



UNIVERSITY OF GOTHENBURG

Socio-cultural Effects on Knowledge Sharing in Collaborative Co-located Software Engineering

Master's thesis in Software Engineering and Technology

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Abstract

Context: Software engineering is an activity involving tedious and time-consuming processes. It is a social activity that requires collaboration between many different developers. Due to the collaboration between different developers, there is a risk of social barriers that can impact the quantity and quality of shared knowledge. The most common challenges that many developers face are generally related to cultural diversities and lack of cultural awareness.

Objective: The purpose of this study is to investigate how socio-cultural difference influences knowledge sharing in co-located collaborative software engineering. In addition, identifying challenges that occur due to the influence of socio-culture.

Methods: An extensive literature review is conducted by searching in established scientific databases in order to identify and gather knowledge about socio-cultural challenges associated with software engineering. In addition, understanding the concept and the problems regarding culture and software engineering and how it affects knowledge sharing. An interview form, together with a questionnaire, was created based on the findings from the literature review. Interviews are conducted across multicultural software development organizations located in Sweden to learn about the issues software development teams face regarding culture, how these teams face it as well as help give a more extensive knowledge of their adaption to it. A total of 10 interviews were conducted to investigate challenges related to socio-cultural and how it impacts knowledge sharing. Literature evidences were utilized to support the results collected from interviews.

Results: Together with a complementary questionnaire, the interviews identified four factors that hamper effective communication and knowledge sharing. The impact of seniority and the impact of hierarchy resulted in consequences such as the unwillingness to express disagreement and opinions openly. The impact of language barriers and cultural behaviour may cause misunderstandings and misinterpretations of communication and shared knowledge.

Conclusion: The study signifies the importance of understanding how socio-cultural aspects influence knowledge sharing between members in co-located teams, which also gives a different perspective to existing research. The study draws insights into various non-technical factors such as cultural, human, organizational, and social while collaborating in a co-located environment. Variations across these factors will lead to issues in regards to mutual understanding, collaboration, and communication.

Keywords: Knowledge sharing, culture, collaboration, socio-culture, co-located, software engineering.

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1 Introduction

Software engineering is an activity involving tedious, complex, and time-consuming processes. It is a social activity that involves collaboration between many different developers where a considerable effort is spent on sharing knowledge between each other (Jolak et al., 2018). Achieving a shared and mutual understanding is key to be able to share knowledge efficiently and effectively (Jolak and Liebel, 2019). Emphasizing these aspects is significant as developers often work in different development teams and collaboratively communicate with many stakeholders. Being able to form a shared and mutual understanding helps in communication and, in turn, knowledge sharing. However, with large collaborative software engineering projects, there is a risk of social barriers being created between developers and teams. The people involved often consist of diverse groups of people with different languages, cultural backgrounds, views, etc. (Morrison-Smith and Ruiz, 2020). These barriers can impact the knowledge sharing between developers and team members, thus challenging the project's progression and development, which can reduce the quality of the end-product (Jolak and Liebel, 2019). One of the main barriers during software development is often the lack of cultural awareness. The most common challenges faced by software developers in global software development are generally related to cultural diversity and culture (Alsanoosy et al., 2018). Shifting focus on human factors such as culture is vital as it shapes how individuals and companies operate and how they utilize techniques and practices to achieve their goals. Each culture predisposes distinctive behaviours, customs, and approaches to communicate (Alsanoosy et al., 2018). By understanding how to account for social barriers, we can achieve effective collaboration. Therefore, it is necessary to put effort into understanding the individual's behaviour and culture as it challenges project processes such as communication, coordination, and control (Ammad et al., 2019).

This study aims to analyze in-depth and present how socio-cultural aspects influence the process of knowledge sharing between members of co-located teams within software engineering. We plan to identify how socio-cultural differences impact knowledge sharing in collaborative software and aims to identify challenges that occur due to the impact of socio-culture. The thesis will contribute to existing research within knowledge sharing in software engineering by giving a different perspective, specially for co-located collaborative software engineering.

1.1 Problem Statement

Software development is a complex process that requires a great amount of collaboration among team members. Social barriers between different stakeholders and development teams can significantly impact the quantity and quality of shared knowledge. Sharing knowledge inadequately can influence the design and functionality of a product. Therefore, a shared and mutual understanding is necessary to guarantee a successful project. Even though progress has been made in the technological aspect of collaborative software engineering, effective collaboration can only be achieved if we understand how to account for social barriers (Jolak and Liebel, 2019).

Socio-cultural diversity, to understand various cultures in the sense of norms and practices is essential to have a coherent team. The diversity in culture is often mentioned within Global Software Development (GSD) as the team is distributed over different geographical locations. This creates a certain distance between members, which is considered a significant factor that impacts the practice of GSD, as the teams are primarily composed of members from different countries, speaking different languages and with different managerial tradition (Casey, 2009). However, this diversity could also be found within a large co-located software development organization. Thus, the same challenges GSD face with socio-culture could also be found within co-located organizations (Barthes et al., 2011; Jablokow and Myers, 2010). Socio-cultural distance is a complex dimension that includes cultural, linguistic, political aspects, and individual issues such as motivation and work ethic (Deshpande et al., 2010). This can affect the problem-solving and communication processes within the team as they often have drastically different values, beliefs, and approaches. These differences can lead to miscommunication and weaken a team's ability to form a shared understanding, which could impact the project processes, progression, and success (Hsieh, 2006).

Knowledge Sharing, to be able to share product and domain knowledge between teams is crucial for building trust and shared understanding within teams (Humayun and Gang, 2012). Having better knowledge management is helpful in solving communication problems and developing a shared understanding of requirements. Team members should frequently strive to share complex and context-specific knowledge that is essential to deliver business value to the customers (Dorairaj et al., 2012). We can improve productivity by effective sharing and transfer of knowledge, but it tends to be a time-consuming and tedious task (Levy and Hazzan, 2009). Misunderstandings can occur within teams of different cultures. The sharing of knowledge becomes more complex due to the cultural barriers, that is to say, language difference or cultural norms difference. In addition, by not sharing the same native language, the diversity in terms of a common language (usually English) also lead to various problems and misunderstandings (Anwar et al., 2019). Furthermore, as culture is intertwined with people's values, attitudes, and beliefs, it can make knowledge sharing a complex endeavour.

1.2 Purpose and Aim

The purpose of this study is to investigate how socio-cultural differences influence knowledge sharing in co-located collaborative software engineering. In addition, we plan to identify challenges that occur due to the influence of socio-cultural. There are many studies conducted in terms of how cultural differences affect software engineering. However, only a few studies have been conducted, in particular, within a colocated environment. Therefore, it is in our interest to investigate how socio-cultural differences affect knowledge sharing in co-located environments within software engineering. We believe that other researchers can benefit from this study by doing a study explicit in a co-located environment. We also think that IT-organisations will benefit from this study since their success highly depends on team performance. By understanding the impact that socio-cultural diversity has on knowledge sharing, IT-organisations can mitigate the adverse effects that might occur.

Therefore, with this study, we aim to increase the understanding of how the effects of socio-cultural differences influence knowledge sharing in software engineering. Also, we aim to explore the challenges that occur as a result of the effect of socio-cultural influences.

1.3 Delimitations

The thesis's scope is relatively broad, and there are many aspects of cultural differences that can be covered. However, limitations were set in order to make the thesis feasible. Furthermore, due to time restrictions, it limited the number of interviews possible. In the early stage of the thesis, it was decided that there would be a focus on having mainly software developers that are working in a multicultural organization and be working onsite. This is done in order to collect experience relevant to the thesis.

The sample group interviewed consisted mainly of software developers in Sweden, even though it would have been interesting to include more people from other parts of the world (that fit the criteria). This could possibly make the findings more generalized. Nonetheless, with limited time, it was an active decision made as focusing mainly on software developers in Sweden, which simplified the search for participants significantly.

1.4 Research Questions

In this research, we aim to answer the following research questions by employing three methodologies, which consist of an literature review, semi-structured interview complemented with a questionnaire. The research questions are:

RQ1: How do socio-cultural differences impact knowledge sharing in collaborative software engineering?

RQ2: Which socio-cultural challenges are identified in collaborative software engineering?

Research question RQ1 aims towards discovering and analyzing how socio-cultural diversity affects the process of knowledge sharing in co-located collaborative software engineering. This is done with the help of semi-structured interviews, quantitative data and extensive literature review. Research question RQ2 is intended to identify the socio-cultural challenges that software developers face derived from the semi-structured interviews.

***RQ3:** How can we mitigate the effects of socio-cultural challenges on collaborative software engineering?

Research question RQ3 aims toward finding mitigation strategies to minimize the impact of identified challenges in RQ2. Mitigation strategies will be derived from additional literature review and validated in a case study.

Due to the current situation regarding COVID-19, the methodology on how to conduct this study had to be changed. Interviews could still be done remotely, while a case study is harder to perform remotely. As a result, RQ3 got removed from the initial research questions.

1.5 Report Structure

The rest of this thesis is structured as follows: Chapter 2 describes the related work and presents research related to the thesis topic. Chapter 3 provides the reader with relevant and necessary background information that helps in understanding various techniques, methods, and concepts that the thesis has applied. Chapter 4 is divided into different sections that presents the steps taken in order to find an answer to the research questions. Chapter 5 presents the results and findings derived from the interviews and questionnaire. Chapter 6 provides the authors' interpretation of the results based on an analysis of the results supported by literature, followed by a discussion about the limitation of the study. Lastly, Chapter 7 concludes the thesis, summarising key findings, and provides suggestions for further research.

Related Work

This section addresses the different socio-culture related issues in co-located as well as the GSD environment. There are various socio-culture related issues considered by various researchers.

Cultural differences play a significant role in how a person performs their work. People with different cultural backgrounds act differently to a situation, and the actions are affected by their values, social structures, and ethics (Abraham, 2009). Marinho et al. (2018) conducted a systematic literature review on cultural differences regarding GSD and presented various strategies to mitigate negative impacts that might occur due to cultural diversity. Alsanoosy et al. (2018) observed and evaluated the influence of culture on the Requirement Engineering (RE) process where the aim was to analyze how the RE process can be improved taking into account cultural aspects. Case studies and multiple interviews were conducted in the study and resulted in a list of 15 challenges and mitigation strategies related to the influence of culture on the RE process. The study demonstrated that the RE process was highly sensitive to culture and significant enough to take into consideration in order to have an effective RE process and avoid issues. Fazli & Bittner (2017) systematic literature review analyzed previous research on cross-cultural software engineering. Their research identifies the potential impacts of national cultural factors on collaborative approaches and behavior in software engineering teams. Their analysis and findings found that cultural differences influence the success of the project and business goals. Furthermore, identifying that cultural aspects impact many SE activities.

Communication is one of the most crucial challenges in GSD environment (Ammad et al., 2019). Holmstrom et al. (2006) categorized the issues associated with GSD, and socio-cultural distance was one of the significant factors. It affected the team communication in terms of misunderstandings and conflicts within projects, which heavily affected the performance of GSD teams. The study stated that it is difficult to establish a shared frame of reference and mutuality in communication, even among those who are co-located. Shameem et al. (2015) identified the various communication-related issues that affect the performance of GSD projects. An exploratory research method was carried out through in-depth interviews and focus group methods from several software professionals working in various software industries. The study resulted in a framework that incorporated some identified factors like temporal distance, geographical distance, socio-cultural distance, team member's attitudinal issues and social communication. Ammad et al,. (2019) performed an extensive systematic literature review to identify the factors affecting communication in GSD which were then classified into eight categories that are geographical distance, temporal distance, socio-cultural distance, team member's attitude, technical issue, team issue, organizational & architectural issue, and customer issue. Furthermore, a conceptual framework was empirically investigated to evaluate the effect of classified communication issues in GSD. In addition, a survey was conducted to gather data to test and validate the hypothesis of the conceptual framework. The findings of the study showed that socio-cultural, among other factors, had a significant impact on communication risk in GSD. However, mitigation practices of the communication risk issues were not identified.

Knowledge sharing is a crucial process for software organizations due to the need to decrease development time, cost, and increase quality. M. Zahedi et al., (2016) addresses knowledge sharing challenges and practices in GSD based on a systematic literature review. The authors classified the problems and practices in six main themes where social attributes are one of them. Social attributes concern trust, and according to the result, trust significantly influences the way teammates approach each other for seeking or sharing knowledge. Han and Anantatmula (2007) conducted a case study on two different large IT-organizations. They stated that organizational culture affects employees' willingness to share knowledge between coworkers. Culture includes factors such as trust, the usability of technology, and leadership support.

Therefore, with this study, we aim to increase the understanding of the effects of socio-cultural differences on knowledge sharing in software engineering. In addition, we aim to explore the mitigation of these effects by providing mechanisms to support knowledge sharing in diverse software engineering teams.

Theory

3.1 Global Software Development

As the software industry is continuously growing, many organizations and industries invest their effort in globalization. As a consequence, global software development(GSD) is becoming more of standard practice. It is a phenomenon that involves people of different national and organizational cultures, working together in software development. The teams are usually distributed globally, over different geographical locations working together to accomplish project goals and coordinated through the use of information and communication technologies (Holmstrom et al., 2006). Adopting GSD gives business benefits as well as competitive advantages (Khan et al., 2015). It provides the ability to have round-the-clock development together with access to a larger labor force, and cost advantages, hence why many different companies around the world are utilizing the GSD model. Nevertheless, with many of its' benefits, there are challenges that comes with GSD. Even though there are benefits of being geographically distributed, it is also a caveat as teams face challenges such as time zone differences as well as cultural differences involving different languages, national traditions, values and norms of behaviour (Holmstrom et al., 2006), which can challenge project diversity and complexity. There is no doubt that GSD increases the scope of organizational operation and expanding the skill and product knowledge base. However, evidence also proves that GSD face constraints related to temporal distance, geographical distance, and socio-culture distances threatening GSD in the areas of communication, coordination, and control mechanism (Holmstrom et al., 2006).

3.2 Culture

To understand cultural differences and how it affects us, it is vital to understand what culture is, as the term is quite broad and complex. There have been many definitions of what the term culture means over the century. Many researchers have described it in various ways, mentioned as early as in the 18th century and not long after got a distinct definition by the English anthropologist Edward B. Taylor. From his book Primitive Culture (1871) he defined it "Culture ... is that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society". Culture is an integral part of human society and integrated with human knowledge, belief, and behavior, which depends on the capacity for learning and transmitting knowledge to future

generations (Deshpande et al., 2010). It plays a crucial part on how a individual or groups performs their work as it influences the individual patterns of thinking, feeling and acting. These attributes are either inherited or socially conditioned, as culture is learned values and behaviors shared by a group of people and can be visible or invisible. Visible attributes refer to for example, clothing, religious rituals, dining, sports, art, music, or architectures. In contrast, invisible attributes refer to time, communication, space, structure, thinking, comprise of orientations to the environment, individualism, and competitiveness (MacGregor et al., 2005). But as the aforementioned culture is a broad term and a general misconception is that it is often defined and simplified through the visible attributes. However, they only take up a small portion of culture, and the invisible attributes actually take up a larger part (MacGregor et al., 2005). As of lately, one concept that describes culture and is frequently cited within software development is the culture dimension from Hofstede, where he describes culture as '... the collective programming of the human mind that distinguishes the members of one human group from those of another. Culture, in this sense, is a system of collective held values' (Hofstede, 1980, p. 24). There are though, many other different cultural definitions nowadays and as consequence it is quite difficult to choose a definition that is able to satisfy everyone. But, for the purpose of this study Hofstede's definition of culture will be used, which will be motivated in-depth further down in the thesis. There is clear evidence of how influential culture is within the organizational environment, which can be seen through different research over the years regarding the topic. To summarize, culture has an affect on an individual's thoughts, attitudes, behaviors, values, and goals. A crucial factor to distinguish a social group from others. Below we present some theories that demonstrate different aspects of how to view culture.

3.3 Hofstede's Cultural Dimensions Theory

In 1970s Geert Hofstede was given the opportunity to conduct a study among IBM employees in more than fifty countries. The purpose of the study was to identify the impact of cultural differences with countries differences as the main focus. The study was based on surveys with questions related to participants' value. The initial results identified four dimensions: power distance, individualism/collectivism, masculinity/femininity, and uncertainty avoidance (Hofstede et al., 2010, pp. 30-32). The dimensions became the foundation for Hofstede's cultural dimension theory. A decade later, in the late 1980s a fifth dimension was introduced named long-term/short-term orientation and was added to the theory, with the reasoning that the previous dimensions do not cover economic growth. This dimension was based on a survey designed by Chinese scholars who conducted a study among students in 23 countries (Hofstede, 2011, pp. 13-14). In 2010 Hofstede added a sixth dimension using Michael Minkov's label, Indulgence/restraint. The six dimensions together resulted in Hofstede's cultural differences.

