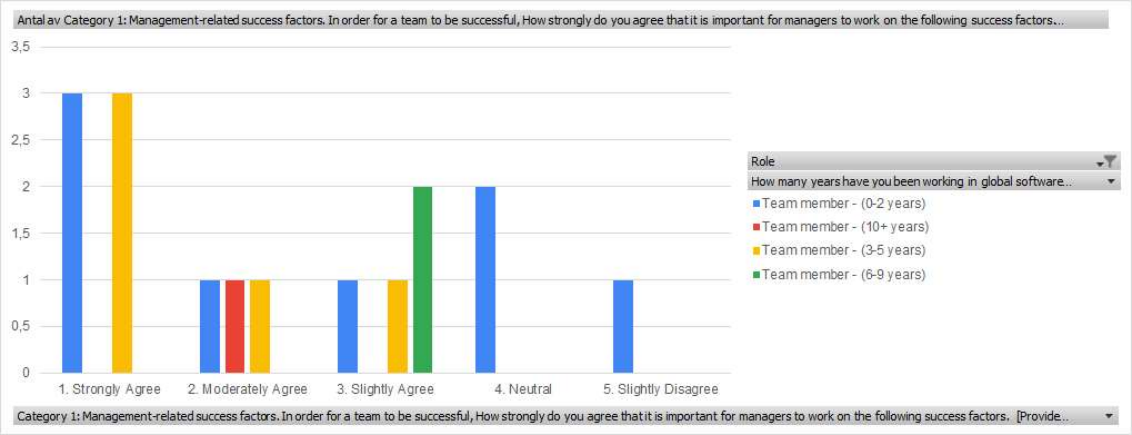
4.2 [Sufficient documents and project knowledge]



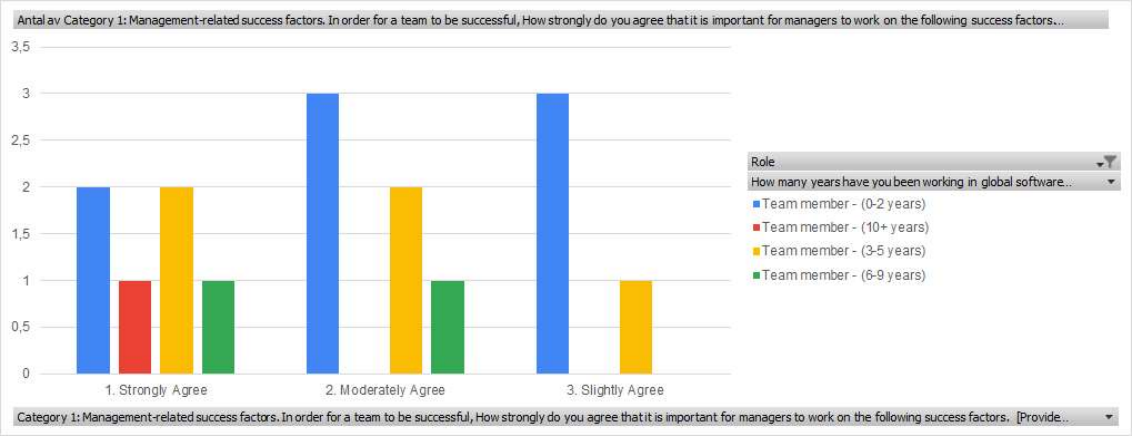
4.3 [Continuous evaluation of agile process in software

