

**The impact of socio-cultural factors and knowledge sharing to the
success of global software development**

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This master's thesis examines the impact of socio-cultural factors and knowledge sharing to the success of global software development. Methods used in this study are literature review, qualitative semi-structured interviews, and quantitative data derived from a survey. The study is conducted using a case study approach. The subject of the case study was a large global software development project situated in Finland and India.

The theory part of this thesis presents the current global software development research results with emphasis on Geert Hofstede's cultural dimensions and Zahedi's and Christiansen's knowledge sharing challenges and practices. The study results were analysed based on these theories.

The findings are inline with previous global software development studies. Based on the results seven knowledge sharing factors impacted negatively on the success of global software development in this case study project. These were employee turnover, hierarchical structures, gap in education and technological knowledge, shortcomings in maintaining group awareness, distance, lack of openness, and linguistic distance.

The following six factors were not considered to have a negative effect on the success of the project: cost of knowledge sharing, low priority perception, limitations of tools, shortcoming in utilising existing tools, documentation problems, and lack of trust and rapport. Two major socio-cultural challenges in the case study project were power distance and language.

Keywords: culture, information sharing, case study, India.

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List of abbreviations

DSD	Distributed Software Development
GSD	Global Software Development
IDC	India Delivery Center
IDV	Individualism versus Collectivism
IND	Indulgence versus Restraint
IS	Information System
LTO	Long-term Orientation versus Short-term Orientation
MAS	Masculinity versus Femininity
PDI	Power Distance Index
RTC	Rational Team Concert
SPI	Software Process Improvement
UAI	Uncertainty Avoidance Index
SD	Software Development

1. Introduction

In the introduction the topic of the thesis is presented as a short insight to the subject area. Also, the research objectives will be unfolded along with the research questions and hypothesis of the results. Finally, there will be a short presentation of how the thesis is structured.

1.1. Presentation of the topic

Globalisation has been a growing trend for decades. Software industry has been increasing its globalisation of business [Herbsleb and Moitra, 2001], and thus, the academic world has taken an interest in studying the different aspects of global software development (GSD). GSD has plenty of advantages, such as cost savings, access to worldwide talents, and gaining competitive advantage. However, there are also disadvantages related to teams working in different locations, also called *virtual teams*, such as cultural issues, communication problems, and management issues.

In global software development teams working on a same goal are geographically distributed to multiple countries. Traditionally teams developing software products have worked together in a same location having the possibility of interacting and communicating with each other face-to-face real-time, as well as, having a shared common organisational culture. GSD differs from this greatly, adding new demands to the process of software development, and further more, potentially threatening all or part of these properties common to traditional SD. [Holmstrom *et al.*, 2006].

The development of software is a complicated process all on itself even when people from same cultural backgrounds are working in a same location. Globalising software development has its own difficulties on top of the traditional ones. Common problem areas in software development (SD) include the gathering of requirements, planning and estimating the cost and duration of the project, misunderstandings with communication, and lack of testing. Distributing the development into different countries creates its own difficulties. Common problems in GSD include cultural issues (different language, norms, and practices), inadequate communication (lack of immediate response to questions due to difference in time zones), knowledge management, project and process management issues, and technical issues, such as problems with bandwidth [Begel and Nagappan, 2008].

Theoretical background of the thesis is based on previous studies of Geert Hofstede on the subject of culture in different countries. Based on the studies constructed by Hofstede and associates, Hofstede has created a six-dimensional model of cultural differences. These dimensions are power distance, individuality, masculinity vs. femininity, tolerance of uncertainty, long-term vs. short-term orientation, and the newest addition, indulgence vs. restraint. These dimensions are explained in chapter 3. Culture has a great impact on virtual teams. It affects coordination, cooperation,

communication, knowledge transfer, project management, training, and even risk management [Gibson and Cohen, 2003].

Knowledge sharing is another obstacle in distributed software projects. Without proper ways to share knowledge, it is impossible to create a good software product. There are multiple ways to smooth the flow of knowledge. For instance, making sure each team member has good spoken language skills, ensuring synchronous communication, rotating people between shores, enhancing social ties between team members, and using groupware to document knowledge are practices that enhance knowledge sharing [Christiansen, 2007; Zahedi *et al.*, 2016]. Especially in GSD, the transfer of knowledge is more difficult than in traditional SD. Time zone differences, culture [Christiansen, 2007], vague role definitions, missing or outdated documents, and lack of trust can all be accountable for making knowledge sharing difficult [Zahedi *et al.*, 2016].

1.2. Research objectives

The aim of this thesis is to discover the impact of socio-cultural factors and knowledge sharing on the success of global software development. The main goal is to firstly find out *what* are the socio-cultural factors and knowledge sharing challenges that have an impact to the success of GSD in this case study project, and secondly, with the help of qualitative data, to find out *how* these factors and challenges come to surface. The main objective is to discover the factors related to this particular case study project, and to compare the results with the results from previous studies on the subject to find out whether the results are similar.

The study addresses the following four research questions:

- 1) *What* socio-cultural factors affect to the success of global software development?
- 2) *How* do socio-cultural factors affect to the success of global software development?
- 3) *What* aspects related to knowledge sharing affect to the success of global software development?
- 4) *How* does knowledge sharing affect to the success of global software development?

The hypothesis is that both socio-cultural factors and knowledge sharing has an affect to the success of global software development. This would also be inline with the previous research results on the subject. However, because of the small time difference, it is hypothesized that temporal distance does not cause any significant challenges to the success of the case study project.

The study was conducted on Finnish and Indian workers in different career levels working on a large Finnish software development project. The workers were situated both in Finland and India, with the possibility of occasionally having the change to travel to the other country to work with the remote team members and to share knowledge. The duration for site visitations varied usually from one week to half a year. Thus, the research has a strong emphasis on the two very different cultures.

There are many studies that have addressed the problems related to global software development. This thesis was limited to study socio-cultural factors and knowledge sharing. The subject was limited based on the unique change to be able to investigate cross-cultural theme in the area of global software development. The theoretical framework, however, does present some of the common problems outside of this thesis' scope related to GSD since it is good to know what are the other main problem areas in GSD.

The methodological approach is based on mixed methods: using both quantitative and qualitative approach to examine the subject. The study is conducted using a case study approach. A questionnaire survey was conducted to gather mainly quantitative, but also qualitative data. Four individual interviews gave an extensive insight about the phenomenon in a qualitative manner. The interviews were conducted first, followed by the survey. The survey data was analysed using statistical methods.

1.3. Structure of the thesis

This thesis is divided into two main sections: theoretical background and the empirical part. Chapters 2, 3 and 4 are part of the theoretical background. Chapter 5, 6 and 7 represents the data collection methods, results of the study, and the analysis of the results. This research is based on previous findings on the subject of socio-cultural factors and knowledge sharing in the area of global software development. One theory is taken into greater consideration: Hofstede's cultural dimensions. In addition, the thesis represents the research results from Zahedi's and Christiansen's studies on knowledge sharing challenges and practices.

Chapter 2 presents the subject of global software development. It will give an insight into what is GSD, what are the benefits and challenges of GSD, what are the risks related to offshoring, what is the IS success model, what are the success factors of GSD, and what factors should be used for assessing country attractiveness for outsourcing and offshoring. This chapter will also shed light on India; as to what is India like as an offshoring country and why is it such a popular destination for outsourcing and offshoring software development projects.

Chapter 3 defines the meaning of the term socio-culture and will give a short presentation of the differences between the Indian and Finnish cultures. It will also include a short presentation of three different distances related to GSD challenges: temporal, geographical, and socio-cultural distances. Furthermore, this chapter introduces the famous cultural dimensions defined by Geert Hofstede and also demonstrates how India and Finland are situated on these dimensions. In addition, a short section is given to presenting four different types of organisations defined by Hofstede.

In chapter 4, the emphasis is on the second subject the thesis explores: knowledge sharing. This chapter will explain the difference between tacit and explicit knowledge. In addition, it will present the challenges as well as the practices of knowledge sharing in distributed settings.

In chapter 5, we finally move on to explore the research. This chapter presents how the data was collected, and it also gives some details of the case study organisation. Chapter 6 analyses the results gathered during the data collection phase. The chapter is divided into five subchapters: location, culture, communication, language, and social aspects. Chapter 7 presents the analysis of the results. This chapter is divided into four subchapters: challenges related to knowledge sharing, challenges related to socio-cultural factors, how to reduce the effect of challenges, and limitations and future work. The final chapter 8 presents the conclusions drawn from the result analysis.

2. Global software development

This chapter comprises of seven subchapters. The first subchapter will present the definition of global software development and the key concepts related to it. The second and the third subchapter will give an insight of the benefits and challenges related to global software development. The fourth subchapter enlists the risks related to offshoring. The fifth subchapter represents DeLone and McLean's IS success model as well as success factors related to global software development. The sixth subchapter sheds a light on which kind of countries are attractive outsourcing of offshoring destinations. The seventh, and final, chapter is about India and why it has become one of the most offshored countries.

2.1. Definition and key concepts

Global software development (GSD) is a process where a company's software is developed by geographically distributed teams, or, a company contracts all or parts of its software development in return for remuneration [Ali-Babar *et al.*, 2007]. Sometimes the term *distributed software development* (DSD) is also used instead of GSD. The difference between global and distributed software development is that GSD requires that the offsite team is located in another country compared to the onsite team. This can be referred to as *offshoring*. But in the case of DSD, the teams don't have to be located in different countries; they can be located in the same country. This can be referred to as *onshoring*. In short, offshoring and onshoring are related to the fact whether the teams are working in the same country or in different countries. [Oshri *et al.*, 2009].

Outsourcing is a term closely related to GSD. In outsourcing, the company finds a supplier who can deliver all or parts of the software in return for remuneration. There can be offshore outsourcing as well as onshore outsourcing (also known as domestic outsourcing). Offshoring and onshoring itself, however, does not mean that there must be another company delivering the software. A company can decide to offshore parts of its development processes within the company. Insourcing is the opposite of outsourcing. When a company chooses to insource, it hires local people to work for the company. Instead of hiring another company and its workforce, companies hire local talent themselves to bring work in-house. This usually makes the hired workforce care more about the end product. [Oshri *et al.*, 2009].

The term 'team' requires that the team has some task(s) to perform, the team members must be interdependent, and, there must be shared outcomes. Teams located in different locations can be referred to as *virtual teams*. A virtual team must have three attributes: the team must be a functioning team, the team members must be geographically dispersed, and the team must rely on technology-mediated communications instead of face-to-face interaction in order to accomplish their tasks. [Gibson and Cohen, 2003] In this case, a functioning team refers to a collection of individuals who share responsibility for outcomes, are interdependent in their tasks, collectively

manage their relationships across organizational boundaries, and see themselves as an intact social unit embedded in one or several social systems [Hackman, 1987; Alderfer, 1977]. A virtual team can also be a *global team*, in case the team is located globally and not just geographically.

2.2. Benefits of GSD

Oshri and Kotlarsky [2009] discovered four key strategic drivers for outsourcing in their study conducted on CIOs and CFOs in 263 European companies. Based on the interviews, getting access to skills that are not already found inside the company is the largest reason (64 percent) to outsource. The three other strategic drivers were cost reduction (41 percent), access to innovative processes and practices (41 percent), and the fact that outsourcing would free up internal resources for other purposes (40 percent). [Oshri and Kotlarsky, 2009]. These are all benefits of globalising software development.

The wages are significantly different across different regions. Companies can get the benefit of reduced cost of development by globalising its software development to lower cost countries. [Ågerfalk *et al.*, 2008]. However, having low-cost employees does not imply getting workers with required skills. Companies should not merely look at the cost, but also, seek for skilled workforce. Gladly, low-cost countries do offer a wide variety of skilled people. One benefit of GSD is being able to find skilled people across the world, and not just relying on local talent [Carmel and Tija, 2005]. At times it might be impossible to find the right person inside the country. Thanks to globalisation, companies are able to find the needed skills located worldwide.

Another great benefit of GSD is being able to have people work around the clock. This is a method called 'follow-the-sun'. [Carmel, 1999]. Due to time zone differences, it is possible to maximise productivity and increase efficiency. At the end of the day one team can transfer their work to another team starting their workday. The benefit of this development model is that it reduces the time the product can get to the market. [Ågerfalk *et al.*, 2008]. Another benefit is the possibility of being closer to the customers. If a company establishes a subsidiary in a country where the customers are located, it can develop its products closer to their customers, and also, increase its knowledge of the local market. [Ebert and De Neve, 2001]. This can also enable the company to expand to other markets [Ågerfalk *et al.*, 2008].

Benefits mentioned above are some of the most known benefits of GSD. These benefits can also be seen as the driving forces behind GSD. Ågerfalk, Fitzgerald, Holmström, and Ó Conchúir discovered some 'unknown' benefits related to GSD in their research. They categorised these benefits into three categories: organization, team, and process/task benefits. [Ågerfalk *et al.*, 2008].

Organizational benefits apply primarily at the organizational level. These benefits include innovation and shared best practices, and, improved resource allocation. [Ågerfalk *et al.*, 2008].

When team members are of different nationalities and have a different organizational background, innovation may be increased. The different backgrounds of workers enable reaching to best practices. [Ebert and De Neve, 2001; Carmel and Tija, 2005]. GSD also enables improved resource allocation, which is a consequence of the benefit of access to a large multi-skilled workforce [Ågerfalk *et al.*, 2008]. Due to this benefit, the company can reassign their higher cost workforce members to other more strategic activities. In return, the company will avoid employee turmoil and backlash associated with workforce reductions. [Weakland, 2005].