3.3.1 Power Distance

The definition of Hofstede's first dimension Power distance refers to the extent where people with lower power or lower ranks in the society accept and expect that power is distributed unequally, meaning that hierarchy has a significant impact in society (Hofstede et al., 2010, p. 61). In Hofstede's study, this dimension was measured in a score called power distance index (PDI). The score of PDI for each country was based on three questions that aim to describe the relationship between the superior and subordinates. The questions involved the participants actual and preferred decision-making styles of management(autocratic style or paternalistic style) and whether or not the employees(subordinates) are afraid to disagree with their superior (Hofstede et al., 2010, p. 56). Based on the IBM study, countries with high PDI include Malaysia, China, Hong Kong, and India. Countries with low PDI include Austria, Germany, the Scandinavian countries, and Great Britain (Hofstede et al., 2010, p. 57-59).

From a society perspective, societies with high PDI indicate that the parents teach their children obedience toward their parents and respect older relatives. At school, the relation and attitude towards teachers are the same as at home, teachers are treated with respect, and the students are expected to study hard. In low PDI societies, children are treated as equals. Rather than obedient, the child is encouraged to learn to say "no" at a very early age. At school, the educational process is student-centered. The students are expected to find their own paths, ask questions whenever they do not understand something, and raise their voices to express disagreement and criticism (Hofstede et al., 2010, pp. 67-69).

Countries with high PDI tend to have a hierarchical organizational structure. There is a significant gap between superior and subordinates, superiors are not comparable with subordinates. Autocrat is the ideal view on a superior in the eye of a subordinate. The superior has the final call in decision-making and is expected to tell the subordinate what to do. Information is passed from top to down, meaning that there is only one way to acquire information. The superior and subordinates are rarely involved in decision making and are not being consulted for opinions (Hofstede et al., 2010, p. 73). Organizations with low PDI has a flat hierarchical structure. Superiors and subordinates consider each other as equal. Titles and roles are established for convenience, and roles can be changed. Someone who today is my subordinate may become my boss tomorrow. Rather than autocrat, an ideal superior is considered as a resourceful democrat, and they should be accessible for subordinates. Even though a superior has the final call when making a decision which is accepted by the subordinate, they are expected to give subordinates a chance to raise their voice, and such opinions are being considered when making a decision (Hofstede et al., 2010, p. 74).

3.3.2 Individualism/Collectivism

Hofstede's second dimension, individualism, refers to a society where everyone is expected to look out for themselves and their immediate family. In such culture, the emphasis is on "I". In contrast, collectivism emphasizes "we" and refers to a society where people belong to groups, loyalty are expected, and in return, the group will defend their interests (Hofstede et al., 2010, p. 92). In the IBM study, collectivism and individualism was measured in Individualism index (IDV), a low IDV score indicated collectivism, and a high IDV score leaned towards individualism. The IDV scores are based on a set of fourteen questions regarding work goals (Hofstede et al., 2010, p. 92). Based on the survey data, countries with high IDV include the United States, Scandinavian countries, Great Britain, and the Netherlands. Countries with low IDV score include South Korea, Arab countries, Malaysia, Hong Kong, and Turkey (Hofstede et al., 2010, pp. 95-97).

Hofstede uses Sweden and Saudia Arabia as references to describe the differences between individualist/collectivist societies. Societies with low IDV often consist of families with a structure "extended family" where the child grows up in an environment that consists of many people living closely together. Except for parents and other siblings, it is a norm to include grandparents, uncles, and other relatives. As the child grows up, they learn to think of themselves as part of a "we" group. In high IDV societies, family structure is often tied to "nuclear family". A child often lives with the two parents, potentially other siblings and other relatives living elsewhere, divorces, and living in a one-parent family is also considered normal. At a very early age, the child is emphasized to think of themselves as "I", they are expected to leave their parental family as soon as they are considered as an adult and can stand on their own feet (Hofstede et al., 2010, pp. 90-91).

In organizations with high IDV, individual work is preferred meaning that employees tend to prefer to work alone and expects to act according to their own interest. According to Hofstede, employees are "economic men" who pursue the employer's interest if it coincides with their own self-interest. The relationship between the employee and employer is seen as a contract between parties on a labor market. No personal feelings are attached. In high IDV cultures, task prevails over relationship (Hofstede et al., 2010, pp. 119-120). In low IDV organizations, employees prefer to work in groups, and the best result is achieved through group work. Unlike individualist work culture, the hiring process always takes the in-group into account, meaning that the employer does not hire an employee only based on the individual, group harmony and to share the same group-interest is taken into consideration. The relationship between the employer and employees are seen as closely, like a family link. In low IDV cultures, relationship prevails over task (Hofstede et al., 2010, p. 120).

3.3.3 Masculinity/Femininity

Geert Hofstede defines the third dimension, masculinity/femininity as: "A society is called masculine when emotional gender roles are clearly distinct, men are supposed to be assertive, tough and focus on material success, whereas women are supposed to be more modest, tender and concerned with the quality of life." "A society is called feminine when emotional gender roles overlap, both men and women are supposed to be modest, tender and concerned with the quality of life" (Hofstede et al., 2010, p. 140). Masculinity index (MAS) was used to measure masculinity/femininity. Masculine countries include Japan, Austria, Ireland, Germany, and feminine countries include Scandinavian countries, South Korea and France (Hofstede et al., 2010, pp. 141-143).

In societies with high MAS (masculine), the relationship between parents and children is according to the societal norm, inequality, children are supposed to be controlled by obedience. Men are supposed to be tough, ambitious, and as a father, they are supposed to deal with facts, women are soft, relationship-oriented, and supposed to deal with feelings. A child learns that boys do not cry, girls do, boys play with others to compete, and girls play to spend time with each other (Hofstede et al., 2010, pp. 151-152). Feminine societies focus on relationships and quality of life. Both men and women can be relationship-oriented. In a family, parents and children are treated as equals. Children have the mindset of both boys and girls are equal, both boys and girls are allowed to cry, fighting is not the right way to solve a problem, and games they play are not seen as competitive (Hofstede et al., 2010, p. 155).

Organization in countries with high MAS, expects fast results and rewards are given based on equity, which refers to reward according to performance. Employees are more likely to live in order to work, and they value security, pay, and career. Employees strive after opportunities for recognition and advancement. Conflicts are solved by either ignoring the conflict or fight until the best man wins. Careers are compulsory for men and optional for women (Hofstede et al., 2010, pp. 164-166). Low MAS organizations, expect results within the given timeline without stressing it and the focus is on the employee's well-being rather than the result. Rewards are given according to equality, meaning that it is likely given to every one according to their need. Employees often have the mindset of working in order to live, rather than pay and career. Employees in low MAS organizations value the quality of work, equality, and relations. Conflicts are preferred to be solved by compromising and negotiations (Hofstede et al., 2010, pp. 166-167).

3.3.4 Uncertainty Avoidance

The fourth dimension, uncertainty avoidance, refers to how societies react, either comfortable or uncomfortable, to unstructured situations and its tolerance for ambiguity (Hofstede, 2011). Uncertainty avoidance index (UAI) is the measure of how society reacts to unknown situations. The score is based on three questions regarding IBM's staffs' view towards job stress, company rules, and the intention of how long the staff will stay with the company. High UAI countries include Greece, Japan,

France, and Spain. Low UAI countries include Sweden, Hong Kong, Singapore, and Great Britain (Hofstede et al., 2010, pp. 190-194).

Countries with high UAI prefer to avoid uncertainties about the future. The population's anxiety level is relatively high even though expressions of emotions are encouraged to be shown (Hofstede et al., 2010, p. 196). Truth is considered absolute; in some high UAI societies, the distinction between good and evil ideas is very precise. Children are being raised up with firm rules, views, and ideas that can be considered dangerous and even taboo (Hofstede et al., 2010, p. 201). Teachers are expected to know all the answers at school. Students are comfortable and prefer structured learning situations, a strict timeline, precise objectives, and detailed assignments (Hofstede et al., 2010, p. 205). Low UAI societies are comfortable in unknown situations and ambiguity, uncertainty is seen as part of life, and people take it one day at a time. The anxiety level of the population is low, aggression and emotions should be controlled, people who act emotionally are socially disapproved of (Hofstede et al., 2010, p. 196). Rules are flexible, and the truth is considered relative, the distinction between good and evil exist, but it is less precise. At school, teachers are not expected to know all the answers, and they may say, "I don't know". Students are comfortable with open-ended learning situations and have discussions to find the right answer (Hofstede et al., 2010, p. 208).

Organizations in countries with high UAI have a structured environment with formal laws and informal rules in order to control the duties of employees and employees. There are more regulations in order to control the work process. Employees feel more comfortable in such an environment due to how high UAI societies handle unstructured situations. People in these societies are programmed since childhood to prefer structured environments with strict rules and regulations (Hofstede et al., 2010, p. 209). Due to the rules and regulations, organizations tend to be less innovative unless the company emphasizes it and rewards whoever dares to break the law. People, in general dislike changes, which causes uncertainty. Changing job is seen as a move which might cause uncertainty. Due to the uncertainty, people tend to stay within the same organizations for a longer time (Hofstede et al., 2010, pp. 212-217). Formal rules and regulations tend to be less in organizations in low UAI countries, and people are more open to changes. Changing jobs is seen as a standard action. Therefore, it is more common with short employment. Workers are more open to taking risks and are more open to ambiguous situations. Due to less formal rules and the open mindset towards unstructured situations, organizations tend to be more innovative, and workers dare to strive for innovation (Hofstede et al., 2010, pp. 212-217).

3.3.5 Long/Short Term Orientation

Hofstede's fifth dimension, long term orientation, values persistence, perseverance, thrift, meaning that society focuses on the future reward more than the present. Willing to delay short-term success in order to prepare for the future. Short-term orientation is the opposite, where it values past and present, respect for tradition, and fulfilling social obligations. Long term orientation index (LTO) was the measure used in this study. A high score indicated long-term orientation, and a low score indicates short-term orientation. High LTO countries include China, Japan, and Hong Kong. Low LTO countries include Sweden, United States, Australia, and Netherlands (Hofstede et al., 2010, pp. 239-240).

In societies with high LTO, people, in general, are more thrifty, which results in saving money rather than spending. Shame is a common feeling and considered normal. Older children in the household have authority over younger siblings. Marriage is a pragmatic arrangement, and living with in-laws is considered normal (Hofstede et al., 2010, p. 241). Family and work are connected, which makes family enterprises normal, and leisure time is not important. Business-wise the focus is not about the profit for this year, but the importance is the profit ten years from now, and long term relationship with partners is what people strive for (Hofstede et al., 2010, p. 245). In low LTO countries, there is an enormous respect for traditions. Shame is not a common feeling. There is no hierarchy between siblings meaning that birth order is not a status thing. Marriage is a moral arrangement, and living with in-laws are often seen as troublesome (Hofstede et al., 2010, p. 241). Family and work do not have a strong bond, leisure time is important. Business-wise the focus is on this year's profit rather than long-term profit. It is enough to have a good relationship as long as they are involved and benefit the business (Hofstede et al., 2010, p. 251).

3.3.6 Indulgence/Restraint

Hofstede's sixth dimension was added to the model in 2010, which uses Michael Minkov's label Indulgence vs Restraint and is based on World Values Survey. Indulgence act as a complementary to Long/short-term orientation in a weakly and negatively way. It focuses on aspects that the other five dimensions miss out on. Indulgence index (IVR) is the measure, and high IVR refers to indulgence, and low IVR refers to restraint. High IVR countries allow or encourage relatively free gratification of people's own drives and emotions, such as enjoying life and having fun. In a society with a low IVR score, there is more emphasis on suppressing gratification and more regulation of people's conduct and behavior, and there are stricter social norms (Hofstede, 2011, pp. 15-16).

Since this paper focuses on cultural differences on a co-located organizational level, this dimension becomes out of scope and will be skipped.

3.4 Edward T. Hall's Cultural Dimensions

Halls's cultural factors is another dimension that focuses on the concept of cultural and social cohesion. It describes people's behaviour and how they react within various types of culturally defined personal spaces. Based on an anthropological viewpoint, Hall's cultural factors focus primarily on a culture's communication patterns and how the concept of time is perceived in the culture (Hall, 1981). Hall's cultural factors involves **Space**, which focuses on natural social distances that can vary by culture, for instance, the space between individuals in a conversation or in seat placements as different cultures behave and react differently depending on the space between them. Material goods, referring to how much status is conveyed through material possession, which can vary depending on the culture. Friendship, focuses on relationships between individuals where some cultures may see friends and business relationships as temporary while others value friendship and business relationships more, resulting in people preferring to do business with those they know. **Time**, this refers to how the different cultures perceive and value time, for e.g certain cultures take deadlines very seriously while others are more fluid. Agreement, referring to expressing disagreement and how formal contracts are done for e.g. some conclude them through for e.g handshakes while other requires specific contracts. In disagreement, some culture tends to have them openly, and others prefer to solve it privately one on one (Olson and Olson, 2003). These cultural factors are summarized as either High Context or Low Context cultures, based on time and space. Hall defines Low context cultures as a culture where things are said explicitly, where information is conveyed through clear and explicit messages. Emphasis is put on explanation, thus lessen the chances of misunderstanding. This means that the one who acts as the sender in the communication process is responsible for making sure that the message can be readily interpreted without any confusion. In contrast, High Context cultures context is everything. Here, the message that gets transmitted (oral or written) often contains a little information. This leads to a responsibility for the person at the receiving end of the communication to interpret the message, taking into account various factors, such as the time of the communication, facial expressions, hand gestures, and the length of silences (MacGregor et al., 2005). Hall also discusses **Monochronic** and **Polychronic** time, referring to how culture structures their time. Monochronic culture prefers to do and complete things sequentially, one task at a time, while Polychronic culture prefers to put more emphasis on human interaction over time and material things (Deshpande et al., 2010).

3.5 Trompenaars's & Turner's Model Of National Culture Differences

Trompenaars' and Hampdens' "Seven dimensions of culture" is also a framework that focuses on the aspect of cross-cultural communication and is generally applied to general business and management. Their framework helps explain the culture and cultural differences in general, national cultural differences in organizations, learning how to recognise and cope with these in a business context (Trompenaars, 2000). They identified that each culture distinguishes itself in a specific way and more so in a predictable way. This is because each culture has a different way of thinking combined with its own values and beliefs as well as different preferences placed on a variety of different factors. They identified seven distinctive dimensions of culture and concluded that what distinguishes people from one culture compared with another is where their preferences fall in one of the seven dimensions. According to Trompenaars & Hampden-Turner (2000) the seven dimensions are as followed:

"Universalism vs particularism", referring to the degree of importance a culture view the law or personal relationships. In a universalistic culture, general rules, codes, values, and standards have a higher priority than relationships with friends and other types of relationships. People place a high emphasis on laws, rules, values, and obligations. In contrast, in a particularistic culture, human friendship and relationships are highly valued. Hence, personal relationships and obligations have a crucial role when making ethical decisions. There is a belief that each circumstance and each relationship dictate the rules they live by.

"Individualism versus communitarianism", refers to how people regard themselves as individuals or as part of a group. In an individualistic culture, people place the individual before the community/group, which means that the individual's own happiness and priorities go before the groups, and people take their own initiative and take care of themselves. In a communitarian culture, the community/group is placed higher than the individual, which means that the individual should act in a way that serves the society.

"Neutral versus emotional", this describes the degree of acceptance regarding showing emotions if our interaction should be objective and detached or is it acceptable to show emotions. In a neutral culture, people are more hidden with their emotions and are encouraged not to display it publicly. The opposite is for an emotional culture, there is no stigma behind showing emotions, and people do not fear to display it publicly. "Specific versus diffuse", in a specific culture, there is a clear distinction between business and home and kept separated, here individuals focuses primarily on hard facts, standards and contracts. People do not put much emphasis on building strong relationships as they believe it does not have a significant impact on work objectives. They believe that you can work together without having a strong or good relationship. A diffuse culture is more or less opposite of a specific culture; here, a small overlap between work and personal life exists, and good relationships are important when it comes to working objectives and doing business. Thus, people focus on building a strong relationship with each other.

"Achievement versus ascription", in a culture based on achievement, the focus is on what the individual has achieved. Higher status is gained depending on what the individual has and is capable of achieving. For a culture based on ascription, an individual's status is more or less associated with kinship, gender, age, connections with other people, and educational records.

"Sequential time versus synchronous time", refers to how each culture handles time and tasks. In a sequential culture, things and events should happen in order. A high emphasis is on planning, deadlines, punctuality, and to stay on schedule. In contrast, in a synchronic culture, people are more flexible, multitasking is common and acceptable, people work on several projects at once, deadlines and plans are considered more flexible and changeable.

"Internal versus External control", describes how each culture handles their way of dealing with culture. In an internalist culture, people see nature and their environment as controllable. For an external controlled culture, people see nature or the environment controls them thus, it is important that the individuals work with their environment to be able to achieve their objectives. Focus is on maintaining a good relationship with others and the willingness to compromise and keep harmony and peace.