Team members

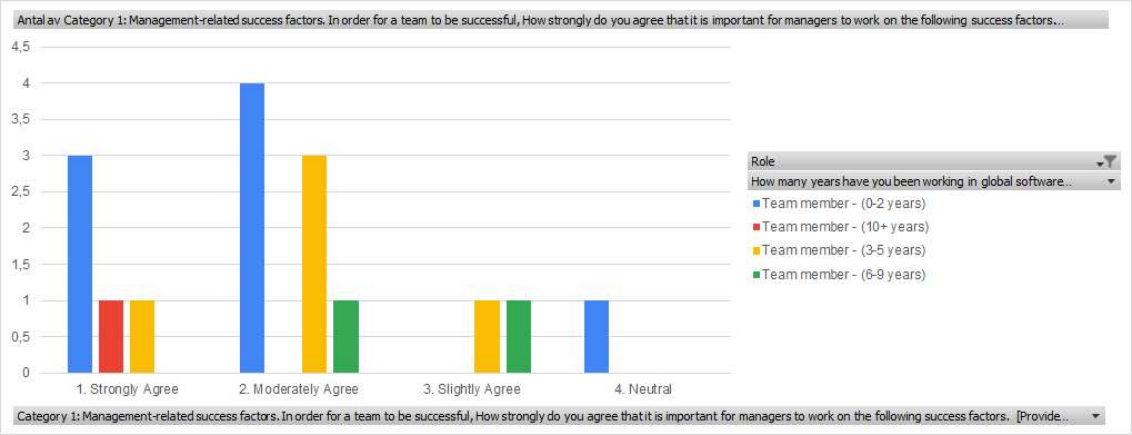
Category 1: Management-related success factors. In order for a team to be successful, How strongly do you agree that it is important for managers to work on the following success factors.



1.1 [Provide continuous support in software development]

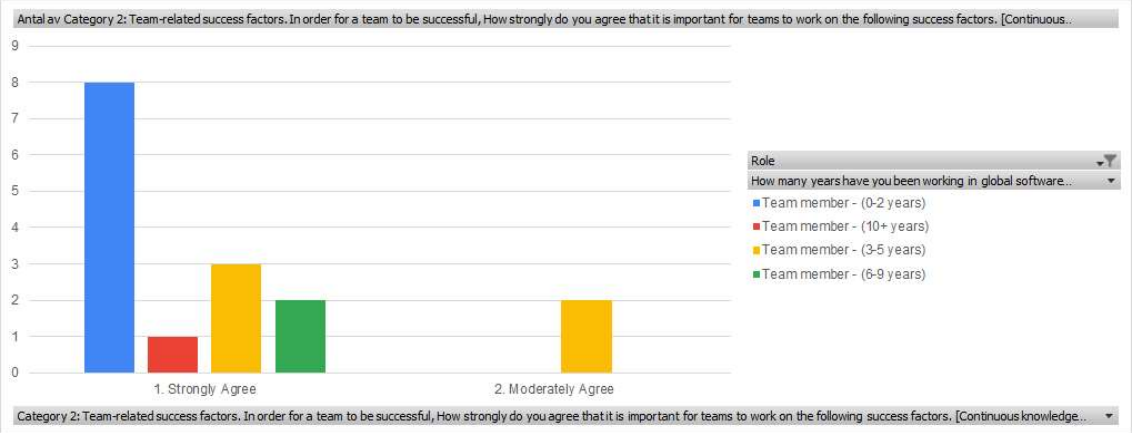


1.2 [Provide training for the team to be self-organized]

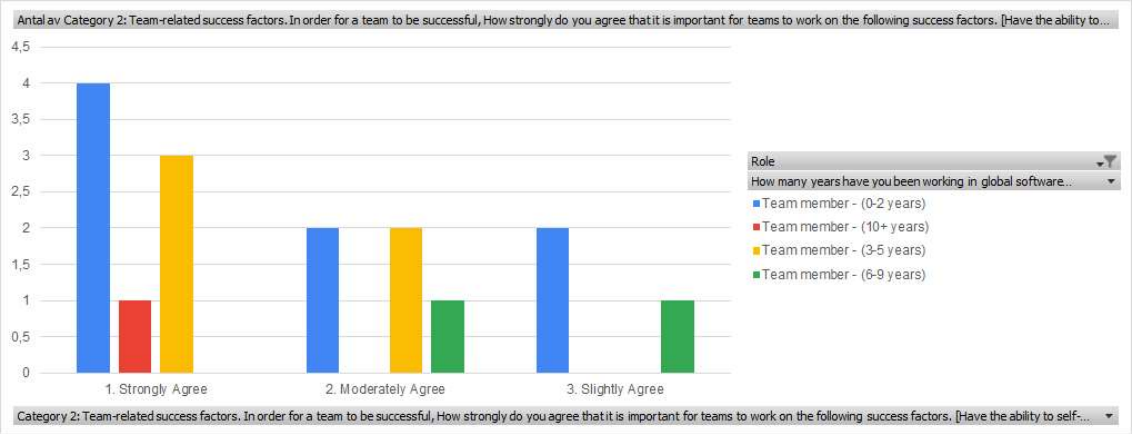


1.3 [Provide agile process training and awareness within the team]