Team benefits include improved task modularization, reduced coordination cost, and increased team autonomy [Ågerfalk *et al.*, 2008]. GSD allows partitioning of work tasks, which results in each team having responsibility for the entire lifecycle of particular modules or functions. This decreases interdependencies, and thus, coordination costs decrease also. [Bass and Paulish, 2004]. Coordination costs get reduced because of no need for coordination due to the fact that people are not working at the same time in the 24-hour cycle. This is a benefit of the temporal distance provided by globalising development. [Ågerfalk *et al.*, 2008]. Due to organizational and geographical distribution of development, each unit has their own autonomy. This autonomy allows maintaining different working cultures for each team. [Gumm, 2006].

Process/task benefits include formal record of communication, improved documentation, and clearly defined processes. There is a positive side effect to working in different locations asynchronously. [Ågerfalk *et al.*, 2008]. Since there cannot be any real-time communication, workers must rely on technologies such as e-mail [Boland and Fitzgerald, 2004]. This provides increased traceability and accountability, since communication between team members remain saved as written down text [Ågerfalk, 2004]. In addition, in order to aid communication, the teams must have an increased focus on having good and frequently updated documentation [Delone *et al.*, 2005]. In GSD projects, process definitions tend to be compiled more carefully, and be more formalized, than in projects where team members remain co-located [Ågerfalk *et al.*, 2008].

2.3. Challenges of GSD

Three different distances affect global software development: geographical, temporal, and socio-cultural distances. These distances have a great impact on three major software development processes: communication, coordination, and control. [Ågerfalk *et al.*, 2005]. Socio-cultural distance can cause misunderstandings, lack of ‘teamness’ due to lack of familiarity with the remotely located team members, reduced sense of trust, and language difficulties for non-native speakers [Ågerfalk *et al.*, 2005].

For virtual teams one of the major challenges is communication and coordination [Huang and Trauth, 2007]. For instance, maintenance of awareness can be difficult due to delays in responses [Armstrong and Cole, 2002]. Sometimes the response may never come. In face-to-face

communication response will usually be immediate, but communicating through various technologies can cause the recipient to delay responding. In this case, the recipient of the request may forget to answer, thus resulting in a no-response situation. According to several studies, delays in getting a response or getting no response at all can cause increased conflict and reduce trust among team members. In return, this can affect negatively on the team's performance. [Armstrong and Cole, 2002].

Geographical and temporal distance makes it difficult to initiate contact with offsite colleagues. Even a small difference in time zones can lead to the other team not being able to continue their work without the offsite teams help since the other team is usually heavily dependent on the offsite team. Due to high cost of travelling, it may be impossible to temporarily locate people from one site to another in order to increase team cohesion and shared understanding. In addition, lack of informal communication can cause problems since written documentation is often inadequate when trying to resolve misunderstandings. [Ågerfalk *et al.*, 2008].

2.4. Risks related to offshoring

Even though offshoring can provide multiple benefits, it also has a lot of risks involved with it. Rottman and Lacity [2005] have created a list of offshore outsourcing risks. However, these risks can also be found in offshore insourcing, so they don't apply only in cases of outsourcing. They managed to create six risk categories: business, legal, political, workforce, social, and logistical.

Offshore outsourcing doesn't always turn out to be a success. Instead the product development may end up being poor quality, deliverables can continually be late, and, in the end there might not be any overall cost savings. These three are all considered as business risks. The country chosen for offshoring can turn out to be a wrong decision. Export restrictions, inflexible labours laws, and inefficient judicial systems can cause problems. Changes in tax laws can cause significant erode in savings. Difficulties obtaining visas can cause major problems in visiting the offshore location. [Rottman and Lacity, 2005]. Choosing the offshoring country with great care should reduce these kind of legal risks.

Political risks include politicians' threats to start taxing companies that offshore, and the political instability within the offshoring country. Offshoring can be considered as unpatriotic, which can cause problems. Poor communication skills of the supplier employees can cause major difficulties in product development. [Rottman and Lacity, 2005]. Without frequent communication and proper language skills, there's a risk of falling back in deadlines and the product becoming low in quality. Possible burnouts of the employees working for the supplier company, fast turnover rate, and the possibility of having inexperienced employees are also major risks in the workforce risk category. [Rottman and Lacity, 2005].

Social risks include cultural differences [Rottman and Lacity, 2005]. Culture is one of the biggest risk factor since it can cause problems in communication and many other parts of the development of software. Cultural differences include language, religion, and customs. Different religions have different celebrations. These plus the national holidays cause differences in the calendar of the onshore and offshore countries. [Rottman and Lacity, 2005]. This causes the other team to be away when the other team is working, thus reducing time to communicate. Because of the geographical distance, there may be challenges regarding time zone differences [Rottman and Lacity, 2005]. Logistical risks also include coordination of travelling and managing remote teams [Rottman and Lacity, 2005], which can be difficult due to the time differences, cultural differences, and possible lower frequency of communication.

2.5. IS success model and success factors of GDS

The success of information systems can be difficult to measure; therefore DeLone and McLean invented the multidimensional information systems success model (or simply, IS success model) in 1992. After a decade later, in 2003, they refined the model in order to reflect the current situation better. The refined model includes six dimensions, which are critical for the success of IS: information quality, system quality, service quality, use/intention to use, user satisfaction, and net benefits. [DeLone and McLean, 2004]. These are illustrated in figure 1.

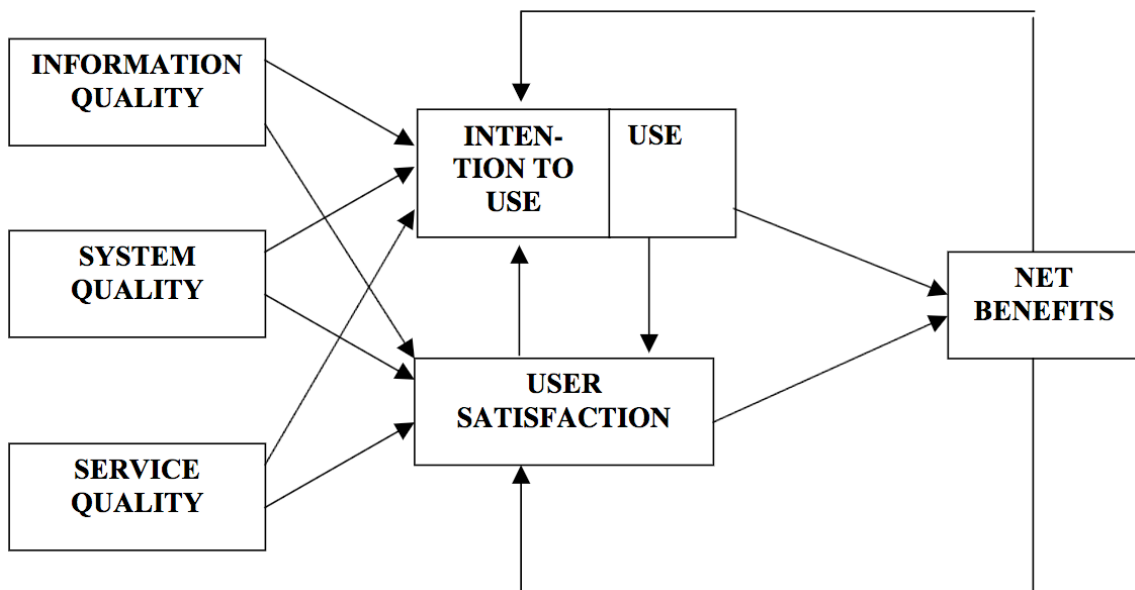


Figure 1. IS success model [DeLone and McLean, 2004].

Information quality is the quality of the information that the system stores and/or produces. For instance, information should be complete, relevant, easy to understand, and secure. System quality refers to the overall quality of the system. Examples of this dimension are availability, adaptability, usability, reality, and response time. [DeLone and McLean, 2004].

Service quality refers to the quality of the service that the system is able to deliver. This includes the overall support that the service provider is able to deliver. [DeLone and McLean, 2004]. This can be measured by the responsiveness, reality, and empathy of the support department [Petter and McLean, 2009]. This dimension has an impact on usage intentions and user satisfaction, which in turn, impact the net benefits produced by the system.

Usage of the system refers to the measurement of how much the system is used. User satisfaction is the measurement of customers' (users) satisfaction rate on the system. Net benefits are the value that the system can offer to its users [DeLone and McLean, 2004]. These are affected by the usage of the system and by user satisfaction.

Kahn and Keung [2016] conducted a study with the aim of identifying success factors and barriers in order to improve software process in global software development. The most common success factor, according to the study, is management commitment. The second most common factor is staff involvement. Other success factors included allocated resources, pilot projects, settings SPI (software process improvement) goals, team training, information sharing, strong relationship, and SPI awareness. The barriers identified in the study were lack of resources, inexperienced staff, organisational politics, time pressure, staff turnover, and lack of formal SPI implementation methodology. [Khan and Keung, 2016].

Niazi, Mahmood, Alshayeb, Qureshi, Faisal, and Cerpa [2016] identified the factors that are essential to project management success in GSD organisations. The top five factors are organisation structure, project managers' skills, communication, requirement specification, and cultural awareness. Organisation structure is the most important factor of GSD success. [Niazi *et al.*, 2016].

2.6. Country attractiveness for outsourcing and offshoring

There are multiple factors associated with country attractiveness when choosing a country for offshoring or outsourcing. Farrell has listed six factors for assessing country attractiveness. These factors include cost, skills, business and living environment, quality of infrastructure, risk profile, and market potential. [Farrell, 2006].

Companies tend to consider costs when choosing a potential outsourcing location. There are three kinds of costs to consider: labour costs, infrastructure costs, and corporate taxes. Labour costs refer to the average wages of workers. Infrastructure costs include costs for Internet access, telecom networks, and office rent. Corporate taxes cover, for instance, tax breaks and regulations. [Farrell, 2006]. Even though offshoring is partly done because of the cost savings, cost cutting is not, however, the number one reason for companies to outsource. According to the study by Oshri and Kotlarsky [2009], access to skills not available internally in the company is the largest key strategic

driver for outsourcing. Cost reduction and access to innovative processes and practices came to be the second driver [Oshri and Kotlarsky, 2009].

But costs are not the only thing that companies care about. It is also important to get skilled workers and managers in order to develop high-quality software. It is not profitable to hire cheap but unskilled people to develop software. The possible outsourcing firm must have the needed size of the labour pool with required skills [Farrell, 2006]. These skills can include business and technical knowledge, management skills, and languages [Farrell, 2006].

Companies reconsidering outsourcing or offshoring need to take in mind business and living environment in the potential location. It is important to find out about the local governance, such as labour laws, level of corruption, and policies on foreign investment. Living environment has a large impact on the well-being of people. It is good to consider what is the overall quality of life and how bad are the crime statistics in the location. When considering global offshoring or outsourcing it is especially important to unfold the business environment and how compatible it is with the prevailing business culture and ethics. Also, how accessible is the location: how much time does it take to travel there and what is the time difference. [Farrell, 2006].

Quality of infrastructure is one key point to take into consideration. Is the telecommunication and IT networks developed enough? How fast can the connection be and what is the likelihood of network downtime? How reliable is the power supply? What is the quality of road or rail networks in the location? What is the quality and availability of potential real estates? [Farrell, 2006].

One of the attractiveness factors is the risk profile of the location in question. When choosing an offshoring country, it's important to find out about the security issues, possibility of disruptive events like natural disasters and political unrest, regulatory risks such as the efficiency of the legal framework, macroeconomic risks like cost inflation or currency fluctuation, and intellectual property risk, which include strength of the data and protection regime. [Farrell, 2006].

Last but not least is market potential. How attractive is the local market? What is the current gross domestic product and how fast is the growth of it? Is there an easy access to the nearby markets both in the host country itself and in the adjacent regions? [Farrell, 2006].

2.7. India as an offshoring country

India has long been a good choice for offshoring software development since it is a major exporter of information technology services and software workers [Central Intelligence Agency, 2016]. There are multiple reasons for this. Firstly, India is a cost-competitive country. Companies are able to get significant cost savings by implementing their software or parts of the software in India. Secondly, India does not only offer cheap workforce, but also skilled and talented people; there are

more than 250 universities in India. Thirdly, Indians are used to speaking English as it is widely used in India due to the vast amount of regional languages and thousands of sub-dialects. However, Indians tend to invent new words. This kind of use of unusual terminology can be confusing for a foreigner. Also Indians tend to speak very fast with a heavy accent, which can take time to get used to. [Abraham, 2009].

India has many assets that have made it one of the most used offshoring country. Even though there is a lot of poverty in India, the country has been able to create a working infrastructure and telecommunicating services, which are a necessity for offshoring. India also has a stable democracy. [Abraham, 2009]. The most common religion in India is Hinduism (80%). The second common is Islam (14%). There are also some other minor religions like Christianity and Sikhism. Hindi is the most widely spoken language (41%). English is a subsidiary official language in India, and, it is especially important in politics and business. There are also 14 other official languages, which include Bengali (8%) and Marathi (7%) for instance. [Central Intelligence Agency, 2016].

In terms of Finland, the time difference between India and Finland is only 3,5 hours (or 2,5 hours during the summer time). This enables real-time communication between Finnish and Indian teams. Also, geographically visitations are quite easily organized, since traveling by flight takes merely about seven to nine hours depending on the destination city. Cultural differences between these two countries are large. For instance, India is a male-dominated family-orientated country, whereas in Finland people are independent and the gap between genders is low. However, there are also similarities. Both Finnish and Indian people have a cultural preference for charismatic leaders. In addition, both Indian and Finnish employees have a preference towards team-oriented style at work. [Boopathi, 2014].

3. Socio-cultural factors

This chapter will firstly explain the three different distances that cause challenges in distributed settings. These are the temporal, geographical, and socio-cultural distances. In the second subchapter Geert Hofstede's famous six cultural dimensions are explained with numerous examples. The third subchapter will go forward to explain the four types of organizations that Hofstede has been able to recognize on the basis of his and his colleagues studies. Finally, the final subchapter will explain the differences between India and Finland based on the cultural dimensions.