3.6 Reasoning For Hofstede Model

Though highly praised and used, Hofstede's research still faces some criticism. One of the more prominent critics of Hofstede's model is Professor Brendan McSweeney, who, among other of his many critiques, argues that Hofstede's theory is highly ambiguous and contradictory (McSweeney, 2002). McSweeney states that only collecting data from a single multinational organization does not mean that they are representative of the whole world. Further questioning whether dimensions of national culture can really be identified by a questionnaire. Another criticism is that statistical measures (which are used in Hoftsedes research) do not inform on contents of culture and impacts on practices (Joannidès de Lautour et al., 2012). In addition, there is a consensus among his critics Rachel F. Baskerville, B. McSweeney, A. Bhimani etc, that there is a methodological weakness in his research and that Hofstede's conclusions are neither reliable nor robust (Joannidès de Lautour et al., 2012).

Despite the criticism of the dimension, Hofstede's research has provided a good base for culture study. There has been a relatively large amount of research conducted based on Hofstede's dimensions. Providing many academics and practitioners around the world the ability to conduct research and study based on the foundation Hoftstede provided (Jones., 2007). The critiques addressed to Hoftstede's model have had a relatively low impact on cross-cultural research as more than half of cross-cultural research has kept relying on Hoftstede (Joannidès de Lautour et al., 2012). According to Jones (2007) whose research takes an in-depth look at Hoftstede's work and his critics. The authors discusses both sides of the arguments and concludes after weighing in the necessary evidence, including observing a dialogue between Hofstede and his critics, that there are greater arguments which supports Hoftstede's work than disputing it. Hofstede's dimensions have often been used to analyze cross-cultural communication or explore the potential influence has on the process of Software development (Fazli and Bittner, 2017). This corresponds to our research objectives, where there is a significant focus on the behavioral differences in the workplace of a co-located environment within the field of software engineering. An environment where many different cultures exist. In addition, Hoftsede's research conducted a survey for software engineers through a large-scale study with IBM in more than 40 countries, which also aligns with our research objectives. Thus, strengthening further why Hofstede's cultural dimensions are utilized to explain the behavioral differences in our research. Lastly, using Hoftstede's cultural model, you can describe society's culture by specific data through the dimensions and highlight its' influence on the thinking model, value and behaviors of its associated members (Marcus and Gould, 2000).

3.7 Knowledge Sharing

Software development is a social activity that involves collaboration between many different developers. It is a collaborative and knowledge-intensive process that requires effective knowledge sharing. The term knowledge sharing is defined as "the willingness of individuals, groups or institutions to convey or spread knowledge to others" (Anwar et al., 2019). This involves the exchange of task-related information, ideas, know-how, and feedback regarding software products, which can occur via meetings, e-mail, or other types of documentation (i.e intranet web pages, wiki) (Ghobadi, 2015; Ford and Chan, 2003). This means that its success is primarily dependent upon performing it effectively among software development teams (Zahedi et al., 2016). Knowledge sharing is a crucial process as it allows team members to discuss critical aspects of projects and overcome the cultural and social challenges of coordinating work across distributed spaces (Ghobadi, 2015). For companies to maintain a competitive advantage and continuously be creative, managing knowledge in an effective way is crucial (Huang et al., 2008). Knowledge sharing is influenced and enabled by four major categories of conditions. These are "social/ behavioral characteristics of teams (e.g., mutual trust, attentive enquiry, open dialogues), cognitive/ epistemic attributes (e.g., common knowledge, shared values and goals), organizational structure/strategies (e.g. empowered divisions, leadership style) and provision of information systems (e.g., internet, intranet, yellow pages)" (Zahedi et al., 2016). Even though it is not often brought up in research, the knowledge sharing process tends to encounter various barriers in GSD, leading to difficulties in organizing, storing, sharing, and disseminating knowledge (Nor et al., 2009). To be able to implement knowledge sharing practices effectively in GSD, software developers need to have a detailed understanding of the various barriers and facilitators (Anwar et al., 2019). Consideration should be given that knowledge not only flows within the individual but also within teams and organizations and in different directions (i.e from top to bottom, across co-workers, or bottom-up) (Ford and Chan, 2003). It resides in different software processes, activates, organizational assets and methodologies, environment, knowledge reside in team members mind (Waheed et al., 2019). Therefore, interrelations between these levels can affect the way knowledge is shared and transferred in addition, become a barrier to efficient knowledge flows (Anwar et al., 2019). Hence, it is crucial that effort is made to share and transfer knowledge, in order to deliver the ideal product to the customer (Waheed et al., 2019).

3.7.1 Tacit Knowledge and Explicit Knowledge

Knowledge is generally divided into two categories: explicit knowledge and tacit knowledge, in which both are considered a valuable asset in an organization. Explicit knowledge refers to knowledge that can be found in written documents, any material in physical form (Waheed et al., 2019). This type of knowledge is relatively easy to transfer and codify as it is formal and systematic (Borges, 2012). In contrast, tacit knowledge is more difficult to communicate and formalize as it is knowledge that resides within the individual's mind (Rumanti et al., 2016). This refers to skills, thoughts, perceptions, values and faiths which makes it harder to share the knowledge (Waheed et al., 2019). Tacit knowledge can be affected by various environmental conditions that support as well as with the challenges in completing a task. Although a valuable asset to organization, they often fail to capture what their employees know due to its nature, which can lead some to ignore the role of tacit knowledge due to its difficulty to capture and communicate (Borges, 2012). Knowledge sharing is crucial for project success and for teams to work together. Hence, each individuals knowledge and capabilities within the organization are one of the most crucial parts in reaching organizational success (Rumanti et al., 2016). With the existence of tacit knowledge and the difficulties around it, failing to utilize and capture it within an organization can significantly influence the organization's core competencies. Thus, GSD complicates it even more, when it comes to sharing both explicit and tacit knowledge due to its circumstances.

3.8 The International Personality Item Pool

The International Personality Item Pool (IPIP) is a collection of items to measure personality characteristics. Personality characteristics consist of:

- Extraversion involves being talkative, assertive, energetic
- Agreeableness involves being good-natured, cooperative, trustful, concern for others
- Conscientiousness involves being orderly, responsible, dependable
- Neuroticism involves being calm, not easily upset, not neurotic
- Intellect/Imagination involves being intellectual, polished, independent minded

The personality traits together are named as The Big Five traits (John and Srivastava, 1999). According to Goldberg and Mervielde (1999), personality inventories in the public domain were very narrow and limited in terms of coverage of personality characteristics, which he refers to as narrow-bandwidth instruments. On the other hand, broad-bandwidth instruments with broader coverage were usually not open for the public and often copyrighted by the authors, making it difficult for other researchers to use them for other studies. Therefore, Goldberg and Mervielde decided to create the IPIP for the public domain. With the IPIP, researchers can freely use any item in the collection and combine it with other items according to their own interests. Questionnaires on a large scale can be considered tedious for the participants, which may put them in a negative mood, which might alter the answers. As a result, mini-IPIP was developed by Donnellan et al. (2006), which is a smaller scale of a personality test based on items in the IPIP. Instead of the fifty items IPIP test, mini-IPIP scales with four items per Big Five attribute, which ended up with 20 items in total (Donnellan et al., 2006).

4

Methodology

In this chapter, the methodology used for conducting the thesis will be presented, describing the research approach and the necessary steps required for gathering evidence to achieve the goal of the thesis.

4.1 Research Design

An overview of the methodology process can be seen on figure 4.1. The initial step of this study were to conduct a literature review in order to gather knowledge about the thesis topic. In addition, a interview form and questionnaire got created with the knowledge gathered from the literature review. The second step was to conduct the interviews and the questionnaire in order to gather insight from a practical viewpoint. With the data acquired from the interview the analysis process started with the help of constructivist grounded theory which involves three steps of coding where the steps got conducted multiple times in order to compare analysis findings. In addition to the qualitative data, quantitative data derived from the questionnaire got analyzed with the help of quantitative methods. As an outcome, a conceptual model got created and with the help of constructivist grounded theory and analysed quantitative findings will be presented in the results section.


Figure 4.1: Overview of the approach

4.1.1 Qualitative Method

The qualitative research approach is often used when investigating social phenomena. This means in circumstances in which people are involved, and different kinds of processes take place. Learning about environments, situations, and processes can not be retrieved through quantitative data analysis methods (Dybå et al., 2011). A method designed and used by social scientists and educational researchers to study complexities of human behavior (e.g., motivation, communication, understanding) (Seaman, 1999). Therefore, qualitative research is vital for researchers to be able to fully understand the complexities of human behavior as it can not adequately be described and explained through statistics and other quantitative methods (Dybå et al., 2011). Dybå et al., (2011) state that the method enables researchers to explore complex situations in-depth and to allow them to highlight many angles of people-centered situations. The aim of the research approach is not as in quantitative research where it often boils down to accepting or rejecting an a priori defined hypothesis but more at constructing a theoretical framework and in overall to build theory and define new variables. The constructed framework is built on the analysis of the data obtained from the research, enabling researchers to explain results in a comprehensible way (Dybå et al., 2011). A few examples of qualitative methods are action research, case study research, ethnography, and grounded theory. For data collection, there are for e.g, observation and participant observation, focus group discussions, open-ended questionnaires, interviews, analysis of videos and photographs, documents analysis. But generally, face-to-face semi-structured interview is utilized. The most common techniques for analyzing the obtained data are thematic analysis, interpretative phenomenological analysis, discourse analysis, descriptive approaches, grounded theory, and narrative analysis (Haq, 2015). Lastly, you can conduct research on the same topics using quantitative or qualitative research, but each of them addresses the topic through different types of questions.

4.1.2 Quantitative Method

The quantitative approach measures and analyzes causal relationships between variables, often dealing with independent and dependent variables. The aim is usually to find a cause and effect or the relationships between variables to verify/nullify theory or hypothesis (Haq, 2015). It is often conducted by setting up controlled experiments or collecting data through case studies. Collecting data is usually in the numerical form obtained from a representative sample and analyzed through statistical methods (Lázaro and Marcos, 2006). For sampling in quantitative research, techniques used are usually random sampling, which has a variety of variations such as systematic random sampling, stratified random sampling, and quota random sampling. For obtaining data, the methods range from telephone interviews, web-based surveys, postal surveys, and structured questionnaires (Haq, 2015). According to Haq (2015), studying social phenomenons seldom naturally generates numerical data. This type of barrier is circumvented by researchers through utilizing various techniques/instruments such as scales in questionnaires where the subjects are asked for e.g to rate a phenomenon like strongly agreed to strongly disagreed. Hence, within quantitative research for social sciences, structured questionnaires are generally used.

4.2 Literature Review

The initial step in this research was to conduct an extensive literature review in order to gather knowledge about socio-cultural diversities within software engineering. This phase aimed to understand the concept and increase the understanding of socio-cultural diversities within software engineering and how it affects knowledge sharing. Various research papers were read to gather insight into the effect of culture within software development. Research papers, e-books, conference papers were found through Google Scholar, Chalmers online library, IEEE, ScienceDirect, Wiley online library, and ACM Digital library. For finding literature, an approach was used utilizing the following keywords:

Software development and Culture, Global Software development, Global software development and challenges, Cultural differences in software development, Cultural differences in Global software development, Knowledge sharing challenges, Knowledge sharing and Global software development, Cultural differences, and knowledge sharing. These terms were used extensively with different endings and combinations in search of relevant literature. To help further in the process, the thesis supervisor also assisted in pointing towards related and relevant literature. In addition, the references of the articles were also explored and reviewed to further increase the knowledge and insight of the subject. Through the literature review, a deeper understanding of how socio-culture affects software development was obtained. In addition, a broader understanding of challenges that arise due to culture was also obtained, which helped generate a well-formed interview. The challenges that arise were categorized in a structured manner following Hofstede's dimensions. This procedure helps in forming a more concrete result and was used when generating the interview form and helped mapping the answers from the interviews.

4.3 Grounded Theory

Two Sociologists Glaser and Strauss (1967) introduced grounded theory (GT) in 1967. GT has been proved as a useful research methodology in various fields, including sociology, nursing, and management, where the research involves human aspect, social and cultural behaviour. Rather than validating existing theories, this methodology generates new theories based on constant comparing the qualitative data. Over the years, GT has evolved. The steps on how to conduct a proper GT might differ depending on the approach. The well-known ones include the traditional GT, also known as Glaserian grounded theory, Straussian grounded theory, and Constructivist grounded theory (Stol et al., 2016). The differences in the different approaches involve how to treat existing literature, how to set up the research questions and the process of coding the data before generating a new theory. The difference between the GT's are, for instance, the way traditional GT uses existing literature, Glaser argues for to be cautious when reading existing literature in order to ensure an open mind and to prevent bias. On the other hand, Straussarian GT and Constructivist GT emphasizes the use of existing literature. They mean that the use of existing literature can inspire the researcher's mind, inspire new questions, and be used as a supplementary validation (Kenny and Fourie, 2015).

In this thesis work, the Constructivist grounded theory proposed by Charmaz (2006) will be used and consists of several parts: Data collection, initial coding, focused coding, and theoretical coding.

4.3.1 Data Collection

According to C. Lethbridge et al. (2005) it is crucial to obtain accurate and reliable information about a phenomenon when conducting field studies. The authors further state that learning about different aspects of a phenomenon in an adequate manner should consider using multiple data collection methods. A large focus of the thesis is on interviewing employees from various Swedish software companies that consist of multicultural employees as the thesis's focus involves software development in that specific environment. The reason for this choice is to minimize factors between widely different companies (for e.g. outside of Sweden) that might affect results. The interviews are conducted in the language the participants feel most comfortable in, and English is used if required for e.g if the interviewee is not Swedish or more comfortable speaking English. The most pivotal parts will be translated and presented in English in Chapter 5 on page 27. In addition, data will also be collected through an online questionnaire using google form. A form of data collection that is easy to manage, convenient, relatively easy to distribute, and provides a suitable way of analyzing data.

4.3.1.1 Sample Group

Research participants are selected in a purposive manner and in a small number of cases and integrated according to their relevance (Haq, 2015). In a qualitative approach, researchers tend to select participants who fit the criteria that align with the research objective to highlight the particular issue of interest. This means that the knowledge of the object of study has priority over sampling theory (Cropley, 2015). The participants were selected based on a few criteria, have an occupation in software development, their experience in the software engineering, being in a multicultural organization, and/or have worked/working with people of different cultures/nationalities. Mostly engineers were interviewed with a mix of senior and junior developers in order to get a more comprehensive knowledge of input. In total, 10 interviews were conducted and can be seen in table 4.1, specifying all interviews, including the interviewee's title, experience, role, culture, ethnicity, and marked if the interview were conducted face-2-face. We believe that the difference in interviewing remotely compared to onsite does not hamper the information acquired due to us being clear that we sought experiences from a practical viewpoint on a co-located environment.

| Т | Experience | | | N T 1 1. | |
|------|------------|---------------------------------|--------|------------------------------|-------------------------|
| ID | (years) | Role | Gender | Nationality | Culture |
| P01 | 10 | System analyst, Database Admin. | Male | Syrian | Middle-eastern |
| P02 | 1 | Test-engineering | Male | Swedish | Swedish, Middle-eastern |
| P03 | 7 | IT-Consultant | Male | Swedish | Swedish |
| P04 | 4 | Software developer | Male | Swedish, Somalia | Swedish, Somalia |
| *P05 | 2 | Web developer | Female | Chinese | Swedish, Chinese |
| *P06 | 2 | Software developer | Female | Vietnamese, Chinese | Vietnamese |
| *P07 | 3 | Test-engineer | Male | Swedish | Swedish, Afghanistan |
| P08 | 3 | Software developer | Male | Swedish | Swedish, Bosnia |
| *P09 | 1 | UX developer | Female | Swedish, Vietnamese, Chinese | Swedish |
| P10 | 5 | Release manager | Male | Swedish | Swedish, Assyrian |

Note: Interview conducted face-2-face, marked with *

 Table 4.1: Sample group information

4.3.1.2 Questionnaire

Based on the knowledge gathered together with findings from the literature review, a preliminary questionnaire was created. Together with our supervisor and a thorough discussion, a finalized version was defined. In preparation before each interview, one questionnaire and one personality test, the mini-IPIP, were given to the participants. The questionnaire acts as a complement to the interviews to provide a broader aspect regarding the participants' organizational structure in terms of knowledge sharing. In addition, it aims to give a deeper understanding of how socio-cultural diversities affects communication processes. The reason for including the mini-IPIP test is to get a better insight into the participant's personality since it might be hard for someone who is introverted to express their thoughts openly. The mini-IPIP test is measured in a 5-point Likert-scale with different levels of agreement to a statement. Example of statements in the mini-IPIP test are reported as follows:

Personality trait: Extraversion

Statement: "I am the life o a party"
Scale:(1) Strongly disagree; (2) Somewhat Disagree; (3) Neither Agree nor Disagree;
(4) Somewhat Agree; (5) Strongly Agree.