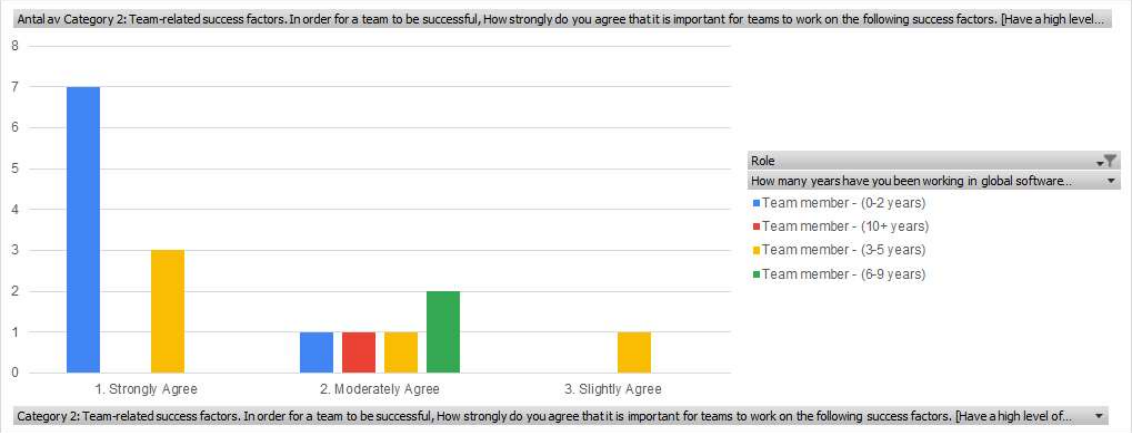
Category 2: Team-related success factors. In order for a team to be successful, How strongly do you agree that it is important for teams to work on the following success factors.



2.1 [Continuous knowledge sharing among the team]

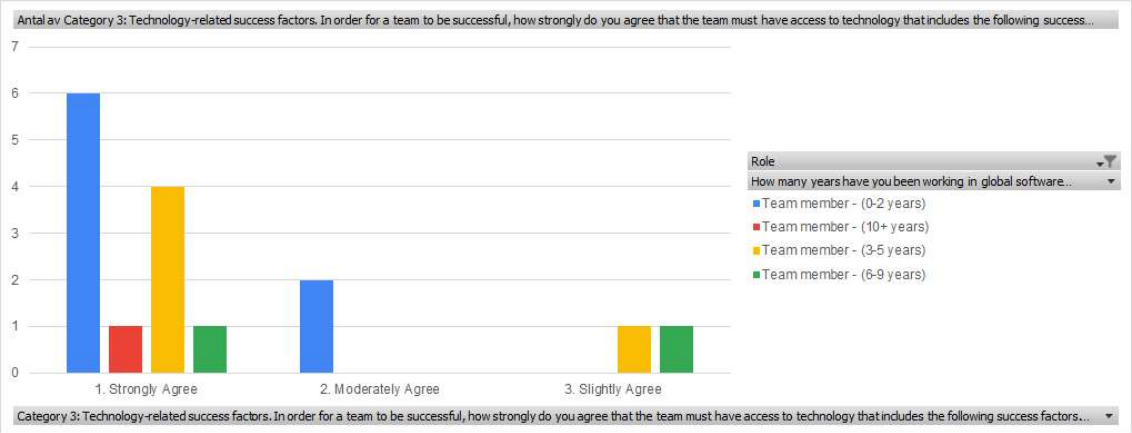


2.2 [Have the ability to self-organize within the team]