3.1. Temporal, geographical, and socio-cultural distances

Socio-cultural distance is one of three distances that have a great impact on global software development. Socio-cultural distance is a measure of a person's understanding of another person's values and normative practices [Ågerfalk *et al.*, 2005]. Culture plays a huge role in the way people interpret and act to situations [Kotlarsky and Oshri, 2005]. Edward Burnett Taylor [1871], an English anthropologist, has defined culture as a "complex whole, which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society".

Geographical distance is a measure of the effort required for one person to visit another. This reduces the intensity of communication. [Ågerfalk *et al.*, 2005]. According to Holmstrom, Ó Conchúir, Ågerfalk, and Fitzgerald [2006], geographical distance should be measured in ease of relocating rather than in kilometres. Geographical distance may cause bigger socio-cultural distance. However, this is not always the case. Cultural distance can be large even when the geographical distribution is low. [Holmstrom *et al.*, 2006]. Temporal distance is a measure of the dislocation in time experienced by two persons who wish to interact [Ågerfalk *et al.*, 2005]. The time difference between two locations causes temporal distance, and thus, minimizes the amount of possible real-time collaboration between teams [Sarker and Sahay, 2004].

3.2. Hofstede's cultural dimensions

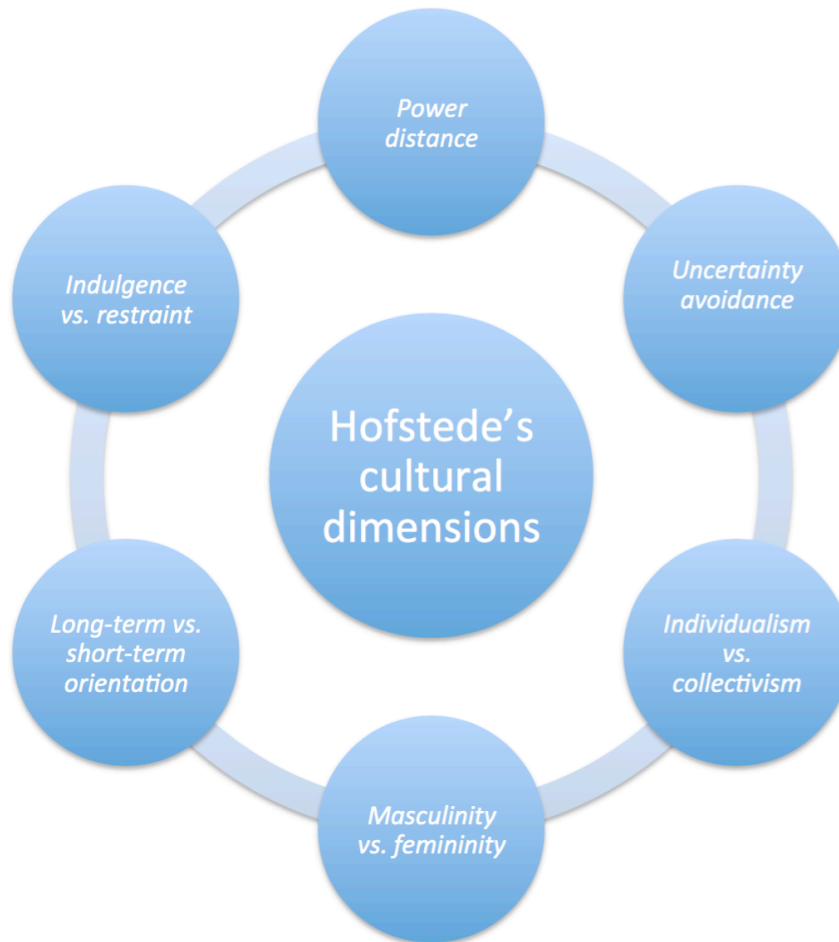


Figure 2. Hofstede's cultural dimensions [Hofstede, 2001].

Geert Hofstede developed his cultural dimensions theory in the 1970's. The theory includes six cultural dimensions as shown in figure 2. The theory is based on an extensive survey conducted among IBM employees in 72 countries. The survey was conducted between 1967 and 1973 in two survey rounds. The focus of the analysis was on country differences. The questions in the survey revolved around employee values. The initial analysis identified four different cultural dimensions: power distance, uncertainty avoidance, collectivism/individualism, and masculinity/femininity. A decade later a fifth dimension, long-term/short-term orientation, was added to the model. [Hofstede, 2001: 41]. This dimension was based on a Chinese Values Survey conducted in 23 countries among students in 1985 [Hofstede, 2001: 351]. In 2005, Hofstede added a sixth dimension, indulgence, which he discovered together with Michael Minkov [Oliver, 2011: 39]. These cultural dimensions offer an insight into different cultures. The dimensions try to explain different cultures in six different angles.

3.2.1. Power distance

The power distance index (PDI) refers to the extent to which “the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally”. PDI indicates the attitudes of employees towards the managers. The score of countries on this dimension differs from high PDI to low PDI. In Hofstede’s study, scores for PDI were given based on the responses to three questions. These questions were aimed to reveal the attitudes of whether or not the employees are afraid of disagreeing with their manager, and actual and preferred decision-making styles of management (autocratic, persuasive/paternalistic, or democratic). [Hofstede, 2001: 79; Oliver, 2011: 40]. High PDI countries include Latin American countries, India, France, Hong Kong, Belgium, and Thailand. Low PDI countries include Scandinavian countries, Australia, Germany, Great Britain, and Austria. [Hofstede, 2001: 87].

There are significant differences between high and low PDI countries. These can be seen in family life, in school, and in work organisations. In high PDI societies, parents teach their children obedience and make children work hard. Infertility may even be a reason for divorce. At school, education is teacher-centered. Teachers are treated with respect. Parents are supposed to side with the teacher. In low PDI societies, children are treated as equals and they are not supposed to work, rather enjoy their childhood and enjoy leisure. There is no gap between ages; children treat their parents and older relatives as equals. At school, education is student-centered. Teachers do not have as much power as in high PDI countries. Parents may even side with students rather than the teacher. [Hofstede, 2001: 107]. Also, values and attitudes tend to differ in high and low PDI countries. In high PDI societies, equality is found more important than freedom, authority is based on tradition, and top leaders tend to be older people. Whereas in low PDI societies freedom is found more important than equality, authority is based on secular-rational arguments, and top leaders tend to be younger than in high PDI societies. [Hofstede, 2001: 96].

In high PDI countries, the organizational structure is hierarchical [Hofstede, 2001: 107-108]. There is a significant inequality between staff and managers. Superiors consider subordinates as being different than themselves [Hofstede, 2001: 98]. Authoritative leadership and close supervision is seen as leading to satisfaction, performance, and productivity. An ideal boss is an autocrat and a benevolent decision maker. Information is constrained by the hierarchy. This can be seen in the way information is transferred. In high PDI countries, the information goes downwards as a one-way flow from management to employees. In this way, the decisions are made at a high level and the information about decisions are transmitted down to subordinate staff. The decision structure is centralised. Managers rely on formal rules and subordinates expect to be told what to do. This kind of a strict hierarchical structure needs a large proportion of supervisory personnel. Innovating requires support from the management. [Hofstede, 2001: 107-108]. In high PDI countries, such as China, status is accorded a high importance [Oliver, 2011: 42].

In low PDI countries, the organizational structure is flat [Hofstede, 2001: 107-108]. Superiors consider subordinates as being “people like me” [Hofstede, 2001: 98]. In this view consultative leadership is seen as leading to satisfaction, performance, and productivity. An ideal boss is a resourceful democrat who relies on support. The decision structure is decentralised. Information can flow upwards, downwards, and sideways between management and staff. A large difference to high PDI countries is the way managers and subordinates act. Managers do not have strict rules, so, they have to rely on personal experience and on subordinates. [Hofstede, 2001: 107-108]. Due to this, decision-making may be ad hoc and not documented. Information in the form of text may not be preferred or even not regarded as authoritative. [Oliver, 2011: 43]. Subordinates do not expect to be told what to do; instead they expect to be consulted. There is a smaller need for supervisory personnel. Innovation can be seen as easier in low PDI countries since there is no need of hierarchical support. There is only a need for a “champion” to lead on with the innovation. [Hofstede, 2001: 107-108].

3.2.2. *Uncertainty avoidance*

The uncertainty avoidance index (UAI) refers to “uncertainty about the future and the extent to which a culture will attempt to minimise that uncertainty”. The higher the value, the lower the tolerance towards risk and uncertainty. In high UAI countries, there is a high need to avoid uncertainty about the future whereas in low UAI countries there is a low need to avoid uncertainty about the future. Scores for UAI were calculated based on three questions, which addressed staff attitudes to regulations, company rules, employment stability, and stress. [Oliver, 2011: 45-46]. High UAI countries include Greece, Japan, Spain, Turkey, Brazil, Austria, and Switzerland. Low UAI countries include United States, Great Britain, Hong Kong, and Sweden. [Hofstede, 2001: 151].

There are certain key differences between high and low UAI societies. For instance, in high UAI societies, there is a higher anxiety level in population, even though expression of emotions is considered normal. [Hofstede, 2001: 160]. Traditional gender roles are preferred, and certain things are strongly considered as taboos. At school, teachers are supposed to have all the answers. Truth is considered as absolute, with no variations. [Hofstede, 2001: 168]. In low UAI societies, anxiety levels are low in population. Emotions have to be controlled. People are tolerant towards diversity. [Hofstede, 2001: 160]. Gender roles are not strict, and there are lenient rules on what is considered a taboo. At school, teachers are not expected to know all the answers. Truth is considered to be relative. [Hofstede, 2001: 169].

In work life, there is a tendency to stay with the same employer in high UAI countries. Managers tend to be selected on the basis of their seniority, and there is a higher average seniority in jobs. This is most probably due to the fact that older people are respected and feared. People are

unwilling to take risks unless the risks are known. People are less open to changes. Workers have high stress levels. [Hofstede, 2001: 160]. People need structure and rules to feel comfortable. Management is highly formalised. There is a high belief in specialists and expertise. Due to the high uncertainty, employment usually lasts for a long duration. [Hofstede, 2001: 169-170]. Organizations are likely to have structured decision-making processes and longer time perspectives [Smith, 1992]. There is a bias towards technological solutions. High UAI countries are task orientated. Employees are naturally punctual. [Hofstede, 2001: 169-170].

In low UAI countries, there is less hesitation to change an employer. Managers are selected on the basis of other criteria than seniority. Younger people are respected too. There is optimism about employer's motives and less resistance towards changes. Workers are also more accepting towards foreigners as their manager. Workers have low stress levels. [Hofstede, 2001: 160]. People are more likely to take risks. There is more tolerance for ambiguity in structures and procedures. Employment tends to last for a short period of time. [Hofstede, 2001: 169-170]. Due to these two reasons, it might be that the personnel are less aware of information management policies and practices [Oliver, 2011: 47]. People tend to believe in generalists and common sense. There is scepticism towards technological solutions. Low UAI countries are relationship orientated. Employees are not naturally punctual and they will have to learn to manage precision. [Hofstede, 2001: 169-170].

3.2.3. Individualism vs. collectivism

Individualism index (IDV) refers to “the degree which a society views individualism as a positive or negative trait” [Oliver, 2011: 52]. In individualistic cultures the emphasis is on the “I” and in collectivist cultures the emphasis is on “we” [Hofstede, 2001: 227]. Scores for IDV are based on the analysis on 14 questions about work goals. [Hofstede, 2001: 214]. High IDV countries include United States, Australia, Great Britain, Netherlands, Scandinavian countries, and Austria. Low IDV countries include Brazil, Arab countries, Turkey, Greece, Hong Kong, and Thailand. [Hofstede, 2001: 215].

High IDV societies are characterized by high economic development, living in moderate or cold climates, monotheist religions, nuclear family structure, and fewer children per family [Hofstede, 2001: 251 and 254]. People live with other human companions, not with pets [Hofstede, 2001: 245]. Family ties are weak and there are more divorces. There are no criteria for marriage partners. Privacy, as well as confrontations, are considered normal. Women tend to express their feelings more strongly than men. [Hofstede 2001: 236]. Low IDV societies are characterized by lower economic development, living in tropical or subtropical climates, polytheist religions, extended family or tribal structures, and a large amount of children in the family [Hofstede, 2001: 251 and 254]. People may have pets they live with [Hofstede, 2001: 245]. Family ties are extremely strong. Marriages are often arranged and divorces are not that common. Nobody is ever left alone. There is

harmony, and confrontations are rare. Women express their emotions less strongly than men. Activities are dictated by gender roles. [Hofstede 2001: 236].

In high IDV organizations employees perform best as individuals. There is a high preference towards individual work. Training should be focused on an individual level. Information is shared through media rather than through social networking. [Hofstede, 2001: 227, 228 and 244]. Communication is low-context implying that a lot of information is made explicit. [Hofstede, 2001: 212]. Withholding information is viewed as an attribute of organisational success. People work longer hours, but the workers also have more control over their jobs and working conditions. Incentives are given to individuals. [Hofstede, 2001: 227, 228 and 244].

In low IDV organizations employees perform best in groups. There is a high preference towards group work. Training should be focused on a group level. The main source of information is social networking. People tend to communicate a lot. [Hofstede, 2001: 227, 228 and 244]. There is a high-context communication where most of the information is shared in the physical environment, only a little has to be said or written down. [Hofstede, 2001: 212]. Information is viewed as an attribute of organisational success. People work less in matter of hours, and they also have less control over their work and working conditions. Incentives are given to groups rather than individuals. [Hofstede, 2001: 227, 228 and 244].