Personality trait: Extraversion

Statement: "I don't talk a lot"

Scale(Reversed):(1) Strongly agree; (2) Somewhat Agree; (3) Neither Agree nor Disagree; (4) Somewhat Disagree; (5) Strongly Disagree.

4.3.1.3 Interviews

Conducting interviews as a part of the research is for collecting data about phenomena that cannot be obtained in a quantitative manner (Hove and Anda, 2005). According to Hove and Anda (2005), interviewing people provides insight into their world; their opinions, thoughts, and feelings. When the aim of this thesis is of a qualitative nature, it is, therefore, appropriate to rely on qualitative measures. According to Gill et al., (Gill et al., 2008) and Runeson et al., (2008), there are three fundamental types of interviews: Structured, semi-structured, and unstructured interviews. Semi-structured interviews consist of several key questions that help define the areas to be explored. It provides the researcher with the ability to diverge and pursue an idea or response in more detail. A semi-structured approach, compared to, e.g., structured interview, allows for more flexibility, allowing for more discovery or elaboration of information. Information that is important to participants but may not have previously been thought of as pertinent by the research team (Gill et al., 2008). Thus, a semi-structured interview was the most appropriate approach as there was no indication of how homogeneous the interviewees would be. At the same time, we would have the ability to adjust the questions towards each subject. With the knowledge gathered from the literature review process, an interview form was created. Interviews would give a more extensive understanding of how the socio-cultural affects knowledge sharing from a more practical viewpoint. Thus, it provides even more insight into the problems the software engineering industry face regarding culture from an industry perspective to a greater extent, highlighting the most common challenges and understand how the industry faces them. In addition, the interview questions also intended to clarify any other uncertainties that were raised in the literature review. The semi-structured interview consisted of open and closed-ended questions, starting with basic questions more or less as a warm-up, then gradually switching to more targeted questions. In order to test the feasibility of the interview and questionnaire, a pilot study was conducted. It would further provide insight into if the information needed was able to be extracted. The result of the pilot interview was successful and insightful. Thus, it provided the necessary information needed in which it was decided to be kept and used to analyze with the rest of the interviews. The interview form that was created and conducted can be seen in Appendix A

4.3.2 Transcripts and Interview Content

In a study example described by Runeson et al. (2008), the analysis method used in combination with interviews was transcription. The same approach was used in this study, and consent for recording the interview was acquired beforehand. The advantage of this method is that both researchers are able to focus on listening and reading the body language during the whole interview process without having the need to take excessive notes. Without the need to take notes, it enabled active listening for us, meaning that it was easier to come up with follow-up questions and paraphrase some parts of the interview to confirm what has been said (Guion et al., 2011). Transcription can be done either by manually transcribing the interviews or using Natural Language Processors (NLP) tools. Manual transcription is very tedious and time-consuming. In order to fully understand the participants, it resulted in listening to the same interview multiple times. Even though NLP tools complement comprehending and labeling qualitative data, we decided to use manual transcription since the tools might miss out on important information due to different English accents and the quality of the recordings.

4.3.3 Coding

In grounded theory, coding is the link between collecting data and developing new theories to explain the data. In constructivist grounded theory, the coding process consists of three steps: **Initial coding**, **Focused coding** and **Theoretical coding** (Charmaz, 2006). Initial coding is the first coding process that requires close reading of the data. By analyzing the data by word, line, or segment, labels will be generated according to the segment of data. The outcome from the initial coding will then be used in focused coding. Rather than close reading of the data, focused coding analyses the generated labels to explain larger segments of data. The analyze uses the most significant and/or the frequency occurrence of earlier codes (Charmaz, 2006, p. 57). Theoretical coding is the last process in terms of coding the data. This process tries to specify the relationships between the defined categories from the previously focused coding (Charmaz, 2006 p. 64).

5

Results

This chapter present the results gathered from the interviews and the questionnaires and will be divided into three sections. The first section presents the findings acquired from the interviews. The second part presents the questionnaire results, and the third section will present findings from the personality test, mini-IPIP.

5.1 Interview Results

In this section, the most reoccurring barriers and challenges the interviewees face in the process of knowledge sharing are presented in figure 5.1. The result acquired from the interviews identified four categories with the help of coding. The four categories consists of: The Impact of Language Barriers, The Impact of Seniority, The Impact of Hierarchy and The Impact of Cultural Behaviour



Figure 5.1: Conceptual model of barriers derived from the coding processes

5.1.1 The Impact of Language Barriers

A common denominator that affected the knowledge sharing in the interviews was the language barrier. This factor had an impact on the communication and the mutual understanding between the individuals. Being in an environment involving different cultures and working with people of different nationalities proved to be a different experience, resulting in considerable communication difficulties and interpretation. The interpretation of communication is an important aspect, and how each culture interprets, differs, and the other party could misunderstand certain queues and behaviour. Difficulties in the interpretation led to parties involved in the conversation, not having a proper mutual understanding. In addition, proficiency in the language affected communication, which affected the effectiveness and their shared understanding.

"I have encountered it on some occasions, there is a difference when working with someone who has a different nationality where language barrier might become a problem. The main reason for the problem is the interpretation due to the language barrier, the person who I talk to does not always understand the whole meaning or idea. We mainly communicate in English and due to different nationality, the English skill level might differ."

- Participant 2

"there is some difference in the quality of English which can cause misunderstandings and confusion since the way you speak and the way you interpret are different".

- Participant 10

Even factors such as accents had a significant impact on the communication, resulting in difficulties in understanding what their colleague wants and what requirements needed in their discussion. Having heavy accents hampered verbal communication, which was an issue according to one of the interviewees.

"I am working in an international company, sometimes we might have a requirement from someone from another nationality or if they have a thick accent. it can be difficult to understand what he really wants and what requirements he wants. It can also happen with co workers, since it is an international company, the mandatory language is English but sometimes the accent of some co workers can be quite difficult to understand."

- Participant 4

"Understanding different accents was another problem and I think that it's since different people with different nationalities work together, the skill level of English or the accent is not always easy to understand." - Participant 7 The flow of communication is also important, and in cases where team members did not share the same native language, it resulted in a significant negative impact on the communication flow. Having to switch between the native language and common language was cumbersome disrupting the flow of communication and could even affect the team synergy.

'...if we are going to sit with a group of people and have a discussion a certain tempo is necessary for it to flow. If we are suddenly going to speak English (referring to all swedes and suddenly switch to English) it feels like this tempo is being interrupted because there are moments during the discussion you don't know what a certain term is called in English, stopping yourself for a second thinking "what is this term called in English?" etc, interrupting the flow of thought and discussion of the individuals.'

- Participant 3

Having a steady flow of communication and team synergy was sometimes deemed so crucial that there were situations where everybody in the group would not be involved in solving a certain task or problem, for instance, when they are not sharing the same native language as it meant switching communication environment and settings.

"If we feel that all the competence needed is already within part of the group then we will only use that part even though you should include the whole group. This means involving the whole group(involving the third party) might slow down the tempo, the work for the rest of the group e.g in the discussion (by for e.g. switching language, thinking)."

- Participant 3

This does not necessarily imply that the group would exclude that specific individual or group but more in the aspect of having communication flow and project tempo as the main priority. But there were situations where the majority of the group adapted to the changes as it deemed crucial for the project task and success.

"There are exceptions sometimes for these situations. For e.g under normal circumstances you would have ignored including this individual (too keep a high tempo) but if this individual is exceptionally skillful and necessary for solving certain problems then switching e.g from Swedish to English is no problem as this individual is crucial for the task/work at hand. Basically, in certain situations if a certain task is going to be solved and a certain tempo is needed to be held." - Participant 3

Working towards the project goals, being as effective as possible and solving problems as fast as possible is crucial and deemed to be high priorities. In this situation where language plays a crucial role, adapting to these changes and environment was willingly made as long as it ensured steady tempo, development process, communication flow etc.

"By the end of the day, the goal is to solve a problem, if it is necessary to solve the problem faster by for e.g speaking English then we do what is necessary that will say speak English, if we need to solve the problem faster by splitting up in small groups, then that is what we are going to do. It is all about solving the problem the fastest way possible, you want to be effective as there is someone who is paying for our work and wants to have their problems solved as soon as possible."

- Participant 3

5.1.2 The Impact of Seniority

In general, seniority is often associated with age, but work experience is also included in the seniority aspect. Many of the participants in the interviews mentioned seniority as a communication barrier in raising their voice whenever disagreement occurs. Mainly, most participants find it hard to criticize or even raise their voice to someone more senior than them. One of the participants emphasized especially that this kind of problem has to be approached conservatively and that this type of problem is a barrier.

"For instance as my first job as a developer, I saw someone who committed poorly written code and the person was a senior, it is much harder to criticize or even correct the problem due to seniority, you have to approach the problem conservatively, its a barrier."

- Participant 1

One common feeling that the majority of the participants with less experience have is that the more senior ones often have a preferred approach on how to do things. This gives them a feeling that the senior has a relative lack of interest whenever they present a new idea or express their thoughts, resulting in less motivation in terms of sharing their ideas or opinions.

"Due to lack of interest for new ideas or thoughts regarding how to do certain things, it makes me less motivated since it feels like it's impossible for them to accept and adapt my suggestions." - Participant 2 "I find it hard to share knowledge to a person who thinks that he/she knows everything, sometimes it feels like they listen to my thoughts just for the sake of it."

- Participant 10

In addition to seniority, being inexperienced and young were also mentioned as a challenge in terms of speaking up and sharing own opinions.

"So mainly because why I did not speak up was due to my inexperience within the field and also due to seniority."

- Participant 4

"As a junior developer, I can feel that my opinions do not come out sometimes. Sometimes you may not dare to express yourself when you do not think that you have as much experience as others."

- Participant 5

"Yes, many times and it's due to their reaction when I do share knowledge and have new ideas. Due to me being young and rather inexperienced compared to others I feel that my knowledge is not received as highly as other more experienced colleagues."

- Participant 6

One interviewee shared a scenario where he presented his idea, and he felt that it got accepted and everyone agreed. But at the same time, when they started the project, the mentioned idea was not even considered.

"Yeah I have, but that is often after my first approach, for instance after suggesting an idea or a new approach and if it feels like it gets ignored, almost like they kind of agree with you but they do not care and still choose to go with their own approach. At the beginning this resulted in me staying quite instead." - Participant 4

5.1.3 The Impact of Hierarchy

The majority of the participants work in organizations with a hierarchical structure. The difference is the hierarchy level within the organization, some work in a strong hierarchical environment, while some work in organizations with a relatively flat hierarchy. One dominant factor that creates hierarchical structure are the different roles or titles associated with the different employees. One common thing that many interviewees mentioned is the challenge when talking to someone higher up, for instance, superior. Most of them mentioned that they felt a need to think twice before raising their voice.

"We do have a hierarchy within our company, it depends on who I am talking to, for instance the higher up in the hierarchy, I would take extra precautions before I raise my voice."

- Participant 2

"Even though the hierarchy in this company is rather flat, there are still position gaps so depending on who I speak to, I may think twice before I raise my voice."

- Participant 4

Multiple interviewees mention the challenge to question a superior. They expressed that it is hard to question a superior's decision due to their respective cultural backgrounds.

"I have experienced where I chose to not question the superior since part of my culture tells me that they need to be treated with respect. So, most of the time I just accept the way the superior wants. Of course it depends on how serious the topic is, if I have no choice other than raise my voice, I'll do it." - Participant 7

"I am fully aware that one should see each position as just a title, but sometimes it can be challenging to have this attitude when culture comes into play, especially for me, who comes from a mixed cultural background." - Participant 5

The need to gain permission from above in a hierarchical organization is not an uncommon thing. One interviewee mentioned a scenario during his time in China, working offshore within the same organization.

"It happens, for instance when I worked in China, I felt the impact of cultural diversities. For instance, hierarchy, I know what I can do but to do it I might need permission from someone above me." - Participant 2 Besides, an organization with a high hierarchical structure does not only require permission whenever things have to be done. It can also make it hard for the employee to share knowledge with coworkers above them in terms of position within the organization. Hierarchy also affects how information should be passed between teams. Even though they are co-located, and the hierarchy structure is relatively flat. The way information is expected to be passed might differ due to different socio-cultural backgrounds.

"The norm for a swede is to pass information regardless of position whereas the norm for a Chinese, the knowledge must be passed according to the positions. The information must come from above and not from another team leader or team. This kind of problem has occurred even though we are working in a Swedish company with a rather flat hierarchy located in Sweden, co workers who comes from China to work offshore treats hierarchy very differently compared to us."

- Participant 10

"In a organization where there are a lot of hierarchy, it might feel difficult for me to share my knowledge and opinions with someone above me." - Participant 2

Even though Sweden has a relatively flat organizational structure in terms of hierarchy, it does not mean that it's always easy to raise your voice in terms of questioning or suggesting things. The feeling that it is not in my place to raise my voice since the receiver has a higher status, and he knows better.

"I selected this option with this in mind, let's say the a lead developer are guiding the team towards the end goal, even though we have a flat hierarchy structure in Sweden I have felt that it is not in my place to question or suggest things to the lead developer due to his position."

- Participant 4

5.1.4 The Impact of Cultural Behaviour

Socio-cultural differences influence many aspects and shape individuals' perceptions, attitudes, and behaviour, leading to certain queues and behaviour being misunderstood. Individuals from different cultures can react differently, even though they are subjected to the same situation. How each individual perceives things can vary depending on each culture.

"I am from a culture with a bit louder voice when speaking, so sometimes in a meeting, some members can talk in a very small voice and some talk a bit louder. What I want to say that the way we communicate might differ because of nationality."

- Participant 4

"Some cultures are more strict with time, for instance, if we said 12:00, 12:01 is not okay and in other cultures sometimes it is more tolerated. ...when you're working with Germans they tend to say things straight up in front of your face, very different from Sweden and these kinds of actions can be taken differently by others." -

- Participant 1

"We have a different work culture in Sweden compared to some western countries, countries in Asia and this has resulted in some communications difficulties. For instance holidays in Sweden are different compared to holidays in India. Co-workers from India tends to answer their work phone and even answers mail during holidays and in contrast to a swede, whenever we leave for holiday or vacation, we turn off our work phone and does not even bother to check our work mails..."

- Participant 10

Being perceived as polite and considerate is often key in keeping harmony and a steady relationship with colleagues. Having a healthy work environment lessens the chances of conflicts, but difficulties can still arise in these situations

"I feel I have a hard time saying "no" sometimes because it might be perceived as impolite even though saying no might be the most appropriate answer. There have been situations where I was ordered to work overtime because of different reasons (colleague on leave, delays etc) and when asked I said yes even though I wanted to say no or at least express that I have a lot to do already and that taking on more work might result in me overworking myself but I felt it would be impolite. Instead I caved and accepted without saying much." - Participant 5 "...that person is very smart/capable but can't contribute with anything that goes against its' own cultural norm for e.g speak up (against others/criticism). It goes against that person's ethical values, in sense where you don't actually speak up. This basically impairs communication because this person maybe sits there and have a very good solution but does not tell anyone."

-Participant 3

"..co-workers from the western tends to speak straight up if there are any misunderstandings or confusion, whereas co-workers from Asia tends to keep it for themselves."

- Participant 10

"I am from a cultural background where harmony in a team is the key for success, which makes me adjust my wordings before I raise my voice, so it does not appear offending." Participant 10

By trying to be too polite, thus a bit passive in the team, and refraining from speaking out too much can affect the team dynamics and be burdensome for the group. In addition, feeling uncomfortable to criticize or give feedback is often more difficult when more experienced people are involved, especially in situations where the individual is the one with less experience. Coming from a culture where there is a lot of emphasis on seniority and experience, individuals tend to speak out less and give their opinions on issues as it feels that they might challenge their seniors

"....need the rest of the group to be proactive and actually approach the person directly for him/her to actually speak to the group. This changes the typical culture in the Swedish IT industry where you most often speak up, state opinions, criticize, thinking out loud etc."

- Participant 3

'... I come from a culture where there is a lot of respect expected to those higher in position/older than me and you seldom criticize them even if it is something wrong or that things need to be changed or improved, I feel it is uncomfortable to criticise or give too much feedback as I feel that I might disrespect or make our relationship uncomfortable. There is an emphasis to listen to those with more experience in my culture as they know "better".'

- Participant 6

Not only in situations where giving feedback or opinions is difficult. When confronted about a situation that happened during a team meeting, the individual felt uncomfortable to the extent that they quickly apologized about the situation even though not being in the wrong. Feeling the need to not stir up the conversation further and keeping a stable relationship was more important than to argue or give a proper explanation behind their action or point of view. "Even though I felt I did nothing wrong I felt I did not want to cause any more drama or rifts in the team thus I apologized profusely wanting it to be over as soon as possible. I feel like in where i am from such confrontations and speaking out like that is unusual and being confronted like that felt very uncomfortable." - Participant 6

Collaborative development activities are affected by each culture as some have it easier to get involved and be active for, e.g., speak up, give opinions, etc. This affects how each individual works within those activities. Changing up the structure of how the development activities are, is sometimes needed in order to include and enable all individuals.