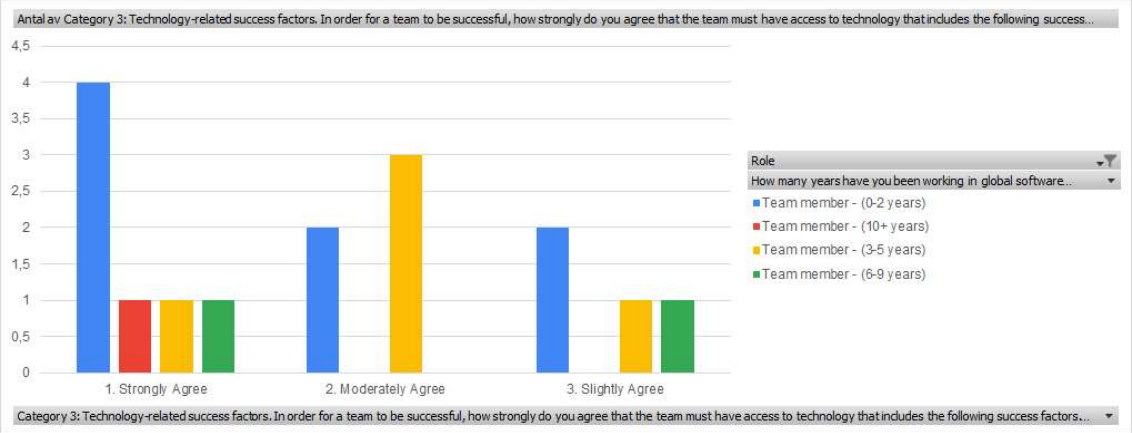


2.3 [Have a high level of trust among team members]

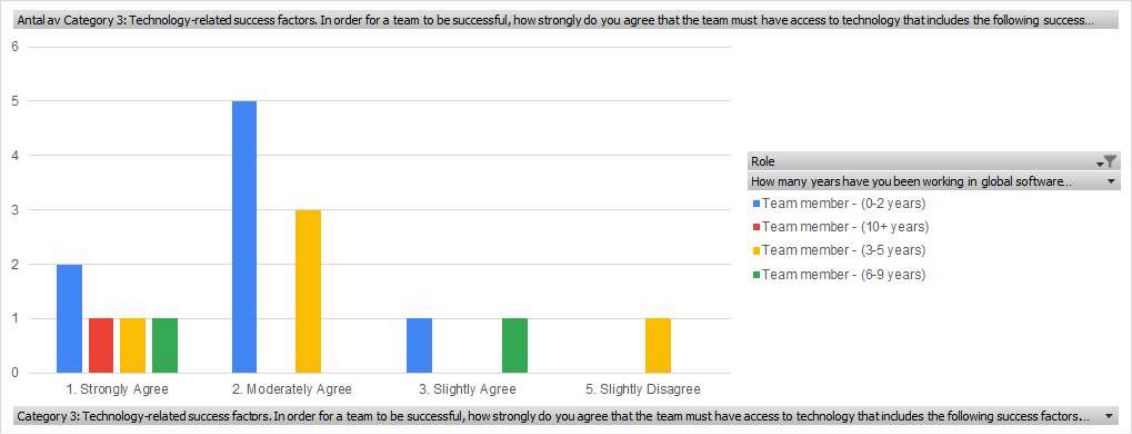
Category 3: Technology-related success factors. In order for a team to be successful, how strongly do you agree that the team must have access to technology that includes the following success factors.



3.1 [Proper communication software tools]