3.2.4. *Masculinity vs. femininity*

Masculinity index (MAS) refers to “how culture views the traditional roles of men and women“ [Oliver, 2011: 58]. In masculine cultures people expect men and women to work in gender-defined roles [Hofstede 2001: 279-181]. Feminine cultures are more caring, and masculine cultures are more assertive [Hofstede 2001: 312]. Masculine countries include Japan, most European countries, and United States. Feminine countries include Spain, Thailand, Scandinavian countries, and the Netherlands. [Hofstede 2001: 286].

Social norms differ in case of masculine or feminine countries. Masculine societies tend to be ego orientated. Money and things are found important in life. There is a huge emotional and social role differentiation between the two genders. Sympathy is given for the strong. People can be very assertive and ambitious. Men are expected to be tough and women to be tender. [Hofstede 2001: 299]. Family is important, and children can express their aggression. People may get married very fast, and it is the decision of the fathers to determine the family size. Children are supposed to be excellent students, failing in school is not accepted. [Hofstede 2001: 306]. In contrast, feminine countries are relationship orientated. People put stress on the importance of people and quality of life. Gender differentiation is at a minimum level. Sympathy is given for the weak. People are expected to be modest. Men are expected to be tender. [Hofstede 2001: 299]. Friends are considered very important. Children are taught to be modest, and they cannot express their

aggression. Mothers tend to decide the number of children. Most students tend to be average in school. Failing is not considered a disaster. [Hofstede 2001: 306].

In high MAS (masculine) countries employees are more likely to live in order to work [Hofstede 2001: 299]. Employees value security, pay, and interesting work. These are seen as contributing factors to job satisfaction. There is a huge preference for higher pay. Employees tend to value equity, mutual competition, and performance. Managers are believed to be culture heroes. There is a tendency to oversell yourself when applying for a job. Conflicts are solved by either denying the conflicts or by fighting until the best man wins. People believe that career ambitions are compulsory for men but optional for women. [Hofstede, 2001: 318].

In low MAS (feminine) countries, employees work in order to live [Hofstede 2001: 299]. The key contributing factors to job satisfactions are the value of relations and working conditions. Employees prefer working fewer hours than higher pay. Employees value equality, solidarity, and quality of work life. Managers are not considered to be anything else but normal employees, such like everybody else. People tend to undersell themselves when trying to apply for a job. Conflicts are resolved through problem solving, compromising, and negotiating. Career ambitions are believed to be optional for both men and women. [Hofstede, 2001: 318].

3.2.5. *Long-term vs. short-term orientation*

The long-term orientation index (LTO) refers to “how culture values long-standing traditions”. High long-term orientation cultures value traditions. Low score cultures value equality. [Hofstede 2001: 351]. High LTO countries include China, Hong Kong, Japan, and Brazil. Low LTO countries include the Netherlands, Sweden, Australia, United States, Great Britain, and the Philippines. [Hofstede 2001: 356].

In high LTO cultures (long-term orientation) people are more persistent. Relationships are ordered by status. Shame is a common feeling. Leisure time is not considered important. [Hofstede 2001: 360]. Money is rather saved and invested than spent. Women are expected to be a stay-at-home mother. There is a differentiation between younger and older siblings. Living with in-laws is not considered a problem. In business, people expect to get short-term results. [Hofstede 2001: 366]. In low LTO cultures (short-term orientation) people expect to get quick results. Relationships are not based on status. Shame is not a common feeling. There is a huge respect for traditions. Leisure time is considered important. [Hofstede 2001: 360]. People like to spend their incomes, rather than save them for later use. Women are expected to work, and it is not considered harmful for the children. Siblings are considered to be equals. In work life, market position is important, as well as building relationships. [Hofstede 2001: 366].

3.2.6. *Indulgence vs. restraint*

The newest dimension indulgence vs. restraint (IVR) is based on World Values Survey. It has a weak negative correlation to long-term/short-term orientation. In a high IVR society, basic natural human desires related to enjoyment of life and having fun is allowed. In a low IVR society gratification of needs is controlled by society by the means of strict social norms. Indulgence prevails in Western Europe, as well as in South and North America. Restrain prevails in Eastern Europe, Muslim countries, and Asia. [Hofstede, 2011].

In high IVR (indulgence) societies people tend to feel happy and in control of their lives. Freedom of speech and leisure time are seen as important. In countries where there is no shortage of food, there is a higher rate of obese people. Sexual norms are lenient in wealthy countries. In low IVR (restraint) countries fewer people declare themselves as being happy. People tend to have a perception of helplessness; they do not feel accountable for the things happening to them. Leisure is not seen as important as in IVR countries. Also, freedom of speech is not a priority. Even though a country would not have a shortage of food, people do not become obese. In wealthy countries, there are strict sexual norms to obey. [Hofstede, 2011].

3.3. Types of organizations

Based on the cultural dimensions, Hofstede was able to identify two key elements that have a strong effect on corporate culture. These dimensions are power distance and uncertainty avoidance. In corporate settings, power distance can be referred to as how much decision-making authority is delegated to the employees. Uncertainty avoidance is characterized by how much stability and certainty do employees need in order to feel comfortable at work. Hofstede identified four types of organizations: the pyramid model, the market model, the family model, and the well-oiled machine model. [Hofstede, 2001: 382].

The most common organisation type for large power distance and strong uncertainty avoidance countries is “full bureaucracy”, also known as the pyramid model. This kind of an organisation is strongly hierarchical. The pyramid model is common in Latin, Mediterranean, and Islamic countries as well as in Japan and some other Asian countries. The opposite of a pyramid model is the market model, which is implicitly structured. This organisation type is common in small power distance and weak uncertainty avoidance countries such as Denmark and other Scandinavian countries, and the Netherlands. [Hofstede, 2001: 377]. The market model emphasizes relationships between people rather than strict rules and regulations [Mead, 1990: 26].

The third model “personnel bureaucracy”, also knows as the family model, is found in countries with large power distance and weak uncertainty avoidance [Hofstede, 2001: 377]. Here there is a strong leader, whose authority is associated with the individual and not the position he or she holds [Oliver, 2011: 169]. Family model is found in countries such as China and India [Hofstede, 2001:

377]. The fourth type is “work-flow bureaucracy”, also known as the well-oiled machine. This is found in small power distance countries with a strong uncertainty avoidance index. This model emphasizes regulating activities. [Mead, 1990: 26]. Organisations with this model in use can be found in German-speaking countries (e.g. Germany, Austria, and Switzerland), Finland, and Israel. [Hofstede, 2001: 377].

3.4. Cultural dimensions of India and Finland

Figure 3 illustrates the differences between India and Finland in terms of Hofstede’s cultural dimensions. The largest difference between these two countries is power distance; the difference being as large as 44. The second and third largest difference can be found in indulgence (31) and masculinity dimension (30). Least difference causes individualism dimension (15), uncertainty avoidance (19), and long-term orientation (13). Due to these differences, India and Finland also have different organization types. As mentioned in the previous subchapter, India follows the family model and Finland has the well-oiled machine model in use.

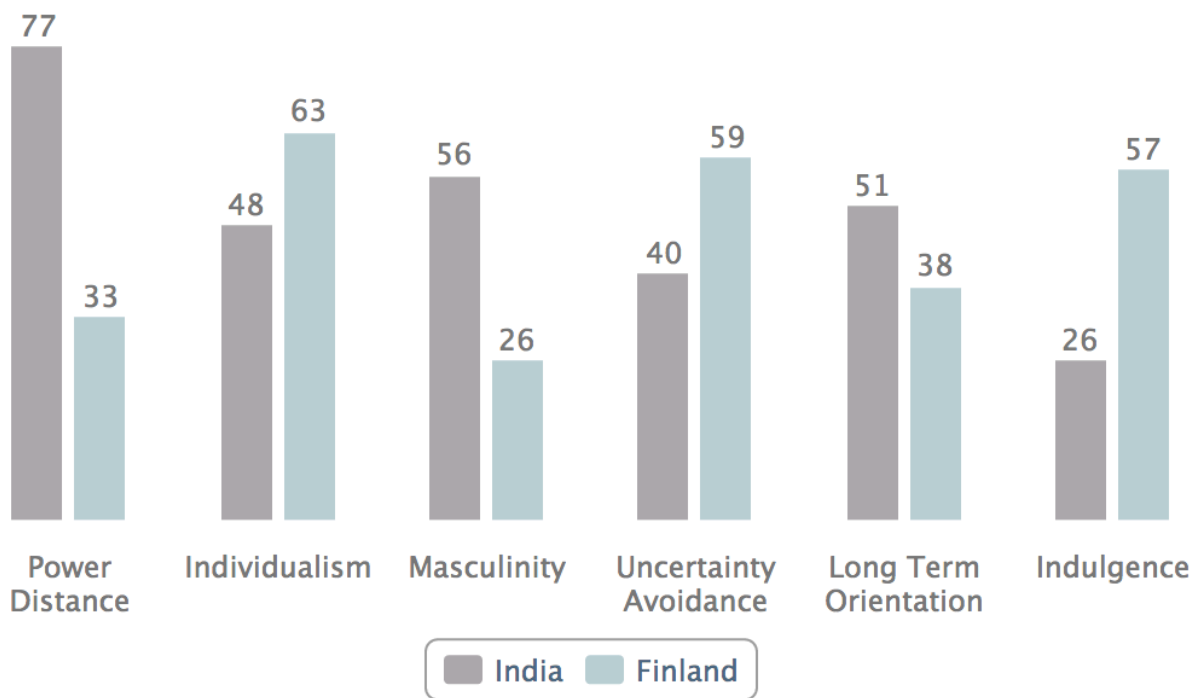


Figure 3. Cultural dimensions of India and Finland [Hofstede, 2001].

India’s PDI value is very high, 77 [Hofstede, 2001: 87], while the world average value is 56.5 [Abraham, 2009]. This means that power is distributed unequally in India. Social status is highly valued. Finland’s value is 33 [Hofstede, 2001: 87]. In software development, high PDI can be seen in the inequality of bosses and subordinates. The boss has greater authority over their subordinates in India than in Finland. [Borchers, 2003]. In Finland, the organizational structure is very flat. Bosses and subordinates are seen as being at the same level with each other.

India's UAI value is 40. Finland's value is 59. [Hofstede, 2001: 151]. The world average value is 65 [Abraham, 2009]. Indians tend to be able to bear uncertainty. Finnish people want to avoid uncertainty and therefore they need more structure and rules to make themselves feel more comfortable. High UAI value can also be seen in that the employees tend to be more naturally punctual, whereas in low UAI countries employees need to learn to manage precision and punctuality. Due to uncertainty avoidance, Finnish people are more likely to work for a longer period of time with the same employer, whereas Indians are more likely to switch between employers in a short period time. [Hofstede, 2001: 169-170].

India is a collectivist country with the value of IDV being 48. The value for Finland is 63, making Finland an individualistic country [Hofstede, 2001: 215]. The average value is 43. This means that in India, family and working in groups is valued, while in Finland people live more independently from the groups they belong to. In software development, high IDV impacts the ability of workers to form strong bonds between other team members. In low IDV cultures, people are able to act more cohesively. [Borchers, 2003].

India scores a MAS value of 56, while the world average is 50. Finland's value is 26. [Hofstede, 2001: 286]. This makes India a masculine country and Finland a feminine country. There is a huge difference between these two values. According to these values, Indians see work important as itself. For Finnish people, work is just a way to earn a living and hence to get to do other interesting things in life. [Hofstede, 2001: 318]. Gender roles are more defined in India [Hofstede, 2001: 318], which can be seen in the absence of women in high power decision-making jobs.

India's LTO value is 61 [Hofstede, 2001: 356]. Finland's value is 38. The world average value is 45. [Hofstede, 2001]. This means that India is long-term orientated and Finland is short-term orientated. Indians value traditions and they tend to plan their future. Finnish people value equality. [Hofstede, 2001: 366]. Indians do not consider leisure time important [Hofstede, 2001: 360], which can also be seen in that India is a masculine country where work is found important. In business, Finnish people expect to get short-term results, whereas Indians are more into holding market position and building relationships [Hofstede, 2001: 366].

The IVR value for India is 26. Finland's value is 57. This means that in India there are more social norms restricting the gratification of needs, whereas in Finland people are allowed to enjoy life and satisfy their human desires. [Hofstede, 2011]. Freedom of speech in high IVR cultures [Hofstede, 2011] also enables employees to feel acceptable to express their contradictory opinions. In restrained cultures employees may feel forced to keep their opinions hidden.

4. Knowledge sharing

This chapter will present the difference between tacit and explicit knowledge. The second subchapter will present Zahedi's and Christiansen's knowledge sharing challenges. Knowledge sharing practices will be presented in the third subchapter.

4.1. Tacit and explicit knowledge

Sharing knowledge is a key process in developing software products. Expert knowledge tends to be mostly tacit. Tacit knowledge is a form of knowledge, which is difficult to transfer to another person by verbalising it or writing it down. [Ryan and Connor, 2013]. Tacit knowledge is opposite of explicit knowledge, which in return is knowledge that is easy to pass on to another person. Tacit knowledge can be gathered through own experience, for instance, through working for a single company for many years. Explicit knowledge could be the knowledge found in requirement specifications. It can be challenging to share tacit knowledge since team members may be unwilling to share their own knowledge to others. The reason for this can be a lack of trust for other team members. [Pinjani and Palvia, 2012]. In order to make sharing tacit knowledge more comfortable, team trust should be built.

Choo and Alvarenga [2010] studied the conditions that enable knowledge sharing. The study revealed four major categories: social/behavioral characteristics of teams (such as mutual trust and open dialogues), cognitive/epistemic attributes (such as common knowledge, shared values, and goals), organizational structure/strategies (such as leadership style), and provision of information systems (such as internet and intranet) [Choo and Alvarenga, 2010]. Mutual trust has been frequently mentioned in numerous studies of this subject. It seems that without trust between team members, people do not feel safe to share their tacit knowledge with their peers [Kotlarsky and Oshri, 2005].