"I have to change the way I host workshops. Before when I hosted workshops I only needed to think and act according to the western culture and I could expect that everyone speaks up and that they are involved in the sessions. But now since we have coworkers with different nationalities, I have noticed that I must change the way I host the workshops, for instance give space for coworkers who doesn't speak due to hierarchy, so they actually can speak up their mind. - Participant 10

Even in the change of environment, culture is still deeply rooted. To be working in a certain country, then switching to a new country with new culture results in certain changes that might be hard to adapt to.

"I am used to it and it's because of my culture. So when I work here in Sweden, it might be me who thinks about seniority as a thing and not them. It is part of my culture that we do have respect to seniors and old people." - Participant 1

Besides these aspects, religious differences seem to have an impact on the team. Not being culturally aware causes misunderstandings within the team.

"..for instance even if you're not religious yourself most people from my culture are conservative, there is a certain time of the year where they fast and not eat food and that is due to religion... Here in Sweden if you're religious and you decided to fast these upcoming days and there are some team building activities that are ongoing and you say no to them all the time and if people don't know you're doing it because of religious reasons, they might misunderstand and you might get misunderstood for not participating in team activities due to fasting since they don't know." - **Participant 1**

5.1.5 Additional Data

Regarding the hierarchical structure in the organization for the respective participant, a weighted question was asked to each participant during the interview. Figure 5.2 shows that 40% of the participants felt that their respective organization are not so hierarchical, whereas 60% och the participants felt that their respective organization are somewhat hierarchical and above.



Figure 5.2: How hierarchial their organization is

The participants were also asked how social their team is, which could give a small indication of their perception of their team's social ability. The result showed that 40% (N=4) felt that their team are extremely social. It was also rather divided in the fact that 20% felt that their team are very social and equally portion felt not so social. Lastly, a small portion (10%, N=1) felt that the team was somewhat social and not at all.



Figure 5.3: How social respondents team are

To get a better insight into how collaborative each team is for every participant, the question "how collaborative is your team" was asked. The result shows that the whole sample group felt that their respective teams are somewhat social and above



Figure 5.4: How collaborative respondents team are

5.2 Questionnaire Results

A majority of the participants felt that they are given the ability to provide feedback or opinions on development decisions or changes within their organization. A large portion felt to some extent and above, while none of the asked participants felt they had a small impact or none at all.

 To which extent are you allowed/encouraged to give feedback or opinion on development decisions or changes in your company?
 ^{10 svar}



Figure 5.5: Giving feedback on development within organization

Even though having the ability to give feedback or opinions, the participants felt differences in doing as it depends on who the receiver was. On table 5.1 the participants were asked how comfortable they were in giving **feedback or opinions** on decisions or changes made by a specific role. The responses were scaled on 1-5 from very uncomfortable to very comfortable. Giving **feedback or opinions** on changes by for, e.g., superiors the respondents seemed to be divided as many expressed being uncomfortable in doing so (N = 4, 40%). However, there were a few (N=3, 30%) who also indicated to be comfortable in expressing feedback/opinions on changes (Mdn = 3.5, IQR = 2.25). When it came to colleagues, subordinates, juniors, different age groups (older vs younger), genders, and individuals of different cultural backgrounds, the respondents seem to be more comfortable expressing their opinions and feedback.

In the aspect of **criticizing/challenging** decisions or changes, the results indicated a sense of hierarchy were taking into consideration. For instance, challenging/criticizing superiors, the majority of the respondents indicated to be either very uncomfortable (N=1, 10%) or uncomfortable (N=5, 50%) in doing so (Mdn=2, IQR=1,25). The results were relatively similar when it came to seniors. Challenging or criticizing changes or decisions made by colleagues (same level on hierarchy), the respondent's opinions seemed to be rather divided. Rather similar indications can be seen when it came to different age groups. When it came to juniors or subordinates, the majority of respondents seem to be relatively more comfortable in criticizing, where none felt very uncomfortable or uncomfortable.

| Role | Very uncomfortable | Uncomfortable | Neither | Comfortable | Very comfortable | Median (1-5) | IQR |
|-------------------------------|-----------------------|---------------|---------|-------------|---------------------|-----------------|------|
| Superior | 0% | 40% | 10% | 30% | 20% | 3.5 | 2.25 |
| Colleague (same hierarchy) | 0% | 10% | 10% | 60% | 20% | 3.5 | 1.25 |
| Subordinates | 0% | 0% | 20% | 40% | 40% | 4.0 | 1.25 |
| Senior (more experienced) | 10% | 10% | 30% | 40% | 10% | 3.5 | 1.25 |
| Junior | 0% | 0% | 0% | 70% | 30% | 4.0 | 1.0 |
| Different age groups | 0% | 10% | 40% | 30% | 20% | 3.5 | 1.25 |
| Gender | 0% | 0% | 10% | 60% | 30% | 4.0 | 1.0 |
| Diff. cultural background | 0% | 0% | 20% | 50% | 30% | 4.0 | 1.25 |

 Table 5.1: How comfortable they are on giving feedback or opinions on decisions made by (role)

| Role | Very uncomfortable | Uncomfortable | Neither | Comfortable | Very comfortable | Median (1-5) | IQR |
|------------------------------|-----------------------|---------------|---------|-------------|---------------------|--------------|------|
| Superior | 10% | 50% | 20% | 10% | 10% | 2.0 | 1.25 |
| Colleague | 10% | 20% | 20% | 30% | 20% | 3.5 | 2.25 |
| Subordinates | 0% | 0% | 40% | 40% | 20% | 4.0 | 1.25 |
| Senior (more experienced) | 20% | 40% | 10% | 30% | 0% | 2.0 | 2.25 |
| Junior (less experienced) | 0% | 0% | 20% | 60% | 20% | 4.0 | 0.5 |
| Different age groups | 0% | 30% | 40% | 20% | 10% | 3.0 | 2.0 |
| Gender | 0% | 10% | 50% | 20% | 20% | 3.0 | 1.25 |
| Diff. cultural background | 0% | 10% | 50% | 20% | 20% | 3.0 | 1.25 |

Table 5.2: How comfortable they are on criticizing/challenging on decisionsmade by (role)

Asking the respondents who they most likely would ask for help from, the results indicated to be likely from the majority of the groups. The majority of respondents were extremely likely when it came to seniors (Mdn = 5.0, IQR = 1.0) and colleagues (Mdn = 5.0, IQR = 1.0). An exception was when it came to asking juniors who are less experienced. Here the responses varied where half were neutral (Mdn = 3.0, IQR = 1.25), and some responded to likely (N = 2. 20%) be asking for help from juniors. Lastly, a portion seemed to be extremely unlikely (N=1, 10%) and unlikely (N=2, 20%) to ask help from juniors.

| Role | Extremely unlikely | Unlikely | Neutral | Likely | Extremely likely | Median (1-5) | IQR |
|-------------------------------|-----------------------|----------|---------|--------|---------------------|-----------------|------|
| Superior | 0% | 20% | 10% | 60% | 10% | 4.0 | 1.25 |
| Colleague (same hierarchy) | 0% | 10% | 0% | 20% | 70% | 5.0 | 1.0 |
| Subordinates | 0% | 10% | 30% | 50% | 10% | 4.0 | 1.0 |
| Senior (more experienced) | 0% | 0% | 0% | 40% | 60% | 5.0 | 1.0 |
| Junior (less experienced) | 10% | 20% | 50% | 20% | 0% | 3.0 | 1.25 |
| Different age groups | 0% | 0% | 40% | 30% | 30% | 4.0 | 2.0 |
| Gender | 0% | 0% | 30% | 30% | 40% | 4.0 | 2.0 |
| Diff. cultural background | 0% | 0% | 20% | 50% | 30% | 4.0 | 1.25 |

Table 5.3: How likely they are asking for help from (role)

When it came to how likely the participants themselves are to help others, the results indicated towards likely and extremely likely indifferent of roles/groups, which can be seen on table 5.4.

| Role | Extremely unlikely | Unlikely | Neutral | Likely | Extremely likely | Median (1-5) | IQR |
|-------------------------------|-----------------------|----------|---------|--------|---------------------|-----------------|------|
| Superior | 0% | 00% | 00% | 60% | 40% | 4.0 | 1.0 |
| Colleague (same hierarchy) | 0% | 0% | 0% | 30% | 70% | 5.0 | 1.0 |
| Subordinates | 0% | 0% | 0% | 40% | 60% | 5.0 | 1.0 |
| Senior (more experienced) | 0% | 0% | 20% | 40% | 40% | 4.0 | 1.25 |
| Junior (less experienced) | 0% | 0% | 30% | 20% | 70% | 5.0 | 1.0 |
| Different age groups | 0% | 0% | 10% | 40% | 50% | 4.5 | 1.0 |
| Gender | 0% | 0% | 30% | 10% | 60% | 5.0 | 2.0 |
| Diff. cultural background | 0% | 0% | 10% | 30% | 60% | 5.0 | 1.0 |

Table 5.4: How likely they are to help when asked by (role)

Maintaining relationships with members of the organization is often important. Half of the participants felt that it is very important to maintain a good relationship, while a few felt that it is moderately important (N = 2, 20%) and fairly important (N=2, 20%). Overall the group seemed to be more inclined to moderately important (Mdn=4.5, IQR=2) in regards to maintaining the relationship with others within their organization.

14. How important is it for you to maintain relationships with others in your organization? ^{10 svar}



Figure 5.6: How important it is maintaining a relationship with others in the organization.

Knowledge sharing within the organization can be strengthened if the organization is actively engaging and enabling the employees in the process. But each organization is different in how they operate, value knowledge sharing, and how much they enable and motivate employees in doing so can vary. In the aspect of to what extent the organization enables the employees to share knowledge, the questionnaire results indicated that half of the respondents felt that the organization enabled them to a moderate extent. A few (N=2, 20%) of them felt to a great extent and likewise in regards to some extent. Lastly, a small portion felt to a small extent (N=1, 10%).

15. To what extent does your organization enable you to share your knowledge with others? 10 svar



Figure 5.7: Extent of enabling in regards to knowledge sharing by organization.

Enabling knowledge sharing is one of the processes but actively motivating employees is also significant. In regards to this aspect, half of the respondents indicated that their organization motivates them to some extent, and a few (N=3, 30%) felt to a great extent. A small portion felt to a moderate extent and equal part in, to a small extent.



16. To what extent does your organization motivate you to share knowledge with others? 10 svar

Figure 5.8: Motivation organization does in regards to knowledge sharing.

Environments where knowledge sharing can occur, is during meetings. Asking the participants to what extent they find progress meetings helpful, the opinions seemed somewhat divided. It was equally divided between "to some extent", "to a moderate extent" and "great extent" and a minor party expressed "to a small extent". Overall, the result showed a positive indication of having progress meetings (Mdn = 4, IQR = 2). When it came to how frequently progress meetings were held, the most frequent answer was once per week (N=5, 50%), while a few of the sample group responded twice a week (N=3, 30%). Lastly, a small portion (N=1, 10%) answered once per 2 weeks, and an equal number responded once a day.



Figure 5.9: How participants felt how helpful progress meetings are.

How frequently do you have progress meetings in your company?
 10 svar



Figure 5.10: Frequency of progress meetings in the organization.

Having proper knowledge management is often a good practice when it comes to knowledge sharing. To document key knowledge is one approach. When asking the respondents how much they valued knowledge documentation and why, the results indicated it was fairly important. The top three reasons for why they valued knowledge documentation were "easier to recall knowledge", "easier to get a quick overview" and "beneficial for the team".





Figure 5.11: How much participants valued knowledge documentation

Even though the participants valued knowledge documentation, there is an indication that they are not actively committed to updating the documented knowledge, which can be seen in figure 5.12. Many respondents answered that they only update sometimes (N=7, 70%), while a small portion answered, often (N=1, 10%). Lastly, a few of them also answered that they rarely (N=2, 20%) update.



13. How often do you make updates to the documented knowledge such as textual docs or software models? 10 svar

Figure 5.12: How often updates are done to knowledge documentation

A common thing mentioned in the interviews was how often instructions or given information were relatively lacking or not often detailed enough. Often instructions were given, and the individual had to some extra work themselves. A majority of the time, these instructions were from customers or stakeholders. However, situations also occurred between team members, for example, when the individual has just started their job and have to get accustomed to the system, they are going to work on. When asked about how important it is to receive detailed instructions/knowledge regarding a task, a majority felt that it was moderately important (N = 6, 60%), and a few even felt that it was very important (N = 3, 30%) (see figure 5.13). Apart from interviews regarding how the instructions/knowledge were received, it was also reflected in the questionnaire, which can be seen in figure 5.14. A majority of the respondents felt that the amount of detailed instructions/knowledge given to them were detailed to some extent and even to a small extent.

"Sometimes I get told to do a task and my supervisor just assume that I know how to perform the task without giving me all the information. If I have lacking information or knowledge performing the task I'll look up the information on my own" - **Participant 9**

"Yes, especially in the beginning of my years, whenever you received the task and you don't have any pre-knowledge which resulted in many questions being asked and a lot of reading." - **Participant 8**

"Instructions regarding what should be done are complete and the end goal is clear. But that does not always mean that I get information on how to achieve it" - **Participant 2**

10. How important is it to receive detailed instructions/knowledge regarding a task that you are assigned to?
10 svar



Figure 5.13: Importance of receiving instructions/knowledge regarding a task



11. How much detailed instruction/knowledge do you receive regarding a task that you are assigned to?



When asking the participants if they have encountered situations where sociocultural diversities negatively impacted knowledge sharing, in other words, demotivate to share knowledge, 9 out of 10 answered the question. The four most selected factors regarding demotivation are due to **Nationality**, **Culture**, **Age** and **Position in hierarchy** which can be seen in figure 5.15



19. Have you ever encountered situations where you feel demotivated to share knowledge due to socio-cultural diversities? If so, which diversities (see below)

Figure 5.15: Demotivated to share knowledge due to socio-cultural diversities

Figure 5.16 shows that 7 out of 10 participants answered the question regarding the influence of socio-cultural diversities on collaborative development activities. The four most selected factors are **Nationality**, **Culture**, **Seniority** and **Position in hierarchy**.

9 svar

10 svar

20. Have you ever encountered situations where socio-cultural diversities influenced collaborative development activities in your team? If so, which diversities (see below). ⁷ svar



Figure 5.16: The influence of socio-cultural diversities on collaborative development activities

In regards to communication difficulties that have occurred due to socio-cultural diversities, the top selected factors were **Age**, **Position in the hiearchy** and shortly behind were **Nationality** and **Culture**.

17. Have you ever encountered situations where communication difficulties have occurred because of socio-cultural diversities? If so, which diversities (see below).



10 svar

Figure 5.17: Socio-cultural factors that has caused communication difficulties

When it came to if the participants have encountered situations where they felt misunderstood due to socio-cultural diversities, the top selected factors were due to **Culture** and **Age**.

5.3 Analysis of Interview and Questionnaire Results

Analyzing the content from the questionnaire and the interviews that specifically targeted at the aspect of seniority and hierarchy. The results showed that a majority of the answers given in the questionnaire are the same compared to the answers in interviews, in regards to challenging/criticizing superiors and seniors. Participants marked with a * means that the questionnaire result reflects to what has been said in the interviews. In addition, participants marked with a ! means that the questionnaire result was not the same when looking back to the interviews. No markings mean that the topic was not mentioned explicitly during the interviews. In regards to giving feedback to superiors or seniors, it was a somewhat mixed result. A few answers was reflected back to the interview from the questionnaire, while some participants were rather different with their answers or did not mention the feedback aspect specifically.

| Superiors | | | | | |
|--------------------------------------|-----------|---------------------------------|--|--|--|
| Very uncomfortable/ uncomfortable | Neither | Comfortable/Very comfortable | | | |
| P01, P04*, P05*, P06*, P09, 10 | P02, P07! | P03*, P08 | | | |
| 60% | 20% | 20% | | | |
| Se | niors | | | | |
| Very uncomfortable/ uncomfortable | Neither | Comfortable/Very comfortable | | | |
| P01*, P04*, P05*, P06*, P07, P09 | P03* | P02, P08, P10 | | | |
| 60% | 10% | 40% | | | |

|* = reflects |! = does not reflects | = no mention |

 Table 5.5:
 How comfortable are you with challenging/criticizing development decisions or changes by role

| Superiors | | | | | | |
|--------------------------------------|------------------|---------------------------------|--|--|--|--|
| Very uncomfortable/ uncomfortable | Neither | Comfortable/Very comfortable | | | | |
| P04*, P05*, P09, P10 | P02* | P01, P03*, P06!, P07!, P08 | | | | |
| 40% | 10% | 50% | | | | |
| | Seniors | | | | | |
| Very uncomfortable/ uncomfortable | Neither | Comfortable/Very comfortable | | | | |
| P05*, P09 | P01*, P03*, P04! | P02*, P06!, P07, P08, P10 | | | | |
| 20% | 30% | 50% | | | | |

|* = reflects |! = does not reflects | = no mention |

 Table 5.6:
 How comfortable are you with giving feedback or opinion on development decisions or changes by role

5.4 Mini-IPIP Results

The personality test mini-IPIP was sent out to the sample group (N=10). A list with descriptive statistics for each item in the mini-IPIP and the total score for each personality trait can be seen in table 5.7.