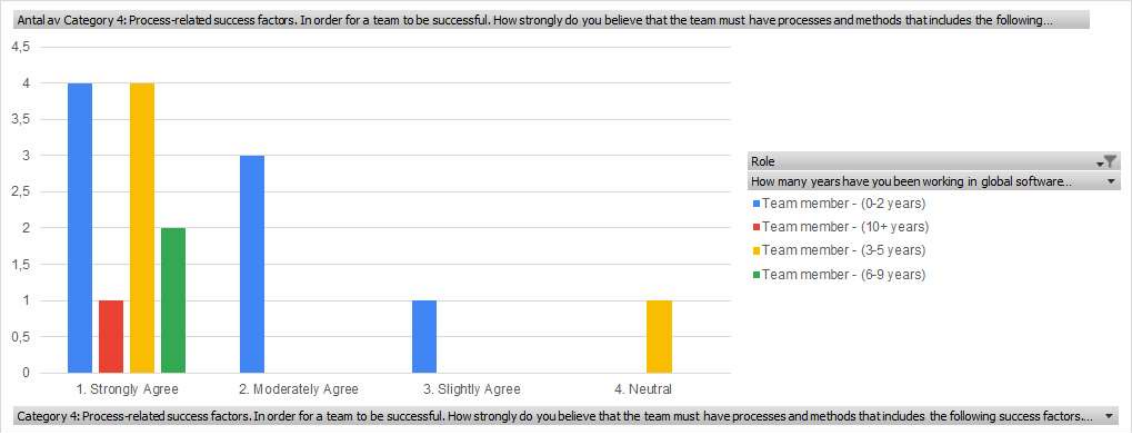


3.2 [Storing and sharing project knowledge]

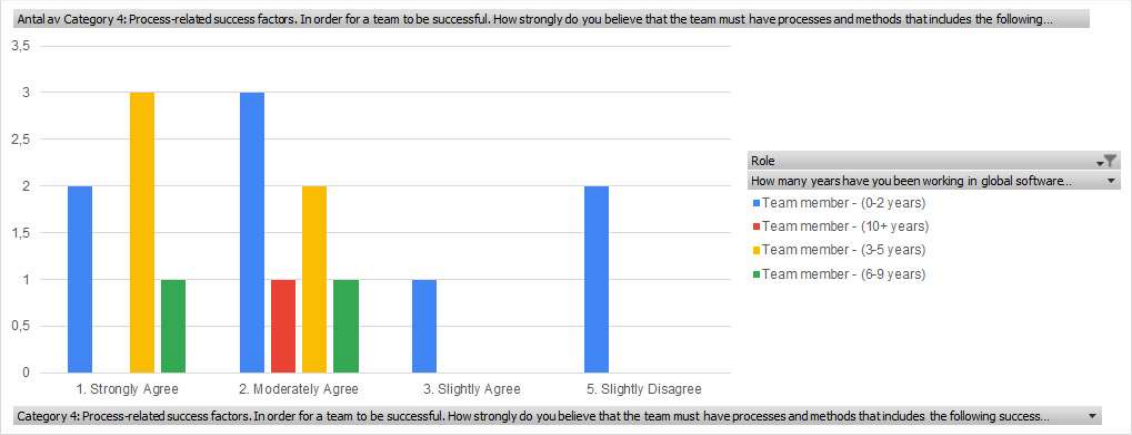


3.3 [Easy tracking of all activities in the project]

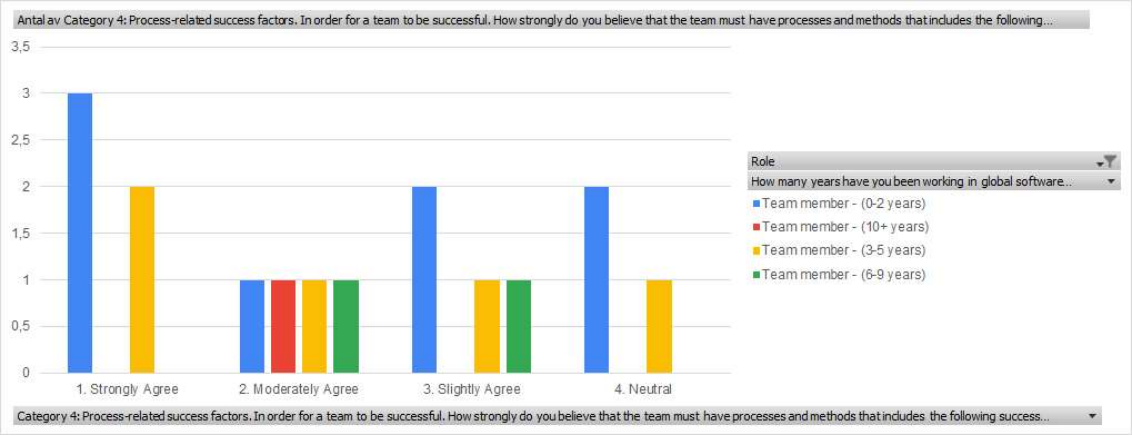
Category 4: Process-related success factors. In order for a team to be successful. How strongly do you believe that the team must have processes and methods that include the following success factors?