4.2. Knowledge sharing challenges in GSD

Offshoring software development creates further difficulties in knowledge sharing. Distance in culture, time, and space makes it more difficult to communicate. Differences in time zones create delays in responses. In direct communication, misunderstandings tend to sort out in just a few minutes, while in indirect communication it may take days. Culture may affect the way people are used to communicating with each other. Usually, offshore team members are more accustomed to different cultures than their onshore colleagues. [Christiansen, 2007]. Zahedi, Shahin, and Babar [2016] used systematic literature review to identify and synthesise knowledge sharing challenges found in 61 studies. They classified the recurrent 16 challenges that they found into six main themes: management, team structure, work processes/practices, team cognition, social attributes, and technology [Zahedi *et al.*, 2016]. These are illustrated in figure 4.

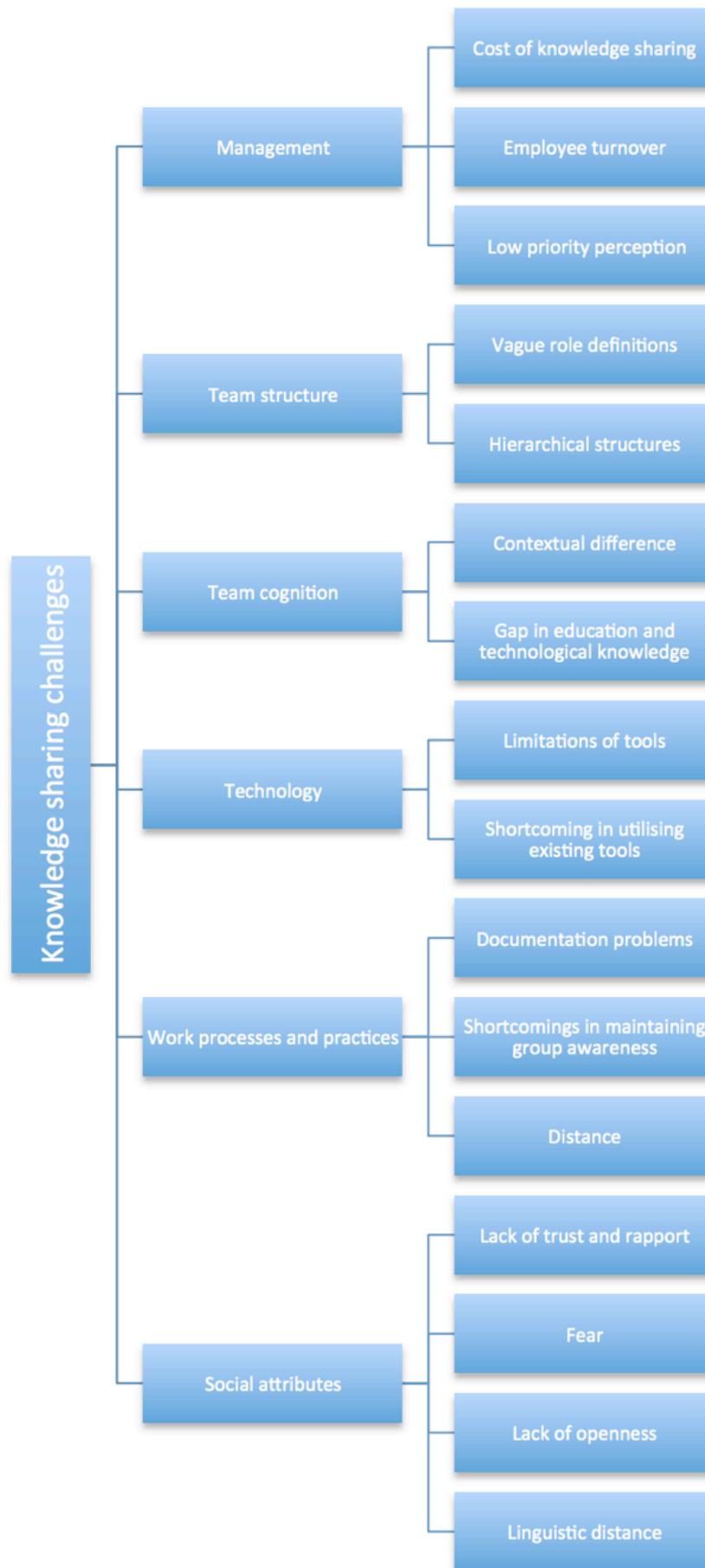


Figure 4. Knowledge sharing challenges [Zahedi *et al.*, 2016].

Three knowledge sharing challenges can be found in the management category. First is the cost of knowledge sharing [Zahedi *et al.*, 2016]. Visitations can cost a lot of money, especially if the distance between the two locations is large [Betz *et al.*, 2014; Dingsøyr and Smite, 2014]. Money is also spent on virtual communication [Betz *et al.*, 2014], such as buying certain virtual conferencing tools like headsets or web cameras. In distributed settings knowledge must be codified in more detail [Dingsøyr and Smite, 2014]. This consumes time and money. Another management related challenge is employee turnover [Zahedi *et al.*, 2016]. Fast employee turnover can cause gaps in sharing and understanding knowledge. Moreover, it requires re-building social relations and re-transferring knowledge to newly joined team members. However, other colleagues may not feel motivated enough to share their knowledge with the newcomers. [Zimmermann and Ravishankar, 2014]. The third challenge is low priority perception [Zahedi *et al.*, 2016]. This means that knowledge sharing activities are sacrificed in order to meet project deadlines [Madsen *et al.*, 2015].

The team structure category has two challenges: vague role definitions between the two sites and hierarchical structures [Zahedi *et al.*, 2016]. Vague role definitions reduce motivation to share knowledge due to vague ownerships [Kotlarsky *et al.*, 2008]. Hierarchies cause bottlenecks in knowledge sharing [Manteli *et al.*, 2011]. Top-down leadership can cause handicapped articulation and clarifications between sites [Bodern and Wulf, 2010]. Team cognition category consists two knowledge sharing challenges [Zahedi *et al.*, 2016]. Contextual difference is characterised by the difficulty to articulate tacit knowledge [Aman and Nicholson, 2008; Zimmermann and Ravishankar, 2014], and to identify knowledge to be transferred [Betz *et al.*, 2014; Madsen *et al.*, 2015]. Gap in education and technical knowledge causes difficulties in communication due to lack of common technical terminologies [Aman and Nicholson, 2008]. In addition, inexperienced workers tend to have a limited understanding [Jensen *et al.*, 2007]. The tools category consists of the following two challenges [Zahedi *et al.*, 2016]. Limitations of tools for knowledge sharing cause a need for collaborative tools [Razzak *et al.*, 2013]. Without proper knowledge repositories, it is challenging to use search functions [Dingsøyr and Smite, 2014]. The second challenge is shortcomings in utilising existing tools [Zahedi *et al.*, 2016]. Knowledge sharing is difficult if the employees are reluctant to use knowledge repositories [Zahedi *et al.*, 2016].

The work processes/practices category consists of three challenges. Documentation problems such as missing, poor, or outdated documents can cause various problems. [Zahedi *et al.*, 2016]. The remote team cannot function properly if requirements documentation is poor [Boden *et al.*, 2012]. Lack of documentation can cause poor organisational memory [Chuaa and Pan, 2008]. Furthermore, missing or outdated documents make it difficult to find accurate source of information [Manteli *et al.*, 2011]. The second challenge in this category is shortcomings in maintaining group awareness [Zahedi *et al.*, 2016]. Maintaining group awareness is difficult in distributed settings [Gutwin *et al.*, 2004]. Group awareness information includes the understanding of who you are working with [Dourish and Bellotti, 1992], where are they working, what are they doing, and what

do they plan to do [Gutwin *et al.*, 2004]. These all are compromised if group awareness is not maintained properly [Boden *et al.*, 2012; Dingsøyr and Smite, 2014]. Group awareness can be used in coordinating actions, discussing about tasks, anticipating other team members' actions, finding help, and managing coupling [Gutwin and Greenberg, 2002]. In distributed settings, people cannot simply watch what the other person is doing and thereby get information on who is doing what. The third challenge in communication is caused by distance. Distance reduces frequency of communication.

Social attributes category consists of four challenges. These are lack of trust and rapport, fear, lack of openness, and linguistic distance [Zahedi *et al.*, 2016]. Lack of social ties inhibits informal sharing of knowledge [Wendlish *et al.*, 2014]. Fear of losing one's job may cause unwillingness to share knowledge [Zimmermann and Ravishankar, 2014]. Lack of openness is characterised by reluctance to ask questions. Linguistic distance makes it difficult to share and absorb knowledge due to language difference. [Betz *et al.*, 2014]. Language can cause misunderstandings. It takes time to get used to a heavy accent. In many cases, offshore developers' written skills are better than their spoken language skills. [Christiansen, 2007]. This would suggest that it is better to write than try to communicate using voice. However, with writing, you lose the richness of tonal expressions, which can be achieved in spoken communication [Christiansen, 2007]. According to Cockburn [2002], communicational richness is always affected when face-to-face communication is not used. All in all, using phone calls enables to hear all the tonal expressions, however, heavy accent or poor spoken language skills can make it hard to understand what the other one is saying. In case synchronous communication is possible, chat is one way to get a fairly fast response. [Christiansen, 2007].

4.3. Knowledge sharing practices in GSD

There are several ways to smooth knowledge sharing as illustrated in figure 5. These include alignment of IT infrastructure, usage of novel techniques, incentives and motivation, flexible communication structure, emphasis on spoken language skills and cultural knowledge, social ties, clarification of work structure, transactive memory system, frequent and synchronous communication, rotating people between shores, and usage of documentation [Christiansen, 2007; Zahedi *et al.*, 2016]. For instance, the company should have their IT infrastructure aligned. In a GSD project, it is important to use same platforms that are standardised in order to make communication as easy as possible technology-wise. [Christiansen, 2007]. In addition, using novel techniques and solutions can help facilitate knowledge sharing in distributed settings [Palacio *et al.*, 2011].



Figure 5. Knowledge sharing practices [Christiansen, 2007; Zahedi *et al.*, 2016].

Incentives and motivation work as promoters of knowledge sharing [Zahedi *et al.*, 2016]. According to a study performed by Mathrani and Parsons [2012], rewarding workers can improve the flow of knowledge among distant team members. Not only can using incentives and motivation keep employees productive, but this also helps the GSD process. In addition, it is important to keep communication flexible [Zahedi *et al.*, 2016]. Information flow is significantly better when hierarchies are removed [Nicholson and Sabav, 2004] and flat communication is allowed [Boden *et al.*, 2010]. According to Boden, Avram, Bannon, and Wulf [2012], it would be beneficial for the offshore team to have direct access to customers. This helps dealing with the difficulties in sharing and understanding requirement specifications [Boden *et al.*, 2012]. However, in many cases, this is not possible. Due to language barriers, it may even be impossible for the offshore team to communicate directly with the customer.

It is extremely important to put stress on spoken language skills. If a team member does not have good enough spoken language skills, it will have a deep impact on communication. Also, it is important to adapt to and understand other cultures. It is important for both teams to absorb same communication strategies. [Christiansen, 2007]. Knowing the culture of the other team makes it

easier to understand the actions one makes. Other ways of improving knowledge sharing are by improving team expertise [Chuaa and Pan, 2008] and investing on social practices [Zahedi *et al.*, 2016]. Improving the social ties between team members has a significant role in building trust and improving team cohesion, which in return help the process of knowledge sharing [Chuaa and Pan, 2008; Jensen *et al.*, 2007; Wendlish *et al.*, 2014; Zahedi *et al.*, 2016].

Working in distributed settings put more emphasis on the work structure [Zahedi *et al.*, 2016]. It is beneficial for the team members to have a good clarification of roles, responsibilities, and assigned tasks. This can help smooth the flow of information [Clerc *et al.*, 2011]. Having a transactive memory system, which basically means knowing who knows what, can help team members to find the information they need, and to assess relevant knowledge [Kotlarsky and Oshri, 2005; Manteli *et al.*, 2014]. Knowledge sharing can be made more frequent by encouraging people to communicate with each other more [Clerc *et al.*, 2011]. Basically, the more people will communicate with each other, the more knowledge they will transfer [Sarker *et al.*, 2005]. It is important to have a common understanding between the onshore and offshore teams [Aman and Nicholson, 2008; Betz *et al.*, 2014; Chuaa and Pan, 2008; Madsen *et al.*, 2015].

It is important to put emphasis on synchronous (real-time) communication, which includes chat, telephone, and face-to-face communication. Communication based on e-mails will cause misunderstandings to occur, and the project will slow down. Synchronous communication will fasten feedback cycles and improve understanding among the virtual team members. Face-to-face meetings are the best way to communicate since it is possible to see one another, hear the tonal expressions, and see all the gestures one makes while speaking. [Christiansen, 2007]. However, it can be expensive [Laplante *et al.*, 2004] and inconvenient [Kobitzsch *et al.*, 2001] to travel to the other destination. Chat is the least informative form of synchronous communication [Cockburn, 2002], although it is useful in cases when spoken language is hard to comprehend due to heavy accents or poor spoken language skills [Christiansen, 2007].

Rotating people between shores allows team members to absorb information that could not be absorbed using any other way of communicating than face-to-face meetings. Temporary collocation of distributed team members allows effective transfer of essential business knowledge [Christiansen, 2007; Chuaa and Pan, 2008]. In this way, the offshore developers can understand what the customer wants [Christiansen, 2007]. Visitations help the visitors to leverage mutual learning and understand context [Chuaa and Pan, 2008]. This can also be done the other way around. An offshore team member can be sent to the onshore location to absorb information and business understanding. After being allocated back home, he or she can then transfer this information to all the other offshore team members. [Christiansen, 2007].