The mean of each item and the mean of the total scores regarding the extraversion domain (Mean < 3) may indicate that the sample group leans towards less extraversion. This means that the sample group tends to be more reserved or quiet.

The mean of each item and the mean of the total score regarding the agreeableness domain (Mean > 3) may indicate that the sample group leans towards altruism, meaning that they tend to be unselfish and considers other feelings before acting.

| Big Five Domain | Text | Mean | SD | Skewness | Kurtosis |
|---|---|--------------------------------------|---|----------|----------|
| Е | I am the life of the party | 2.1 | 1.287 | 1.338 | 1.864 |
| А | I sympathize with others' feelings | 4.3 | 0.483 | 1.035 | -1.224 |
| С | I get chores done right away | 2.7 | 1.16 | -0.342 | -1.227 |
| Ν | I have frequent mood swings | 2.3 | 1.16 | 0.342 | -1.227 |
| Ι | I have a vivid imagination | 3.5 | 0.972 | -0.454 | -0.516 |
| Ε | I don't talk a lot (R) | 2.5 | 1.179 | -0.255 | -1.440 |
| А | I'm not interested in other people's problems.(R) | 2.2 | 0.919 | 0.6 | 0.396 |
| С | I often forget to put things back in their proper place (R) | 2.6 | 1.43 | -0.251 | -2.165 |
| Ν | I am relaxed most of the time (R) | 3.4 | 1.35 | -0.583 | -0.756 |
| Ι | I am not interested in abstract ideas (R) | 1.9 | 0.99 | 0.237 | -2.3 |
| Ε | I talk to a lot of different people at parties | 2.8 | 1.394 | 0.439 | -0.420 |
| А | I feel others' emotions | 4.2 | 1.033 | -1.241 | 0.946 |
| С | I like order | 3.7 | 0.949 | 0.439 | -0.347 |
| Ν | I get upset easily | 2.8 | 1.135 | -0.091 | -1.655 |
| Ι | I have difficulty understanding abstract ideas(R) | 1.7 | 0.675 | -0.234 | -0.283 |
| Ε | I keep in the background(R) | 2.9 | 1.37 | -0.104 | -1.169 |
| А | I am not really interested in others (R) | 2.1 | 0.99 | 0.687 | -0.157 |
| С | I make a mess of things (R) | 2.4 | 1.07 | 0.322 | -0.882 |
| Ν | I seldom feel blue (R) | 2.9 | 0.99 | -0.61 | -0.157 |
| Ι | I do not have a good imagination (R) | 2.6 | 1.173 | 0.989 | 0.751 |
| Total scores Extraversion Agreeableness Concientiousness Neuroticism Intellect/Imagination | | 2.575 3.2 2.85 2.85 2.42 | 0.313 0.483 0.428 0.543 0.566 | | |

Note: A = Agreeableness; C = Conscientiousness; E = Extraversion; N = Neuroticism; I = Intellect/Imagination; (R) = Reverse Score Item

Table 5.7: Descriptive statistics for every item in the mini-IPIP

Participants also mentioned in the interviews that rather than only having culture as a factor for how a person acts in certain situations such as disagreements or raising voices, personality has some impact. One interviewee mentioned introversion as his personality, which influences his willingness to speak up to express his thoughts in such situations. In contrast, another participant described himself as a person who speaks up due to his personality, regardless of cultural factors. "Rather than only cultural impact I believe that personality plays a huge role in how a person acts when disagreements occur" - Participant 2

"Most of the time I don't raise my voice, but I do think that this has to do with my own personality rather than cultural background. I am a pretty introvert person which makes it hard for me to raise my voice in those situations and also confidence is something I might lack, I am not sure." - Participant 8

"It happens, I am a person who speaks up whenever I feel the need to do so, and by doing so it can appear offending. Not that I am being rude, sometimes I just forget and talks without a filter and speak as I think. " - Participant 10

5.5 Socio-cultural Effects on Software Development Activities

Based on the findings derived from the interviews in regards to which software development activities are negatively influenced by which identified barrier from the conceptual model. A summarizing table 5.8 provides insight on which software development activities are mostly influenced by the identified barriers. This can help organize software development activities in a more efficient and effective manner through understanding which activity is affected by which barrier.

| Software Development Activities | KS Barriers |
|---------------------------------|----------------|
| Knowledge sharing | LB, SB, HB, CB |
| Task discussion | LB, SB, HB, CB |
| Workshops | LB, SB, HB, CB |
| Coding | SB, HB, CB |
| Development decisions | SB, HB, CB |
| Meetings | LB, SB, HB |
| Design | LB, SB, CB |
| Requirements gathering | LB, CB |
| Documentations | LB |
| | |

| LB — Language harrier | SB - Senior Barrier | HB – Hierarchy Barrier | CB - Cultural Barrier |
|---|-------------------------------------|---|---|
| $\mathbf{L}\mathbf{D} = \text{Language Darmer}$ | $\mathbf{SD} = \text{Semon Darmer}$ | $\mathbf{n}\mathbf{D} = \text{merarchy Darmer}$ | $\mathbf{OD} = \mathbf{Outural Darmer}$ |

 Table 5.8: Software development activities affected by identified barriers derived from the interviews

Based on the table, knowledge sharing is one of the activities that are vulnerable to all the identified barriers. Interviewees shared experiences on situation affected by the barriers. For instance, language barriers, seniority barriers, and hierarchy barriers were mentioned in multiple interviews.

"...if we are going to sit with a group of people and have a discussion a certain tempo is necessary for it to flow. If we are suddenly going to speak english (referring to all swedes and suddenly switch to english) it feels like this tempo is being interrupted because there are moments during the discussion you don't know what a certain term is called in english "

- Participant 3

"Yes, many times and it's due to their reaction when I do share knowledge and have new ideas. Due to me being young and rather inexperienced compared to others I feel that my knowledge is not received as highly as other more experienced colleagues."

- Participant 6

"Even though I work in Sweden, sometimes I can't share knowledge directly to a coworker in another team, I have to go through his/her supervisor, which sometimes comes from the way they treat hierarchy" - Participant 10

An interviewee shared his experience regarding the effect of seniority barrier on coding activities and another example are requirements gathering where one participant mentioned language barrier and cultural barrier which negatively affects the activity.

"For instance as my first job as a developer, I saw someone who committed poorly written code and the person was a senior, it is much harder to criticize or even correct the problem due to seniority, you have to approach the problem conservatively, its a barrier. "

- Participant 1

"if they have a thick accent. Let's say someone from Birmingham to give you an example, it can be difficult to understand what he really wants and what requirements he wants"

- Participant 4

"I am from a culture with a bit louder voice when speaking, so sometimes in a meeting, some members can talk in a very small voice and some talk a bit louder. What I want to say that the way we communicate might differ because of nationality."

- Participant 4

Discussion

In this chapter, reflections and discussions are made on the achieved results from chapter 5. The discussion covers the main findings from the result based on a number of mentions, interconnections, and interviewee emphasis. It aims to answer the research questions by considering the results with regard to previous related works. In addition, followed by a discussion regarding the threats to validity for this study.

6.1 Language and Interpretation

Based on the results, there is an implication that culture is rather influential when it comes to team dynamics, communication, and collaboration between teammates. Difficulties experienced related to socio-culture are also widely mentioned in various studies and often related to language and interpretation (Anwar et al., 2019). The language barriers were a common factor among the interviewees that tend to cause misunderstandings and difficulties among each other. According to Anwar et al. (2019), the language factor was a strong factor that influences knowledge sharing among members of software development. Our study indicated that having conversations with members with heavy accents made further difficulties in the communication and knowledge sharing process. These issues caused difficulties in, for example, understanding and following a conversation, which made it harder for e.g getting a clear understanding of requirements or needs. Difficulties with accents or dialects correspond with other previous research, which reported that members find the difficulty in understanding increases when people from different countries have heavy accents (Wendling et al., 2013; Betz et al., 2014). In addition, the proficiency level was a factor mentioned in the interviews, how it could affect the mutual understanding of the conversation and cause issues. The proficiency level and confidence in speaking can affect the quality of communication but also the tools to communicate through as shared by one interviewee:

"..the skill level of English or the accent is not always easy to understand. One way we got through the problem was to communicate with documentation such as mails, slack, where everything was written down in words instead." (P-7).

Implying that sometimes when members are not confident enough in their language skills, they may resort/prefer to use text-based media (instant messaging or email) over telephone or video conferencing as it gives more time to comprehend and com-

pose a response (Noll et al., 2011). But resorting to use text-based media does not convey everything as it can hide important aspects such as the visual or auditory queues, which holds important information that can show how well an individual truly understands a conversation (Noll et al., 2011). However, it does not imply that it is negative to use text-based media. In fact, different types of media have different strengths in communicating different kinds of information. Thus, occasionally textbased media is necessary and useful (where fine details are needed, source code or logs), while other times non-text based media is more suitable, for instance, in situations where body language and intonation can convey the degree of understanding or agreement among participant (Noll et al., 2011). Differences in proficiency levels can also lead to members (the less proficient) refraining from asking for clarification due to a fear of being perceived as stupid. Hence, can result in incorrect assumptions (Noll et al., 2011). Besides the language aspect, interpretation and meaning can be different across each individual and culture. How things get across, whether in communication, body language, or facial expression, can vary as people have different interpretation methods. Furthermore, how they react or interpret situations can be significantly affected by culture (Holmstrom et al., 2006). Encountering situations where misunderstandings have happened due to socio-cultural diversities, one of the questionnaire's top selected reasons were culture. Thus, misunderstandings of situations and misinterpretation of communication can occur due to culture, as shared by the interviewees:

"I do have a mix of cultural background and yes (participants country) think in a way and communicates in a way differently compared to a Swede" (P-8). Furthermore, also shared by another interviewee ""I feel i have a hard time saying "no" sometimes because it might be perceived as impolite even though saying no might be the most appropriate answer" (P-5).

The risk of being perceived as impolite due to clash of cultural differences is also mentioned by one interviewee in Holmstrom et al., (2006) study. Furthermore, Noll et al., (2011) mentioned how polite expressions of acknowledgement by Asian engineers could be misinterpreted as agreement or commitment by their European and American colleagues.

In settings where English is not the native language and more of a common language, it resulted in difficulties in communication. Further, when the native language was not the same, the diversity in common language (usually English) also causes various problems and misunderstandings (Aranda et al., 2010). As described by one interviewee, it sometimes became burdensome to switch languages, especially being in an environment where the native tongue is often spoken. Further, it interrupted the flow of communication, and there was sometimes a need to translate certain words or sentences to the common language from the more comfortable native tongue or vice versa. The difficulties experienced can be due to when translating into their native tongue, the words can, for example, have multiple meanings, which complicates the whole process. Furthermore, these types of issues create barriers between team members with different linguistic backgrounds, which leads to difficulties in initiating a proper information exchange due to missing capability to share knowledge (Betz et al., 2014). Thus, not sharing the same native language thus caused difficulties in the communication and knowledge sharing process resulting in an improper flow of knowledge and information exchange. These types of issues are common in countries where English is not the native language as misunderstandings are more prone to occur as the use of a bridge language creates further barriers to communication (Betz et al., 2014).

6.2 Cultural Norms & Organizational Culture

With culture also comes cultural norms, which can interfere with collaboration and the knowledge sharing process resulting in conflicts due to different norms and ways of problem solving (Noll et al., 2011; Anwar et al., 2019). Some cultures tend to speak up freely while some speak when asked directly, which can cause issues in the knowledge sharing process and problem solving. From the interview, it was especially problematic in cases where opinions or solutions were needed in meetings or in task discussions. Not speaking up can be due to culture in which factors such as hierarchy or age (elaborated further down below) are taken into consideration, and giving opinions can be seen as challenging or criticizing. It could also be that personality wise (also discussed further down below), the individual is not used to speak up unless spoken directly to (which to some extent forces them to speak). In addition, it may depend on if the culture is collectivistic or individualistic. High collectivism meant that there was a lot of emphasis on group harmony and group dynamics, which takes a higher priority above things such as individual opinions. Which was indicated from the results where some participants mentioned how group dynamics and harmony were more important than their own opinions and also shared by one interviewee:

"But if it's not too serious and everything works fine I rather not to speak up in order to avoid unnecessary discussions and to keep the harmony and dynamic within the team." (P-7)

Cultures that are high on individualism may have more difficulty in sharing knowledge compared to cultures that are high on collectivism. Furthermore, transferring knowledge may also be more difficult within heterogeneous cultural groups or to the extent of requiring more time and effort compared to doing it between homogeneous cultural groups. (Rivera-Vazquez et al., 2009; Ford and Chan, 2003) as shared by one of the interviewees.

"I know that the faster we reach a solution the faster we understand each other (we will reach a solution faster and understand each other faster) compared to if we sit there and be completely culturally different as well as nationality" - (P-3)

In addition, in a survey conducted by Al Attar and Shaalan (2016) at Siemens Middle East, it was reported that a few employees refrained from sharing and asking questions due to a culture of "it is a shame to ask". Refraining to ask and feeling uncomfortable to ask too much is also shared by one of the interviewee: "I can't not always express myself fully, questions like "what, what do you mean" happens which leads to further questions. This leads to me starting to just simply agree to avoid this awkwardness". (P-7)

Culture has an impact on the organizational aspect, where the difference in corporate culture can result in different ways of communication and work procedures. The differences in how organizations work depending on culture could, therefore, when mismatched, cause frustration and negative impressions on both sides due to their differences (Noll et al., 2011). For example, one of the interviewees stated how employees answer emails or phone during vacations or holidays, which could differ depending on the culture. Some would answer even though on holiday, while some would have no communication at all. Hence, these types of differences in communication and approach can thus be misinterpreted and could even to the extent of being misinterpreted as rudeness or incompetence (Noll et al., 2011). When the organizational culture place emphasis on knowledge management and knowledge sharing practices actively, it allows the ability to exercise it in an effective and optimal manner. However, utilizing the proper tools and having optimal practices is not always apparent. For example, apparent from the results of the questionnaire was that the most selected frequency of progress meetings was once per week, and closely behind were twice a week. More frequent progress meetings are something organizations should consider as it can give team members more opportunity to share knowledge with each other regarding their task at hand (Anwar et al., 2019). With more frequent progress meetings, they will be able to share their task progress more frequently and share task related issues. In addition, they might get second opinions on solutions, get help, or help other members who might be stuck with a task. Having frequent meetings between members allows for knowledge to be exchanged, especially physical meetings. According to the interviewees, having "face-to-face" meetings was the most optimal and preferred method as it gave more depth to the conversation and allowed you to see the visual queues, elevating the conversation. According to Al Attar and Shaalan (2016), one of the top facilitators and most preferred method for knowledge sharing within the organization was "face to face" interaction. Having "face to face" interaction made communication easier (Ghobadi, 2015). Allowing more frequent communication and meetings between members allowed knowledge to be exchanged and positively influenced the process (Zahedi et al., 2016). Another practice is to document knowledge in order to alleviate the knowledge sharing process (Kroll et al., 2016; Moe et al., 2016). Even though the participant's respective organizations enabled and motivated them to knowledge share and felt that knowledge documentation was valuable, it was indicated that they only updated the documented knowledge sometimes. The underlying reasons could be, for instance, that the organizations could lack in defining a well-formed process, not defining clear roles and responsibilities of team members regarding knowledge sharing processes. Furthermore, it could be a lack of time due to them being overloaded with tasks thus, not having enough time to share or seek knowledge or not being aware of their own knowledge (Anwar et al., 2019). But it could also be that even though they have technological tools and resources avail-
able, they do not feel to put a fair amount of time and effort into it. Members who tend to make little or no use of available resources is also reported in many studies (Aranda et al., 2010). In addition, even though the organizations motivated and enabled them to share knowledge, there were no indications that the employees are obligated to participate or share knowledge. In comparison, cultures with high Power Distance where if the top management deemed knowledge sharing to be important and that employees shall participate, then they most likely will (Ford and Chan, 2003). But as Sweden is rather low on the Power Distance Index, it is less likely the case.