4.1 [Well defined project scope and requirements]

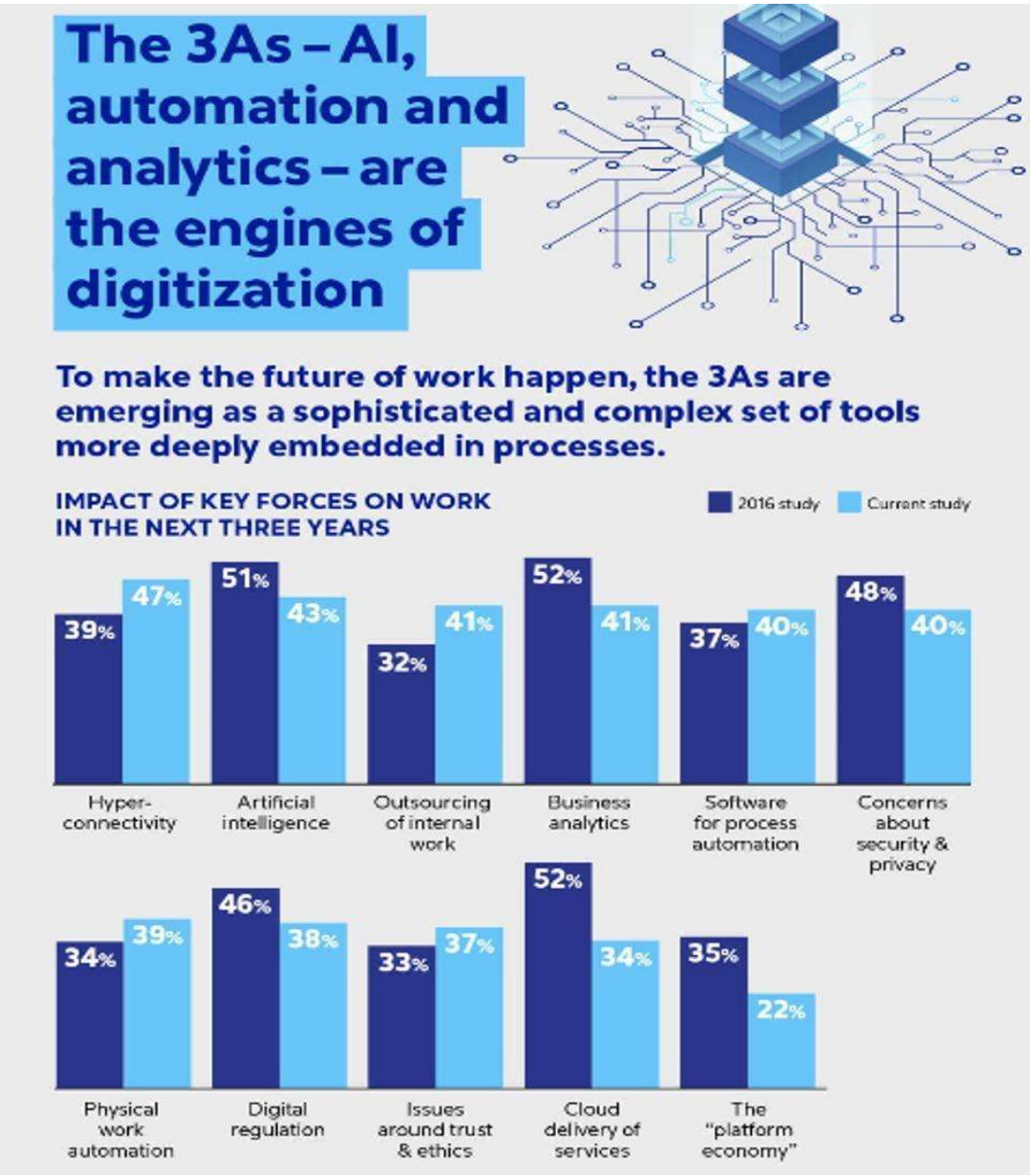


4.2 [Sufficient documents and project knowledge]



4.3 [Continuous evaluation of agile process in software]

9 Appendix B



Source: Cognizant

10 Appendix C

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