Artefacts can refer to requirements specification, or in case of agile projects, the code base and the user stories. It is important to use these artefacts in order to maintain and give understanding in the project. [Christiansen, 2007]. Groupware tools help to codify and centralise organisational knowledge. Document management systems (such as Microsoft SharePoint), for instance, help to manage project documents, especially in distributed settings. These systems provide features like versioning and classification. [Zahedi and Ali Babar, 2014]. Documentation is a way of coordinating expertise between the client and the onshore and offshore team [Kotlarsky *et al.*, 2014]. Reviewing all the documents and prototypes related to the project can help newly joined team members to create an understanding of what the final product should be. However, requirement specifications should be used with care since they tend to contain a huge amount of implicit knowledge. Transferring implicit knowledge takes time, which will in return add costs. However, it is important to make sure implicit knowledge is transferred to explicit knowledge, in order for the offshore developers to understand the requirement specifications. [Christiansen, 2007].

5. Research methods

The empirical part of this thesis is an attempt to gather data from one case study organization in order to get answers to the four research questions that were introduced in the first chapter. Methods used in data collection were semi-structured interviews and a survey. The reason for conducting semi-structured theme-based interviews was a need to get in-depth knowledge of the phenomenon. This was an attempt to allow informants to express their feelings and thoughts concerning the themes of the interview without restricting their answer options. A survey was chosen as a research method in order to get mostly quantitative data from a large amount of informants. With the help of these two methods, the research was able to gather both quantitative and qualitative data. A case study approach was chosen partly due to a limited time frame but also due to a need to gather a deeper insight into the case organization as a whole and the phenomenon of GSD in that particular case study organization.

5.1. Case study organization

The data were gathered from one case study organization. The organization is a large global company that serves customers worldwide. The company has a large amount of its employees located in India. The case study was conducted in a software development project. The project had multiple Finnish clients from one business sector. The project involved employees both in Finland and in the Indian Delivery Center (IDC). Most of the programming work was conducted in India.

The reason for choosing this company for the case study was the large interplay between the two sites: the offsite (IDC) and the onsite (Finland). This company had a long history in offshoring programming work to its Indian offices. This was a good opportunity to investigate how large of an impact can offshoring to another country have in a software project, and to compare the findings with the results of previous studies conducted in the offshoring-outsourcing field.

5.2. Semi-structured interviews

In order to get more in-depth qualitative data, four semi-structured interviews were conducted. Each interview was recorded and later littered down. The interview consisted of four themes. Each theme had one or two premeditated questions to open conversation on the subject, but otherwise, the interviewees were free to share their thoughts on the subject manner. The data collected from these interviews were classified based on the interview themes. The interviews were conducted before the making of the survey. The interviewees were selected on the basis of their experience and role in the project. A 30-minute time slot was reserved for every interview, while the estimated duration for the interviews varied from 15 to 30 minutes. At the beginning of the interview, each participant was asked to fulfil background information on a piece of paper. The background information gathered from each interviewee can be found in table 1.

	Gender	Role in project	Project working duration	Visited IDC	Duration
Interviewee 1	Female	Tester	1-2 years	Yes	27 min
Interviewee 2	Male	Tester	6-12 months	No	12 min
Interviewee 3	Male	Project manager	over 4 years	Yes	29 min
Interviewee 4	Male	Team leader	over 4 years	No	11 min

Table 1. Interviewee information.

The interviews were held in a small conference room in Finland on three different days during one week. All the interviewees were Finnish. The duration of the interviews varied from 11 minutes to 29 minutes. Two of the interviewees worked as a tester, one worked as a project manager, and one as a team leader. Their working duration in the project varied from 6-12 months to over 4 years. Two of the interviewees had also experience in working in IDC during this project. One of them had worked in India for six months, and the other one had visited India twice for a one-month period of time. Table 2 presents more detailed information about each interviewee.

Theme 1: Communication
1. How much does working in two different locations (e.g. lack of face-to-face communication) affect to the amount and quality of communication in your opinion?
2. Have you ever noticed any language barriers, such as understanding others or being understood by others?
Theme 2: Culture
3. Have you ever noticed any cultural differences (e.g. values, customs) while you have worked with the IDC team?
Theme 3: Social relationships
4. Do you feel like you know the onsite team members better than the IDC team members?
5. Do you find visitations to the other site helpful in any way? Do they increase team spirit?
Theme 4: Summation
6. Think about your whole working time in this project. Based on your experience, what are the factors that have had a positive contribution to communication and social relationships between onsite and IDC, and the overall progress of the project? What factors have had a negative contribution to these?

Table 2. Interview themes and questions.

The interview had four themes: communication, culture, social relationships, and a summation. The specific questions can be seen above in table 2. Theme 1 revolved around the subject of communication and was comprised of two questions related to location issues and language barriers. These two questions were incorporated into the theme because both location and language can have a great impact on the success of communication, and hence, to knowledge sharing. Geographical distance is known to make communication more difficult due to different time zones

and lack of visual contact [Ågerfalk *et al.*, 2008]. Language is known to cause misunderstandings in GSD settings [Christiansen, 2007]. It was important to incorporate these two factors related to communication as these are frequently mentioned in the GSD literature and research.

Theme 2 was culture and it included one question about cultural differences. The main purpose of this question was to find out whether cultural differences were significant enough to be noticed by the team members. As Hofstede [2001] has revealed in his studies, India and Finland have two different organizational types, which most likely affect the way people behave in their work surroundings. The differences in power distance [Hofstede, 2001] in particular would most likely be one of the most noticeable differences between the Indian and Finnish colleagues.

Theme 3 focused on social relationships and was comprised of two questions revolving around knowing one another and the usefulness of site visitations. Based on the studies of Chuaa and Pan [2008] and Christiansen [2007] temporary collocation of distributed team members helps to transfer business knowledge more effectively. In addition, it allows colleagues to build social relationships [Wendlish *et al.*, 2014] and trust, which will increase tacit knowledge sharing [Kotlarsky and Oshri, 2005]. This theme was included in order to collect data on how the interviewees felt about the importance of knowing your colleagues and whether or not they did find rotating people between shores useful.

Theme 4 was a sum-up of all previously mentioned themes. The main idea of the last question was to sum-up the thoughts of the interviewees about the subject, and also to let them speak more freely about the subject matters without the help of leading questions.

5.3. Survey

The survey was conducted after the interviews. The object was to gather data from the team members who had connections to the other team members working in the other location. The survey revolved around the same subject as the interviews, but it had a vast amount of detailed Likert-scale questions in order to derive a large amount of quantitative data. The survey questions were based on the interview results and the findings from the previous GSD studies. IBM's SPSS, software for statistical analysis, was used to analyse the results. With the help of factor analysis, the survey questions were categorised into seven sections: location factors, cultural factors, communication factors, communication frequency factors, language factors, social factors, and employee turnover factors.

The survey used SurveyGizmo as a platform. A link to the survey was sent via email to about 130 employees working in the project both in Finland and in India. The survey remained open to answers for about one week. After the gathering of the data, 45 employees had taken a part in the survey. 13 answers were done only partially and not submitted, so these were eliminated from the

final analysis. One answer was eliminated because the results suggested that the survey participant was a newly joined employee who did not yet have any experience of working with the offsite team. After the elimination process, 31 survey answers remained for the final analysis. The survey gathered the following background information from the participants: gender, age, main location (Finland or India), nationality, first language, rate of the participant's English skills (based on own perception), working duration in the project, and role in the project. Detailed information about the participants of the questionnaire can be seen in table 3.

The sample population of the survey was fairly representative based on the background information since a majority of the workers on this project were relatively young men and most participants were on a regular basis in contact with the remote team members. However, the sample could have included more Indian workers and more programmers in order to make it even more representative.

Location	Frequency	Percent
Finland	21	67,7
India	10	32,3

Nationality	Frequency	Percent
Finnish	21	67,7
Indian	10	32,3

Gender	Frequency	Percent
Male	22	71
Female	9	29

Age	Frequency	Percent
Under 25	6	19,4
25-30	19	61,3
30-40	6	19,4

First Language	Frequency	Percent
Finnish	18	58,1
Swedish	3	9,7
English	1	3,2
Hindi	4	12,9
Marathi	2	6,5
English and Hindi	3	9,7

English Skills	Frequency	Percent
Native speaker	1	3,2
Excellent	16	15,6
Very good	10	32,3
Good	3	9,7
Fair	1	3,2

Work Time	Frequency	Percent
Under 3 months	4	12,9
3-6 months	2	6,5
6-12 months	2	6,5
1-2 years	10	32,3
2-4 years	7	22,6
Over 4 years	6	19,4

Role	Frequency	Percent
Programmer	5	16,1
Tester	15	48,4
Business Architect	3	9,7
Team leader	6	19,4
Project manager	2	6,5

Table 3. Background information of survey participants.

The survey was answered by 22 males (71%) and 9 females (29%). There are more men working in the project, so this is not surprising. 21 of the participants were Finnish and 10 Indians. Most common first languages were Finnish (18), Swedish (3), Hindi (4), Marathi (2), and English (1).

Some participants considered their first language to be both Hindi and English (3). Most people find their English skills to be excellent (52%) or very good (32%). Most of the participants were 25-30 years old (61%). Only 19% were under 25 and 19% were 30-40 years old. Most participants had worked in the project for 1-2 years (32%), 3-4 years (23%) or over 4 years (19%). The roles were represented in the survey as following: 15 testers, 5 programmers, 3 business architects, 6 team leaders, and 2 project managers.

The survey was sorted into the following sections: background information (page 1), communication (page 2), culture and language (page 3), social factors (page 4), culture (page 5), social factors and communication (page 6), and final comments (page 7). Most of the questions were quantitative Likert-scaled questions with agree/disagree answer options, but there were also five qualitative questions, which were optional. All Likert-scale questions were mandatory. All of these survey questions can be found in the following results and analysis chapter, and also, as an appendix.

6. Results

This chapter presents the results of the interviews and the survey combined. The chapter is divided into following subchapters: results from survey and interviews (location, culture, communication, language, social aspects, and significance of software project success factors), challenges related to knowledge sharing, challenges related to socio-cultural factors, and how to reduce the effects of challenges. The first subchapter will present the data derived from the survey and the interviews. The last three subchapters will present answers to the research questions. First subchapter will present the challenges related to knowledge sharing. Since this chapter presents some topics that are in common with socio-cultural factors, these will not be mentioned in the second subchapter that presents the challenges related to socio-cultural factors. In the third subchapter, I will present my own thoughts on how to manage these challenges.

6.1. Results from survey and interviews

Results derived from the survey and the interviews have been categorised into seven factors using factor analysis. These factors are location factors, cultural factors, communication factors, communication frequency factors, language factors, social factors, and employee turnover factors. The results for each factor will be presented in the following six subchapters.

Illustrative tables show the mean values of respondents' answers, standard deviations, how many respondents either agree or disagree with the statement, and how many did not have any opinion or did not know the answer to the question. The mean value is scaled from 1 (strongly disagree) to 5 (strongly agree). Strongly agree and agree values have been combined together to "Agree". The same has been done with strongly disagree and disagree ("Disagree"). These values are given as percents (%). The "no opinion" option was chosen in case the respondent did not have any opinion or did not know an answer (e.g. did not yet have any experience of the proposition).

6.1.1. Location

Geographical distance was not considered to be a distraction. The time difference between India and Finland is only 2,5 hours so this did not cause significant problems. Location related factors are illustrated in table 4. Most respondents (67,7%) of the survey did not feel that they had to adapt their working hours to be able to communicate with the remote team. However, 41,8% of the respondents felt that the time difference does reduce time to communicate with each other.

"The only challenge that I faced while communicating with the remote team is the 'Time zone difference' due to which there is a few hours at the start and the end, which do not coincide with remote team country working hours."

To what extent do you agree or disagree with the following statements?	Mean (scale 1-5)	Std. Deviation	Agree (%)	Disagree (%)	No opinion (%)
I have to adapt my working hours to be able to work with the remote team	2,23	1,023	16,2	67,7	16,1
The time difference reduces time we can communicate with each other	3,00	1,065	41,8	38,8	19,4
The distance makes it harder to make regular visits to the remote site	4,16	0,86	83,8	6,5	9,7
The distance reduces the amount of communication	3,1	1,221	45,1	42,0	12,9
If we were located in the same place, I would rather talk face-to-face than use other communication tools (e.g. Skype messaging)	4,26	0,815	90,3	6,5	3,2
I find site visits (someone from the remote site visiting for a short period of time) useful	4,10	0,908	77,4	6,5	16,1

Table 4. Location factors.

The survey participants felt that site visits were extremely useful to the success of the project (77,4%). However, the distance between India and Finland was considered to be so long that it makes it difficult to organize site visitations on regular basis (83,8%). In case the offsite and onsite teams were located in the same place, 90,3% respondents would rather use face-to-face communication rather than other communication like Skype messaging.

“It’s good to have the Indians here. It helps with our work and also builds up relationships to a whole new level.”

6.1.2. Culture

The numbers related to cultural factors can be found from table 5. A vast majority of those surveyed (77,4%) had noticed any cultural differences in some situations. The number of years spent working on this project increased the possibility of noticing cultural differences. It might be that it takes time to get to know the other culture to be able to notice that a difference in behaviour can be a result of culture and not just a personal feature. However, almost all respondents (93,5%) were aware of cultural differences, and hence, they try to adjust oneself in respect of others. For most this meant changing verbal or non-verbal behaviour and facial expressions when needed in a cross-cultural situation.

“Cultural differences are more noticeable at higher levels.”