6.3 Seniority and Hierarchy

Seniority and hierarchy were identified as two major factors in our model and were often mentioned during the interviews. Seniority in an organization is usually determined by age and working experience, bringing higher status to the employee. Other factors such as competence can also get higher status to an employee. Having different status within the organization creates a hierarchical structure which makes seniority and hierarchy closely related to Hofstede's dimension Power distance, mentioned in section **3.3.1**. According to Hofstede et al. (2010), in organizations with high power distance and hierarchical structure, subordinates are unwilling to openly express disagreement and opinions due to fear of losing face or making someone else lose face. Rather than only the fear of losing face or making someone else lose face, being inexperienced can also make subordinates reluctant to express their thoughts openly, mentioned by one of the interviewees:

"As a junior developer, I can feel that my opinions do not come out sometimes. Sometimes you may not dare to express yourself when you do not think that you have as much experience as others. (P-5)"

Khatri (2009) states that organizations with high power distance tend to have decision making processes centralized in a few hands, which will hamper effective decisions. Since it is centralized in a few hands, knowledge, experience, and diverse perspectives from the subordinates might be missed. He also mentioned that senior managers in organizations with high power distance always have right even if they are wrong and take it affront when a junior starts to question even if the junior is correct. This type of communication gap can discourage open discussions and demotivate knowledge sharing, which multiple interviewees mentioned.

Białas (2009) mentioned that power distance is linked with internal communication in an organization, meaning that the level of power distance indicates how information is transferred between managers and subordinates. Organizations with high power distance tend to have the information passed "top-down," and low power distance tends to be more open, resulting in a higher possibility of contact between top managers and subordinates. We believe that it also affects how information is being passed between different teams. The need to give the information to the supervisor to reach another subordinate in the other team is mentioned in the interview:

"Even though I work in Sweden, sometimes I can't share knowledge directly to a coworker in another team, I have to go through his/her supervisor, which sometimes comes from the way they treat hierarchy. (P-10)"

In regards to how hierarchical respective organization is for each participant, the additional data derived from the interviews show that even though the different organizations are located in Sweden, hierarchical structure still exists, which may indicate that the low power distance index for Sweden does not fully impact organizational structure in terms of hierarchy.

In addition to the interview results, the questionnaire's data showed that most of the sample group felt that they could give feedback on development decisions in their respective organization. This might be because the whole sample group works in organizations located in Sweden, which has a relatively flat hierarchical structure. Even though they are somewhat encouraged to give feedback on development decisions, 40% of the sample group felt uncomfortable to provide feedback to a superior while 50 % felt comfortable. But in the context of giving feedback to someone more senior, most of the sample group felt comfortable. When it comes to criticizing or questioning decisions made by both superior or someone more senior than themselves, the majority of the participants were rather uncomfortable. The reason why it is hard to criticize or to give feedback to a superior might be due to their own cultural background, which was mentioned in the majority of the interviews.

6.4 Personality

In a study mentioned by Hofstede and McCrae (2004), all five personality traits were significantly associated with at least one culture dimension. Four culture dimensions, power distance, individualism, masculinity, and uncertainty avoidance, were associated with at least one personality trait. According to Hofstede's interpretation of culture's consequences for personality traits (2004), individualism has a significant impact on extraversion, meaning that the extraversion scores were higher in individualist cultures.

The result gathered from the mini-IPIP test indicates the scoring for our sample group's personality traits used in this study. Extraversion and agreeableness are the two traits that reflect personality behaviour in terms of sociable, and the view on harmony, concern for others. The sample group leaned toward introversion, which might be why most participants find it hard to raise their voice when expressing their thoughts or criticize someone who, for example, have a higher position, more experience, or are older. The score regarding agreeableness might also affect criticizing someone else since the importance of keeping a good harmony and a good group dynamic was mentioned in multiple interviews, meaning that they are somewhat cautious about how their behavior and critique affect others.

In addition to the mini-IPIP test, participants mentioned personality as a factor in their behaviour in the interviews. For instance, one participant mentioned that he is from a culture that emphasizes harmony, yet due to his personality, he does not hesitate to speak up even if it might affect the harmony within the group. Also, in regards to how social each team is, due to the opinions being divided, it may depend on factors such as how the personality of the respondent's team members is, which may influence the respondents' perception to answer on their own team's social ability.

Since most participants have a mix of Swedish culture and their own respective cultures, it can affect the personality test scoring because participants may consider both cultures when answering the personality test, which may correspond to Hofstede's interpretation.

Since this study did not aim to investigate personality in-depth, we hesitate to conclude that the individual's personality, being a factor for the participant's social ability. Also, we can not argue for Hofstede's interpretation since we did not investigate the correlation between culture and personality. A more comprehensive study has to be conducted to get a better understanding of how personality affects human behaviour and a better understanding of the correlation between culture and personality.

6.5 Correlation between interview and questionnaire results

As seniority and hierarchy were relative influential factors in regards to knowledge sharing. When analyzing how the questionnaire results reflect back to the interview results, specifically in the aspect of seniority and hierarchy, the results showed a relative consistency. A majority of the of the questionnaire answers reflected back on the interview answers, but there were a few of the participants answers that were not the same compared to what had been said in the interviews. The reason for the differences might be related to how the questions are phrased in the interview and questionnaire. As some of the questions specifically in the interviews are rather negatively loaded, it may when asking the participant lead them to think of negative situations only. Comparing this to the questionnaire, the questions specifically in regards to feedback which was rather neutral phrased. By phrasing it in a rather neutral way, the participants could therefore think of it in situations in general. For instance, giving feedback in meetings might be uncomfortable to seniors, but when a senior asks for minor feedback on something directly, they might feel more comfortable in doing so. We could not identify any specific cases where participants experienced difficulties in dealing with people from other culture derived from the interviews that is aggravated because of personality traits such as introversion. Due to personality only being mentioned as a possible factor outside of culture without any further discussions. In result we could not observe any relation of the effect of personality behaviour to socio-cultural barries. Since the focus of this study was not about personality in-depth, targeted questions regarding personality were not included in the interviews nor in the questionnaires. Mentions of personality came from a rather small portion of the participants when discussing probable factors to certain behaviours in certain situations. But as the input was not sufficient enough to find connections between personality with the results derived from interview and questionnaire other than the assumptions made in the previous discussion sections.

6.6 Mixed-Cultural Background

One interesting finding that was not within our consideration before conducting this study was participants having a multicultural background. This has been mentioned in some of the interviews that the participant takes both cultural backgrounds into consideration before acting. For instance, the choice to speak up but with the risk of hampering the group harmony or staying quiet to keep the group harmony was a clear scenario described by multiple interviewees. As a result, it becomes an internal conflict for the participants due to the respect towards both cultures. Looking for, e.g., at the participant who has a single culture (Sweden) which is rather confident in expressing himself and does not hesitate to give feedback reflects back on the assumption of the Swedish culture according to Hofstede's indexes for Sweden. Comparing this with the participants from the mix of Swedish culture and others, which were not the same in that aspect, which may be due to the reasoning mentioned above involving mixed culture. However, as there is only one participant of a single culture in our sample group, we hesitate to explicitly infer that he represents the whole population of Sweden. Even though some evidence can be found with the help of Hofstede's cultural dimensions theory regarding Sweden.

We can not argue if being of mixed culture helps or hinders the knowledge sharing processes or the understanding of the socio-culture aspect. Mixed-cultural background became an external finding of this study, and we did not investigate it in-depth, nor could we find sufficient evidence for it from the interviews or questionnaire.

6.7 Threat to Validity

The thesis result is mainly based on 10 interviews, which are further complemented through a relative extensive questionnaire. In this section, a discussion of the validity is made in regards to the thesis methods and results. In addition, a discussion about the steps to mitigate potential threats to thesis validity.

6.7.1 Internal Validity

Internal validity is according to Trochim (2020) "the approximate truth about inferences regarding cause-effect or causal relationships within a context of particular study". Ensuring high validity for this study means that the conclusion is correctly supported by the interviews and the questionnaire throughout the process. Hence, if the factors (conclusions, interviews, etc.) are not in the same directions, it may imply a relatively low internal validity.

Regarding the interviews, threats such as misinterpretation of what has been said and information that might have been missed out may threaten the internal validity. To address these threats, all interviews were recorded, which were then transcribed individually by both researchers and later compared to avoid bias and inconsistency. Also, to prevent misinterpretation, all transcriptions were reviewed by respective interviewees to ensure mutual agreement of what has been said. In addition, due to the semi-structured interviews having open-ended questions, follow-up questions may differ depending on the context, which may lead to another potential threat. We try to lower the threat regarding the semi-structured interviews by having relatively defined follow-up questions to avoid divergence. Since the interviews were recorded and transcribed, it also ensured that original answers and the interview format had traceability. Thus, the results should be traceable to at least one of the transcripts. But with consideration to anonymity and protection of participant's information, the names are not revealed with the citations.

6.7.2 External Validity

External validity refers to the extent to which the research and findings from the study can be generalized, meaning to which extent it can be applied to other situations, contexts, or people. Hence, if it can't be applicable to a variety of other settings, it implies a rather low external validity.

The main aspect of this study consisted of interviews (complemented with a questionnaire) with software engineers working in a multicultural organization. Due to the relatively small sample size, it limits the generalization of the study and only suggests issues that may occur in companies within Sweden. In regards to the cultural dimensions, it may vary if the research is conducted in another geographical location. Besides, in the context of niche, there is nothing else than that the participants worked in a multicultural organization within software engineering. But with current technology and the available tools to reach out to different people and platforms, it should not be that difficult. In regards to the possibility to replicate the study is relatively high considered that the attempting researchers are able to find software engineers with similar background/working in a multicultural organization. 7

Conclusion

This thesis aimed to analyze in-depth and present how socio-cultural aspects influence the process of knowledge sharing between members of co-located teams within software engineering.

Knowledge sharing has been identified as a crucial aspect of software development and innovation. A process that involves the exchange of task-related information, ideas, know-how, and feedback regarding software products and processes. This means that it is crucial to know and understand how socio-culture influences the process and the ability of knowledge sharing within different organizations. A fundamental process that may occur in organizations whether it's locally, regionally or internationally.

The study was conducted based on knowledge sharing and the impact of cultural dimensions defined by Geert Hofstede. The impact of the cultural dimensions on knowledge sharing was studied through interviews and questionnaires. The result mainly showed that power distance, individualism vs. collectivism impacted knowledge sharing. Many participants considered the hierarchical position and seniority in situations such as criticizing or giving feedback to, for instance, a superior. Also, multiple participants expressed the importance of keeping good harmony within the group and chose not to express opinions, which might hamper the harmony. This might be because most participants have a mix of cultural backgrounds, meaning that they take both cultures into account before raising their voice, questioning a decision, or openly expressing their thoughts. Even though the study was conducted with organizations located in Sweden, which has a low power distance index, meaning that the hierarchies are relatively flat, and a high individualist index, meaning that the emphasis is on "I" rather than "we".

In addition to the influence of cultural dimensions, language and interpretation were identified as factors that may hamper knowledge sharing. It is noted that communication and interpretation become easier when using the native language, but due to many organizations being multicultural, where English is used as a bridge language, it creates a barrier to communication. This may cause misunderstandings and misinterpretations of situations and conversations due to the involvement of different English accents and the proficiency level of English. In addition to language, culture may also affect understandings and interpretation and may negatively affect communication. Cultural norms may also interfere with collaboration and the knowledge sharing process resulting in conflicts due to different norms and ways of problem solving. It became especially problematic in cases where opinions or solutions were needed (meetings or in task discussions) as different cultures had different ways of communicating and approach to problems and problem solving. Further, culture also has its impact on the organizational aspect, where the difference in corporate culture can result in different ways of communication and work procedures. These differences may lead to when mismatched to difficulties, misinterpretation, and leave negative impressions in both parties.

An interesting aspect of this study was the involvement of mixed culture which may have had an impact on how our participants behaved in different situations. With the involvement of mixed culture there was a sense of internal clash between the typical behaviour of each culture causing in a unpredictable behavioural pattern according to a specific culture. The mix of culture makes it all more complex in regards to how the individual identify to each culture and to what extent they are influenced by each culture. Thus, it may complicate the understanding of sociocultures impact on knowledge sharing even further.

7.1 Recommendation to Researchers and Practitioners

This research contributes to existing research within knowledge sharing by understanding how socio-cultural aspects influence knowledge sharing between members of co-located teams, aiming to give a different perspective to existing research. The challenges identified in existing studies that occur globally can also be identified in co-located environments. Increasing the understanding of how to account for social barriers can result in more effective collaboration and communication. Therefore, this study can be beneficial for practitioners and researchers.

Practitioners should consider increasing the understanding and awareness of the socio-cultural diversities and the negative impact that comes with them. One way to increase such understanding might be for organizations to offer intercultural classes and workshops. In addition, the employees could also participate in such classes outside of work hours, which are compensated through the organizations. Hence, it might further increase employees' motivation to participate voluntarily. Utilizing these tools might increase the employees' awareness, which can help them develop a positive attitude towards intercultural communication and working in such environments. It may broaden their perspective and help them interpret and analyze different communication situations in regards to the intercultural aspect. In addition, it can also help them understand different individuals and group characteristics that may occur due to socio-cultural diversities in which they then can take into consideration when interacting with people with different cultural backgrounds. To tackle the issues of the proficiency level of commonly used language such as English, organizations can offer language classes to increase proficiency. In order to ease mutual understandings, organizations could emphasize the use of the universal language between employees.

7.2 Future Work

Regarding the limitation in the aspect of sample size, future research could be to increase the sample group (including questionnaire) with even more diverse groups of people, for example, include more people from other countries or mixed cultures (even more). In addition, perform the study in other countries. This can, therefore, increase the generalization of the study and get a better understanding of the effect of socio-cultural factors on knowledge sharing. Studying more people with mixed cultures could reveal further what kind of significance it has on collaboration and factors such as knowledge sharing. Furthermore, since this study did not investigate the personality aspect in-depth and the aim to find a correlation between cultural impact on personality was not within this thesis's scope. Future research would be to conduct more extensive research that emphasizes personality further in correlation to culture. This might result in a better understanding of how personality affects human behaviour and how culture may affect personality.

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A

Interview questions

Background question

- 1. Age
- 2. Gender (that you identify with)
- 3. Nationality
- 4. Culture that you identify with
- 5. Describe your current role in your organization (tasks, position, responsibility etc.)
- 6. How long have you been working in your company? (months)
- 7. Is this your first job?
- 8. Country you have the most years of work experience in?
- 9. How much work experience/ How many years have you had in the field of software development? (total)

Main interview question

- 1. How do you communicate knowledge about the software project with your team?
- 2. Do you feel that you get enough or complete instructions regarding a new task that you are assigned to? Have you ever felt that you got little information?
 - Is it because of the quality of instructions that makes you feel that it is not enough?
- 3. Have you ever encountered situations where communication difficulties have occurred because of socio-cultural diversities? (factors pre-selected before interview from questionnaire)
 - Do you feel the same in Sweden as well? (if they had work experience outside of Sweden)
- 4. Any particular situations that you remember where you had to act according to your cultural aspect, for example seniority?

- 5. Have you encountered situations where you feel misunderstood due to sociocultural diversities? (factors pre-selected before interview from questionnaire)
 - Does it happen often or is it particular during those times? (follow up question based on answer given)
- 6. Have you encountered situations where you feel demotivated to share knowledge due to socio-cultural diversities?
- 7. Have you encountered situations where socio-cultural diversities influenced collaborative development activities?
- 8. To what extent does your organization motivate you to share knowledge with others?
 - What type of knowledge do you share?
- 9. When you disagreed or have a different view on certain knowledge that has been shared within a team, do you voice your opinions, if so how? How do you manage to solve it?
- 10. Do you feel that you have held back information due to your culture?
- 11. When it comes to disagreeing or have a different view, how do you handle it?
- 12. On a scale on 1 to 5 how hierarchical is your organization?
 1 (Not at all), 2 (Not so hierarchical), 3 (Somewhat hierarchical), 4 (Very hierarchical), 5 (Extremely hierarchical)
- 13. To what extent does a hierarchical working environment help knowledge sharing?
- 14. On a scale on 1 to 5 how social is your team?1 (Not at all), 2 (Not so social), 3 (Somewhat social), 4 (Very social), 5 (Extremely social)
- 15. To what extent does a social working environment help knowledge sharing?
- 16. How collaborative are the people in your team? (5-point scale)1 (Not at all), 2 (Not so collaborative), 3 (Somewhat collaborative), 4 (Very collaborative), 5 (Extremely collaborative)
- 17. To what extent does a collaborative working environment help knowledge sharing? Why?
- 18. Does your organization organize social events? How many per year?
- 19. To what extent does organizing social events help knowledge sharing?