To what extent do you agree or disagree with the following statements?	Mean (scale 1-5)	Std. Deviation	Agree (%)	Disagree (%)	No opinion (%)
I have noticed cultural differences in some situations	4,00	0,931	77,4	9,7	12,9
I am aware of the cultural differences and I try to adjust myself in respect of others	4,32	0,599	93,5	0	6,5
I change my verbal behavior (e.g., accent, tone) when a cross-cultural interaction requires it	3,65	1,170	67,7	19,4	12,9
I change my non-verbal behavior when a cross-cultural situation requires it	3,48	0,962	58,1	16,1	25,8
I alter my facial expressions when a cross-cultural interaction requires it	3,16	1,068	41,9	32,3	25,8

Table 5. Cultural factors.

Based on the results of the survey and the interviews, it is clear that culture is taken into account, and that there is an effort to understand the other culture and to make the two cultures work together. Site visits are beneficial in order to build relationships and learn about other’s culture.

“It’s extremely important to understand the culture better. So I believe that the site visits change our way of thinking. It would be beneficial for the Finns to be able to have more open conversations.”

There is a huge difference between the leadership styles in Finland and in India. The hierarchy is very noticeable especially for people working in executive levels as project managers or team leaders. In Finland, it is okay for someone lower in hierarchy to directly talk to the project manager. However, in India rules are strictly followed and the hierarchy is more visible than in the Finnish style of leadership. Hence, in the Indian hierarchy, everyone communicates with the persons directly above them or beneath them, but no stages of hierarchy are passed. It is also important for Finnish team members to keep in mind that when communicating with IDC one should talk with their counterparts and not directly contact a person who is not in the same hierarchy level.

“Leadership styles are very different between the two countries. In Finland people have more power over the work they do and also more ownership.”

6.1.3. Communication

In global software development communication tools have a significant role in effective communicating. The survey asked the participants to rate the usefulness of various communication and project management tools used in the project. The communication tools mentioned were email, phone, Skype messages, Skype conferencing, and desktop sharing. Project management tools mentioned were Microsoft SharePoint and RTC (Rational Team Concert). SharePoint is used to manage and store project documents. RTC is a collaborative lifecycle management tool created by IBM. The results can be found in table 6. Based on the results almost all tools listed in the survey were found either very useful or somewhat useful. Only phone was considered to be “not very useful” or “not at all useful” (51,7%). The most useful communication tool was Skype messaging, as nearly all (90,3%) of the employees, who completed the questionnaire, felt it was useful. Skype Conferencing was considered to be very useful especially by project managers (100%) and business architects (100%).

“Status calls are a good practice.”

How useful do you find these communication and project management tools when trying to share information with the remote team members?	Mean (scale 1-5)	Std. Deviation	Useful (%)	Not useful (%)	No opinion (%)
Email	4,26	1,182	87,0	6,5	6,5
Phone	2,97	1,303	32,2	51,7	16,1
Skype Messages	4,42	1,119	90,3	3,2	6,5
Skype Conferencing	4,29	1,243	83,8	6,5	9,7
Desktop sharing	4,19	1,376	80,6	6,5	12,9
Microsoft SharePoint	4,06	1,209	80,6	9,7	9,7
RTC	4,06	1,315	83,9	3,2	12,9

Table 6. Communication and project management tools.

Table 7 displays the factors and values related to communication. Most respondents felt that it is easy (77,4%) and fast (71,0%) to share information with the remote team members. 70,9% of survey participants share their knowledge frequently with their remote colleagues. Most participants (74,2%) revealed that they usually get answered quickly when they have asked a question from a remote team member. However, 58% of respondents stated that there have been times when they have not received an answer to their question sent to a remote team member. When located in the same place, it is always a possibility to go and ask face-to-face, but in globally distributed settings this is not a solution. Nearly half (51,6%) of the survey participants felt that it takes more time to get information from remote team members than onsite team members.

"Sometimes the message doesn't reach the remote team member. Also sometimes both ends speaking in non-native language doesn't result in too deep of an understanding."

To what extent do you agree or disagree with the following statements?	Mean (scale 1-5)	Std. Deviation	Agree (%)	Disagree (%)	No opinion (%)
It is easy to share information with the remote team members	3,87	0,846	77,4	9,7	12,9
It is fast to share information with the remote team members	3,74	1,064	71	16,1	12,9
I frequently share my knowledge with my remote colleagues	3,77	1,055	70,9	19,4	9,7
I usually get answered quickly when I have asked a question from a remote colleague	3,84	0,860	74,2	9,7	16,1
There have been times when I haven't received an answer to my question that I've asked from a remote colleague	3,45	1,060	58	22,6	19,4
It takes more time to get information from the remote team members than from my own team members	3,42	1,232	51,6	35,5	12,9
I have had difficulties in understanding who knows what and who to ask for information	3,29	1,346	54,8	42,0	3,2
I have access to needed information	3,65	0,985	74,2	22,6	3,2
I find the documentation (specifications, SharePoint tutorials for new beginners etc.) to be adequate	3,65	1,018	67,8	16,1	16,1

Table 7. Communication factors.

A majority of those who responded felt that they have access to the information they need (74,2%) and that they find all the documentation (e.g. specifications, SharePoint tutorials) to be adequate (67,8%). Although, 54,8% of respondents have had difficulties in understanding who knows what and who to ask for information.

Table 8 depicts four factors related to the frequency of communication. About half of the respondents (54,8%) felt that there should be more regular team meetings in order to keep track of what the remote team is doing. Most respondents (80,6%) felt that they had been encouraged to talk

to remote team members in order to get answers. Most of the employees who completed the questionnaire (77,4%) had frequent communication with some of their remote team members and approximately half of those surveyed (51,5%) thought that they spent a lot of time interacting with the remote team members.

"Client expectations. Also when offshore has not had some information they need, this is not communicated well enough with onsite. This is not only the problem caused by offshore, onsite should also communicate more."

To what extent do you agree or disagree with the following statements?	Mean (scale 1-5)	Std. Deviation	Agree (%)	Disagree (%)	No opinion (%)
I feel like there should be more regular team meetings in order to keep track of what the remote team is doing	3,48	1,029	54,8	22,6	22,6
I've been encouraged to talk to the remote team members to get the answers I need	3,90	0,831	80,6	9,7	9,7
I spend a lot of time interacting with my remote team members	3,39	1,256	51,5	29,1	19,4
I have frequent communication with some of my remote team members	3,81	0,980	77,4	12,9	9,7

Table 8. Communication frequency factors.

6.1.4. Language

English was used as a common language in the project. This was a foreign language for a vast majority of the respondents, which obviously makes communicating more difficult. Language was found to be one of the biggest success factors according to the results. It causes misunderstandings and diminishes communication speed. Project managers found language to have a bigger impact on the success of the project than participants working in other roles. The mean for project managers was 3,5 while for other roles it varies from 2,73 to 3,0. It seems to be that in higher roles language plays a bigger role. In this offshored project, communication happened mostly through the use of Skype messaging or conferencing without being able to see the other person talking to you. This, included with language barriers, is found to be a hurdle.

"Communication problems, language is always a problem and to communicate complex problems might be difficult via email/Lync."

As illustrated in table 9, for a vast majority of respondents English was not their mother language (87,0%). Nearly half of the respondents (41,9%) felt that they had no difficulties in communicating with a foreign language, but over a third (35,5%) felt that they had had difficulties sometimes. About half (54,9%) of those who completed the questionnaire also thought that they had not been understood correctly sometimes. Only a third thought this had never happened. A majority of those surveyed (67,8%) had had difficulties in understanding what the other person was trying to say. However, approximately half of the respondents (51,7%) disagreed with the statement that language barrier had caused difficulties in communication. All in all, it seems that the biggest problem is not using a foreign language; rather it is more about communicating through Skype messaging, which is slow and lacks visual sighting.

“Usually the hardest thing is to explain something complex via messenger/email when you should be able to draw and see the person to actually know if she/he understood it.”

To what extent do you agree or disagree with the following statements?	Mean (scale 1-5)	Std. Deviation	Agree (%)	Disagree (%)	No opinion (%)
I have to use some other language than my mother language to communicate with the remote team members	4,42	0,886	87,0	6,5	6,5
I sometimes have difficulties in communicating with a foreign language	2,81	1,167	35,5	41,9	22,6
Sometimes I have not been understood correctly	3,19	0,98	54,9	32,2	12,9
Sometimes I have had difficulties in understanding what the other person is trying to say	3,55	0,995	67,8	19,3	12,9
I have had difficulties in understanding the other person because of his/her accent	3,19	1,25	58,1	38,7	3,2
The language barrier has caused difficulties in communication	2,74	1,094	22,5	51,7	25,8

Table 9. Language factors.

Obviously, expressing oneself in a foreign language is more difficult than in one’s native language. And it takes some time to get used to a foreign accent if communicating through speaking. Over half of those surveyed (58,1%) had had difficulties in understanding the other person because of the accent. But it is not always the foreign language that is causing problems. For a newly joined team

member without an education, nor experience in software development, it may be hard to master the new terminology even in one's native language.

"The accent can be hard at the beginning, but you get used to it, so that's not a problem. -- It's more about how you present your ideas rather than strictly about language skills or the accent."

6.1.5. Social aspects

Based on the survey results, both offsite and onsite teams found that the two teams have shared values (64,5%), are working on the same goal (83,9%), and have a good team spirit (90,3%) as can be seen in table 10. Since social factors were also considered to have the most impact on the success of the project, as mentioned in the beginning of this chapter, these results would suggest that the project will most likely turn out to be a success.

"It is great to work with remote team members to understand their work styles, culture, social responsibilities etc."

Respondents felt that they can trust the remote team members (80,7%). It seems to be harder to share a bond with remote team members, although it is possible. Approximately two-thirds of those who completed the questionnaire (64,4%) considered to having shared a bond with some of their remote team members. However, a little over half of the respondents (58%) felt that they did not know their remote team members as well as their onsite team members. Nearly two-thirds of those surveyed (61,2%) thought they knew some of their remote team members well, although close social relationships were quite rare, only 25,7% of survey participants considered having close relationships with some of their remote team colleagues. Approximately half of those who responded the survey (54,7%) thought that the firm has made an effort in trying to establish relationships between the offsite and onsite teams.

"I have been able to establish good relationships with off-shore team members and strive to serve them as well as they serve me in different type of tasks."

To what extent do you agree or disagree with the following statements?	Mean (scale 1-5)	Std. Deviation	Agree (%)	Disagree (%)	No opinion (%)
I feel like we have shared values with the remote team	3,58	0,807	64,5	12,9	22,6
I feel like we are working on the same goal	4,03	0,706	83,9	3,2	12,9
The organization culture is the same as ours in the remote site	3,16	1,186	41,9	38,7	19,4
We have a good team spirit	4,13	0,670	90,3	3,2	6,5
I feel like I can trust the remote team members	3,97	0,706	80,7	3,2	16,1
I don't know my remote team members as well as my onsite colleagues	3,48	1,288	58,0	29,1	12,9
I know some of my remote team members well	3,32	1,249	61,2	32,3	6,5
I have shared a bond with some of my remote team members	3,48	1,180	64,4	25,9	9,7
The firm has made an effort to establish relationships between the onsite and the offsite team	3,32	1,107	54,7	25,9	19,4
I maintain close social relationships with some of my remote team members	2,77	1,117	25,7	51,7	22,6
I feel like I have a shared understanding with the remote team	3,77	0,805	77,5	6,4	16,1

Table 10. Social factors.

The effects of employee turnover are depicted in figure 11. Most respondents (71%) claimed they knew who to contact from the remote site when they needed help. About two-thirds of the survey respondents (64,4%) considered knowing the people working on the project on the remote site. However, the fast rate of people leaving the workplace and new people joining seems to make it difficult to have a clear image on the remote site's current workforce. A majority of those surveyed (61,3%) felt that they were not told fast enough when a new member had joined the remote team. The leaving of a remote team member can also leave behind a loss of knowledge (51,7%). A majority of the respondents (64,5%) felt that the leaving team member should transfer his/her knowledge to the remaining team members more effectively in order to keep the knowledge in the company.

"We have no clear picture who works there and in what role."

To what extent do you agree or disagree with the following statements?	Mean (scale 1-5)	Std. Deviation	Agree (%)	Disagree (%)	No opinion (%)
I know the people who are working on the project on the remote site	3,39	1,086	64,4	25,9	9,7
I am not told fast enough when a new member has arrived to the remote team	3,68	1,107	61,3	16,1	22,6
I know who to contact from the remote site when I need help	3,81	1,108	71	16,1	12,9
There has been a loss of knowledge when a remote team member has left the project	3,45	1,060	51,7	19,3	29,0
When a remote team member is leaving, he/she should transfer his/her knowledge more effectively to other team members in order to keep the knowledge in the company	3,81	0,946	64,5	9,7	25,8

Table 11. Employee turnover factors.

All in all, it is important to know the people you work with regularly, not necessarily people from another hierarchy level or other teams.

“In my opinion, it is essential that those people who work together, the test teams and development teams, know each other. It’s a bad situation when people change and we don’t know who does what.”

6.1.6. Significance of software project success factors

At the end of the survey, the respondents were asked to value seven different factors (time difference, geographical distance, cultural differences, language, common goal, team spirit, and trust) as to what extent these factors have had an effect, whether positive or negative, to the success of the project so far. These results can be found in table 12. “Great” includes answers “to a great extent” and “somewhat”. “Little” is comprised of answers “very little” and “not at all”.

To what extent do you think the following things have had an effect (negative or positive) on the success of the project you are working on?	Mean (scale 1-5)	Std. Deviation	Great (%)	Little (%)
Time difference	2,29	0,693	35,5	64,5
Geographical distance	2,58	0,886	58,1	41,9
Cultural differences	2,55	0,888	61,3	38,7
Language	2,84	0,638	71,0	29,0
Common goal	3,16	0,779	83,9	16,1
Team spirit	3,10	0,944	74,2	25,8
Trust	3,16	0,898	80,6	19,4

Table 12. Software project success factors.