В

Questionnaire

| Questionnaire * Required | |
|--|--|
| Please state your ID * | |
| Your answer | ۵. |
| | |
| Io which extent are you allowed/e development decisions or changes | ncouraged to give feedback or opinion on in your company? * |
| O 1 - Not at all | |
| 2 - To a small extent | |
| O 3 - To some extent | |
| O 4- To a moderate extent | |
| 5 - To a great extent | |
| | |



| uncomfortable | 2 - Uncomfortable | 3 - Neither | 4 - Comfortable | 5 - Very comfortable |
|---------------|----------------------|----------------|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| | | | O O O O O O | O O |

2. How comfortable are you with giving feedback or opinion on development decisions or changes by *



:

| | 1 - Very uncomfortable | 2 - Uncomfortable | 3 - Neither | 4 - Comfortable | 5 - Very comfortable |
|---|---------------------------|----------------------|----------------|--------------------|-------------------------|
| Superiors | 0 | 0 | 0 | 0 | 0 |
| Colleagues (same level on the hierarchy), and | 0 | 0 | 0 | 0 | 0 |
| Subordinates | 0 | 0 | 0 | 0 | 0 |
| Senior people (more experienced) | 0 | 0 | 0 | 0 | 0 |
| Junior people. (less experienced) | 0 | 0 | 0 | 0 | 0 |
| Different age groups (older vs. younger) | 0 | 0 | 0 | 0 | 0 |
| Gender (M vs. F vs other). | 0 | 0 | 0 | 0 | 0 |
| People with different cultural backgrounds | 0 | 0 | 0 | 0 | 0 |

3. How comfortable are you with challenging/criticizing development decisions or changes by *

| 1. How likely are you to ask a(see option down below) for help? * | | | | k - | |
|---|---------------------------|--------------|-------------|------------|-------------------------|
| | 1 - Extremely unlikely | 2 - Unlikely | 3 - Neutral | 4 - Likely | 5 - Extremely likely |
| Superiors | 0 | 0 | 0 | 0 | 0 |
| Colleagues (same level on the hierarchy), and | 0 | 0 | 0 | 0 | 0 |
| Subordinates | 0 | 0 | 0 | 0 | 0 |
| Senior people (more experienced) | 0 | 0 | 0 | 0 | 0 |
| Junior people. (less experienced) | 0 | 0 | 0 | 0 | 0 |
| Different age groups (older vs. younger) | 0 | 0 | 0 | 0 | 0 |
| Gender (M vs. F vs other). | 0 | 0 | 0 | 0 | 0 |
| People with different cultural backgrounds | 0 | 0 | 0 | 0 | 0 |

| | 1 - Extremely unlikely | 2 - Unlikely | 3 - Neutral | 4 - Likely | 5 - Extremely likely |
|--|---------------------------|--------------|-------------|------------|-------------------------|
| Superiors | 0 | 0 | 0 | 0 | 0 |
| Colleagues (same level on the hierarchy), and | 0 | 0 | 0 | 0 | 0 |
| Subordinates | 0 | 0 | 0 | 0 | 0 |
| Senior people (more experienced) | 0 | 0 | 0 | 0 | 0 |
| Junior people. (less experienced) | 0 | 0 | 0 | 0 | 0 |
| Different age groups (older vs. younger) | 0 | 0 | 0 | 0 | 0 |
| Gender (M vs. F vs other). | 0 | 0 | 0 | 0 | 0 |
| People with different cultural backgrounds | 0 | 0 | 0 | 0 | 0 |
| | | | | | |

development activities with your team members? (in %)

Your answer

/

| 7. How frequently do you have progress meetings in your company?* • twice a week • once per week • once a month • Other: 8. To what extent is it helpful to have progress meetings in your company?* • 1 - Not at all • 2 - To a small extent • 3 - To some extent • 4 - To a moderate extent • 5 - To a great extent • Other: 9. How much do you value knowledge documentation (knowledge about software)?* • 1 - Not at all important • 2 - Slightly important • 3 - Fairly important • 5 - Very important | |
|--|---|
| twice a week once per week once a month Other: 8. To what extent is it helpful to have progress meetings in your company? * 1 - Not at all 2 - To a small extent 3 - To some extent 4 - To a moderate extent 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)? * 1 - Not at all important 2 - Slightly important 4 - Moderately important 5 - Very important | 7. How frequently do you have progress meetings in your company? * |
| once per week once per 2 weeks once a month Other: 8. To what extent is it helpful to have progress meetings in your company?* 1 - Not at all 2 - To a small extent 3 - To some extent 4 - To a moderate extent 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)?* 1 - Not at all important 2 - Slightly important 3 - Fairly important 5 - Very important | O twice a week |
| once per 2 weeks once a month Other: 8. To what extent is it helpful to have progress meetings in your company?* 1 - Not at all 2 - To a small extent 3 - To some extent 4 - To a moderate extent 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)?* 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | O once per week |
| once a month Other: 8. To what extent is it helpful to have progress meetings in your company?* 1 - Not at all 2 - To a small extent 3 - To some extent 4 - To a moderate extent 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)?* 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | O once per 2 weeks |
| Other: 8. To what extent is it helpful to have progress meetings in your company?* 1 - Not at all 2 - To a small extent 3 - To some extent 4 - To a moderate extent 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)?* 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | O once a month |
| 8. To what extent is it helpful to have progress meetings in your company?* 1 - Not at all 2 - To a small extent 3 - To some extent 4 - To a moderate extent 5 - To a great extent Other: • How much do you value knowledge documentation (knowledge about software)?* 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | O Other: |
| 8. To what extent is it helpful to have progress meetings in your company?* 1 - Not at all 2 - To a small extent 3 - To some extent 4 - To a moderate extent 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)?* 1 - Not at all important 2 - Slightly important 3 - Fairly important 5 - Very important | |
| 1 - Not at all 2 - To a small extent 3 - To some extent 4 - To a moderate extent 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)? * 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | 8. To what extent is it helpful to have progress meetings in your company? * |
| 2 - To a small extent 3 - To some extent 4 - To a moderate extent 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)? * 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | 1 - Not at all |
| 3 - To some extent 4 - To a moderate extent 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)? * 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | O 2 - To a small extent |
| 4 - To a moderate extent 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)? * 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | O 3 - To some extent |
| 5 - To a great extent Other: 9. How much do you value knowledge documentation (knowledge about software)? * 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | O 4 - To a moderate extent |
| Other: 9. How much do you value knowledge documentation (knowledge about software)? * 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | 5 - To a great extent |
| 9. How much do you value knowledge documentation (knowledge about software)? * 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | O 0ther: |
| 9. How much do you value knowledge documentation (knowledge about software)? * 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | |
| 1 - Not at all important 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | 9. How much do you value knowledge documentation (knowledge about software)? * |
| 2 - Slightly important 3 - Fairly important 4 - Moderately important 5 - Very important | ○ 1 – Not at all important |
| 3 - Fairly important 4 - Moderately important 5 - Very important | O 2 – Slightly important |
| 4 - Moderately important 5 - Very important | O 3 – Fairly important |
| O 5 – Very important | O 4 – Moderately important |
| | O 5 – Very important |
| | |
| | |
| | |

| Base | d on previous question |
|-------|--|
| | Easier to get a quick overview |
| | Easier to communicate knowledge to others |
| | Easier to explain knowledge to others |
| | Easier to recall the knowledge |
| | Mutual understanding of the system |
| | Negotiation between stakeholders |
| | Capture decisions |
| | Easier re-use of the knowledge in similar software |
| | Benefit for the team |
| | Long term purposes (e.g., for maintenance and evolution) |
| | Reduce Risk |
| | Other: |
| | |
| 10. I | How important is it to receive detailed instructions/knowledge regarding a |
| task | that you are assigned to? * |
| 0 | 1 - Not at all important |
| 0 | 2 - Slightlty important |
| 0 | 3 – Fairly important |
| 0 | 4 - Moderately Important |
| 0 | 5 - Very important |
| - | |
| | |
| | |
| | |

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| 11. th | How much detailed instruction/knowledge do you receive regarding a task at you are assigned to? * |
|------------|--|
| С |) 1 - Not at all |
| С |) 2 - To a small extent |
| С |) 3 - To some extent |
| С |) 4 - To a moderate extent |
| С |) 5 - To a great extent |
| 12. of | . How actively do you use retrospectives in your organization to become aware what you should improve in the upcoming iteration/s? * |
| С |) 1 - Never |
| С |) 2 - Rarely |
| С |) 3 - Sometimes |
| С |) 4 - Often |
| С |) 5 - Always |
| 13. te: | . How often do you make updates to the documented knowledge such as xtual docs or software models? * |
| С |) 1- Never |
| С |) 2 - Rarely |
| С |) 3 – Sometimes |
| С |) 4 - Often |
| С |) 5 – Always |
| | |
| | |
| | |

| 14. How important is it for you to maintain relationships with others in your organization? * | |
|---|--|
| O 1 - Not at all important | |
| O 2 - Slightly Important | |
| O 3 – Fairly important | |
| O 4 - Moderatly important | |
| O 5 - Very Important | |
| 15. To what extent does your organization enable you to share your knowledge with others? * | |
| 1 - Not at all | |
| O 2 - To a small extent | |
| O 3 - To some extent | |
| O 4 - To a moderate extent | |
| 5 - To a great extent | |
| | |
| 16. To what extent does your organization motivate you to share knowledge with others? * | |
| O 1 - Not at all | |
| 2 - To a small extent | |
| O 3 - To some extent | |
| O 4 - To a moderate extent | |
| 5 - To a great extent | |
| | |
| | |
| | |
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E

| 17. Have you ever encountered situations where communication difficulties have occurred because of socio-cultural diversities? If so, which diversities (see below). | |
|--|---|
| Nationality | |
| Culture | |
| Religion | |
| Gender | |
| Age | |
| Seniority | |
| Position in the hierarchy | |
| | |
| 18. Have you ever encountered situations where you feel misunderstood due to socio-cultural diversities? If so, which diversities (see below). | |
| Nationality | |
| Culture | |
| Religion | |
| Gender | |
| Age | |
| Seniority | |
| Position in the hierarchy | |
| | |
| | |
| | |
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| | |
| | |
| | 1 |
| | ~ |

| 19. Have you ever encountered situations where you feel demotivated to share knowledge due to socio-cultural diversities? If so, which diversities (see below |) |
|---|---|
| Nationality | |
| Culture | |
| Religion | |
| Gender | |
| Age | |
| Seniority | |
| Position in the hierarchy | |
| 20. Have you ever encountered situations where socio-cultural diversities influenced collaborative development activities in your team? If so, which diversities (see below). | |
| Nationality | |
| Culture | |
| Religion | |
| Gender | |
| Age | |
| Seniority | |
| Position in the hierarchy | |
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C Personality test

| Please state your ID * Your answer 1.1 talk to a lot of different people at parties * 1.1 talk to a lot of different people at parties * 1.1 talk to a lot of different people at parties * 2.1 Strongly Disagree 2.1 like order * 1.1 Strongly Disagree 2.1 like order * 3. Neither Agree nor Disagree 3. Neither Agree nor Disagree 3. Neither Agree nor Disagree 4. Somewhat Agree 5. Strongly Agree 4. Somewhat Agree 5. Strongly Agree 5. Stro | * Red | quired |
|--|---------|---|
| Your answer 1. I talk to a lot of different people at parties * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree 1 Strongly Disagree 3 Neither Agree nor Disagree 3 Neither Agree 5 Strongly Agree 3 Neither Agree nor Disagree 5 Strongly Agree | Plea | se state your ID * |
| 1. I talk to a lot of different people at parties * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree 2. I like order * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | Your | answer |
| 1. I talk to a lot of different people at parties * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree 2. I like order * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 3 Neither Agree nor Disagree 3 Neither Agree nor Disagree 3 Strongly Agree 5 Strongly Agree | | |
| 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree 2.1 like order * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | 1. ta | alk to a lot of different people at parties * |
| 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree 2.1 like order * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | 0 | 1 Strongly Disagree |
| 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree 2.1 like order * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | 0 | 2 Somewhat Disagree |
| 4 Somewhat Agree 5 Strongly Agree 2.1 like order * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | 0 | 3 Neither Agree nor Disagree |
| S Strongly Agree 2. I like order * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | 0 | 4 Somewhat Agree |
| 2. I like order * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | 0 | 5 Strongly Agree |
| 2. I like order * 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | | |
| 1 Strongly Disagree 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | 2. I li | ike order * |
| 2 Somewhat Disagree 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | 0 | 1 Strongly Disagree |
| 3 Neither Agree nor Disagree 4 Somewhat Agree 5 Strongly Agree | 0 | 2 Somewhat Disagree |
| 4 Somewhat Agree 5 Strongly Agree | 0 | 3 Neither Agree nor Disagree |
| 5 Strongly Agree | 0 | 4 Somewhat Agree |
| | 0 | 5 Strongly Agree |

| 3. I have difficulty understanding abstract ideas * | |
|---|--|
| 5 Strongly Disagree | |
| O 4 Somewhat Disagree | |
| O 3 Neither Agree nor Disagree | |
| O 2 Somewhat Agree | |
| O 1 Strongly Agree | |
| | |
| 4. I am not really interested in others * | |
| 5 Strongly Disagree | |
| O 4 Somewhat Disagree | |
| O 3 Neither Agree nor Disagree | |
| O 2 Somewhat Agree | |
| O 1 Strongly Agree | |
| | |
| 5. I am relaxed most of the time * | |
| 5 Strongly Disagree | |
| O 4 Somewhat Disagree | |
| O 3 Neither Agree nor Disagree | |
| O 2 Somewhat Agree | |
| O 1 Strongly Agree | |
| | |

E

| 6 I don't talk a lot * | |
|---|--|
| | |
| O 5 Strongly Disagree | |
| 4 Somewhat Disagree | |
| 3 Neither Agree nor Disagree | |
| 2 Somewhat Agree | |
| 1 Strongly Agree | |
| | |
| 7. I often forget to put things back in their proper place * | |
| O 5 Strongly Disagree | |
| O 4 Somewhat Disagree | |
| 3 Neither Agree nor Disagree | |
| 2 Somewhat Agree | |
| 1 Strongly Agree | |
| | |
| 8. I am not interested in abstract ideas * | |
| O 5 Strongly Disagree | |
| O 4 Somewhat Disagree | |
| 3 Neither Agree nor Disagree | |
| O 2 Somewhat Agree | |
| O 1 Strongly Agree | |
| | |
| | |
| | |
| | |
| | |
| | |

| 9. I am not interested in other people's problems * |
|---|
| 5 Strongly Disagree |
| O 4 Somewhat Disagree |
| O 3 Neither Agree nor Disagree |
| 2 Somewhat Agree |
| O 1 Strongly Agree |
| |
| 10. I have frequent mood swings * |
| 1 Strongly Disagree |
| 2 Somewhat Disagree |
| O 3 Neither Agree nor Disagree |
| O 4 Somewhat Agree |
| 5 Strongly Agree |
| |
| 11. I am the life of the party * |
| 1 Strongly Disagree |
| 2 Somewhat Disagree |
| O 3 Neither Agree nor Disagree |
| O 4 Somewhat Agree |
| ○ 5 Strongly Agree |
| |
| |
| |
| |
| |

| 12. I | |
|--------|----------------------------------|
| | make a mess of things * |
| 0 | 5 Strongly Disagree |
| 0 | 4 Somewhat Disagree |
| 0 | 3 Neither Agree nor Disagree |
| 0 | 2 Somewhat Agree |
| 0 | 1 Strongly Agree |
| | |
| 13. I | do not have a good imagination * |
| 0 | 5 Strongly Disagree |
| 0 | 4 Somewhat Disagree |
| 0 | 3 Neither Agree nor Disagree |
| 0 | 2 Somewhat Agree |
| 0 | 1 Strongly Agree |
| | |
| 14. l | feel others' emotions * |
| 0 | 1 Strongly Disagree |
| 0 | 2 Somewhat Disagree |
| 0 | 3 Neither Agree nor Disagree |
| | 4 Somewhat Agree |
| 0 | |
| 0 0 | 5 Strongly Agree |

| 15. I get upset easily * |
|--|
| O 1 Strongly Disagree |
| O 2 Somewhat Disagree |
| O 3 Neither Agree nor Disagree |
| O 4 Somewhat Agree |
| 5 Strongly Agree |
| |
| 16. I keep in the background * to remain unobtrusive, inconspicuous or out of sight |
| 5 Strongly Disagree |
| O 4 Somewhat Disagree |
| O 3 Neither Agree nor Disagree |
| 2 Somewhat Agree |
| 1 Strongly Agree |
| |
| 17. I get chores done right away * Chores: routines, tasks or duties |
| 1 Strongly Disagree |
| O 2 Somewhat Disagree |
| O 3 Neither Agree nor Disagree |
| O 4 Somewhat Agree |
| O 5 Strongly Agree |
| |

.

| | 18. I have a vivid imagination * |
|----|--|
| | vivid: clear and powerful |
| | 1 Strongly Disagree |
| | 2 Somewhat Disagree |
| | 3 Neither Agree nor Disagree |
| | 4 Somewhat Agree |
| | 5 Strongly Agree |
| | |
| | |
| | 19. I sympathize with others feelings " |
| | O 1 Strongly Disagree |
| | O 2 Somewhat Disagree |
| | O 3 Neither Agree nor Disagree |
| | O 4 Somewhat Agree |
| | 5 Strongly Agree |
| | |
| | 20. l seldom feel blue * |
| | Seldom: rarely, infrequently - Feel blue: be depressed or sad |
| | 5 Strongly Disagree |
| | 4 Somewhat Disagree |
| | 3 Neither Agree nor Disagree |
| | O 2 Somewhat Agree |
| | 1 Strongly Agree |
| | |
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