The survey respondents considered social aspects (common goal, team spirit, and trust) to be the most important factors that have an influence to the success of the project. Language was the fourth most important factor (71,0%). Cultural differences (61,3%) and geographical distance (58,1%) was seen to cause some effects, but not that significant effect in this particular project. Time difference was considered to have the least effect on the success of the project. About two-thirds (64,5%) of those who responded thought that the impact of time difference between India and Finland was small. All in all, it seems to be that social factors are much more important success factors than the factors normally related to global software development such as time difference and geographical distance.

“I think that the away team has quite fast learned the European/Finnish way of working and the cultural distance has been reduced.”

6.2. Challenges related to knowledge sharing

The first research aim was to figure out what are the knowledge sharing issues that the people working in the case study organisations find having the most impact to the success of global software development. This section will go through the results with the help of known knowledge sharing challenges gathered by Zahedi, Shahin, and Babar [2016] in their systematic literature review. These challenges are illustrated as a chart in figure 6.



Figure 6. Categories for knowledge sharing challenges [Zahedi *et al.*, 2016].

The management category consisted of three knowledge sharing challenges: cost of knowledge sharing, employee turnover, and low priority perception. On the basis of the results, it can be concluded that only employee turnover has a negative impact on the success of the software project in question. Low priority perception, however, was not a problem in this particular case study. Most respondents felt that the documentations were adequate. According to this it can be assumed that there is enough effort put into maintaining documentations up-to-date. Hence, knowledge sharing activities do not seem to be sacrificed in order to meet project deadlines.

Site visitations were considered as extremely crucial to knowledge sharing and also to building social relationships. However, cost of travelling can minimize the possibilities of visitations. Although, it is not necessary only the cost that makes travelling difficult. Due to travel time of a little less than ten hours depending on the destination city, it is not ideal to travel for a short period of time. For some employees, travelling to a far country for a longer period is not possible due to family issues. Consequently, it can be impossible to get some of the key team members to travel to the other country to share their knowledge with the other team members. However, the results suggest that there is great enough effort in making site visitations possible. Costs of virtual communication tools and hardware can also affect knowledge sharing. Although the survey did not directly ask the participants whether they were pleased with the knowledge sharing tools,

respondents did find the current tools to be adequate. Hence, it can be concluded that there has been enough cost put in virtual communication.

In a large project, like the case study project, employee turnover can be huge. There are always people leaving and joining the company. The results suggest that employee turnover does cause loss of knowledge, and it would be beneficial to try to enable knowledge transition before the absence of a leaving team member. Employee turnover also has an impact on team cognition. It is extremely hard for team members to keep in track of who is working on the other side, when there is a constant movement of people leaving and joining the team. Inability to see the other team members makes it even more difficult to have a clear image of the whole team.

The team structure category consisted of two challenges: vague role definitions and hierarchical structures. The survey did not contain any questions on role definitions. However, the results about hierarchical structures of the two sites were consistent with previous studies on the subject. The low hierarchy in Finland enables linear and fast knowledge sharing. In India information goes through the many levels of the hierarchy before reaching the right person. This can slow down the information flow and create bottlenecks in information sharing. This is a cultural difference that - according to information gathered in the interviews - is evident especially for employees working in executive levels.

Team cognition category challenges were contextual difference and gap in education and technological knowledge. The first one was not part of the survey nor the interviews. According to the interviews, gap in education and technological knowledge can cause difficulties in communication and knowledge sharing. Since all the employees in the project do not have a background of technology related studies, for some technology related terminologies can be unfamiliar. It takes time to get to know the technological lingo.

The technology category consisted of limitations of tools and shortcoming in utilizing existing tools. The survey results indicate that the tools used are sufficient enough and they support knowledge sharing and storing. Similarly, there were no indications of insufficient utilization of the existing tools. Hence, it can be concluded that storing or utilizing data is not a pitfall in the case study project.

The challenges in the work processes and practices category were documentation problems, shortcomings in maintaining group awareness, and distance. As mentioned previously, according to the results there are no documentation issues that would have a negative impact on the success of the project. However, if the documentation were outdated or missing, it would most likely have a tremendous impact on the project. Without proper documentation working in remote locations

would be difficult; especially during the hours when the other team members were absent from work, as then it is impossible to get information from the other team.

As mentioned earlier, maintaining group awareness is difficult in distributed settings. The results suggest that there is uncertainty of who is working on the other side, what is their role in the project, and what are they doing at the moment. This can result into slowness of knowledge sharing, as it takes time to find out who knows what. Distance is another factor that has an impact on the success of the project. Obviously it does contribute to the speed and frequency of knowledge sharing. Writing takes more time than speaking. It also lacks the essential attributes of human gestures and tone of voice, thus more likely resulting into misunderstandings. Due to time difference and free working hours, there are a few hours in the day when it is impossible to contact a team member working in the other location. This can decrease the frequency of communication.

The final category of social attributes consisted of the following four challenges: lack of trust and rapport, fear, lack of openness, and linguistic distance. The results indicate that team members are able to trust each other even though not ever having met. Hence, trust is not an issue in this particular project. The survey nor the interviews did not address the fear of losing one's job. Based on the interviews it can be concluded that asking questions is not as common in Indian culture as it is in Finnish culture. This can be a case of lack of openness. Finns do not find it difficult to ask questions if they do not understand something. Indians, however, may often be more reluctant to ask questions even if they do not know something and would need more clarification.

The results also suggest that language is a problem that has a negative effect on knowledge sharing. An unfamiliar accent takes some time to get used to. Finnish people learn English in school. The school system usually emphasizes British English, however, due to television programmes not being dubbed, Finns are also used to hearing American English. Indian English has its own special accent that may not be that common for most Finns. The Finnish way of English pronunciation is most likely foreign to most Indians, so it takes time to get used to the accent for both newly joined offsite and onsite team members. However, as almost all survey respondents rated their English skills as either excellent or very good, the foreign language itself is not the biggest problem. Based on the open survey questions and interview results, the biggest problem is the distance, and consequently, the usage of writing instead of real-life face-to-face communication. As already mentioned, lack of visual sight and vocalization lead to misunderstandings.

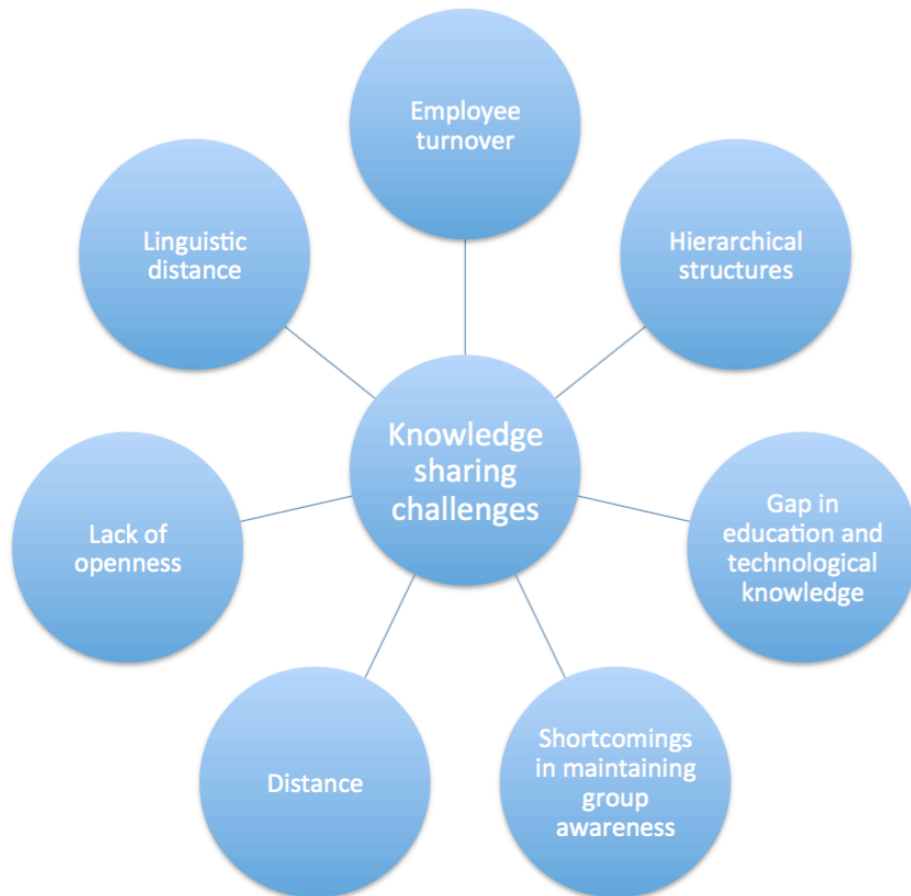


Figure 7. Knowledge sharing challenges found in case study.

Zahedi and others [2016] had gathered 16 different knowledge sharing challenges found in various separate studies. According to the results, in this particular case study seven of these challenges were causing issues that affect to the fastness and easiness of knowledge sharing, thus affecting to the success of the software project in question. These are employee turnover, hierarchical structures, gap in education and technological knowledge, shortcomings in maintaining group awareness, distance, lack of openness and linguistic distance. These knowledge sharing challenges are also illustrated in figure 7.



Figure 8. Knowledge sharing challenges not present in case study.

Six of the challenges did not seem to cause any problems in the project. These were cost of knowledge sharing, low priority perception, limitations of tools, shortcoming in utilising existing tools, documentation problems, and lack of trust and rapport. These are illustrated in figure 8. Three of the 16 knowledge sharing challenges were not under investigation in this study: vague role definitions, fear, and contextual difference.

6.3. Challenges related to socio-cultural factors

Finland and India are relatively far from each other culturally. According to Hofstede's [2001] studies, the largest differences are found on power distance, masculinity/femininity, and indulgence vs. restraint dimensions. These dimensions also affect to the workplace culture. India indulges the "personnel bureaucracy" model, where there is a strong leader, which is not surprising since India has a very large power distance index value of 77. In Finland, "work-flow bureaucracy" model is in use. This model emphasizes regulating activities.

The cultural differences were noticeable especially for management level employees of the project. This was due to the fact of high hierarchy in India versus low hierarchy in Finland, which is evident also in the two countries huge difference in power distance. It is important for project team

members working in management levels, to pay attention to communicating with their counterparts instead of directly talking to someone underneath or above their hierarchy level. In India, the hierarchy works like waterfall. Every level must be passed through before finally arriving to the person who needs the knowledge. For an example, if a Finnish project manager wants an Indian programmer to do something, he or she must tell this information to the Indian project manager, who will then share the knowledge with a team leader, who will finally pass this information to the programmer. This is illustrated in figure 9.

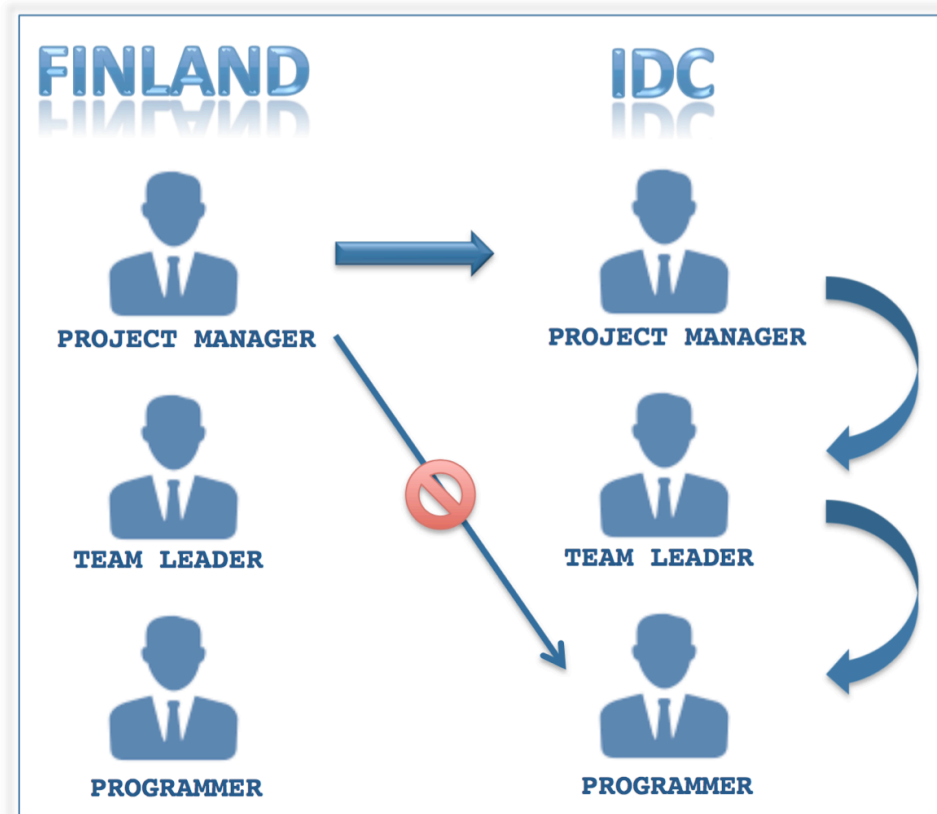


Figure 9. Information flow in a high hierarchy organisation.

Obviously there is a workplace hierarchy also in Finland, but it is not as strict as in India. It is not extremely uncommon for a low-level team member to directly talk to the project manager or vice-versa. Sometimes this can be an effective way to transfer information, since the information gets transferred immediately without any middlemen. If information needs to go through many levels before arriving to its target, there is a risk of the information getting corrupted. The middlemen may have understood something wrong, hence resulting into the information having lost its original meaning.

Indians are more likely to switch between employers in a short period of time. Since in India social status is highly valued, it is important to try to get to a higher level in the workplace hierarchy. If there is no chance of getting a promotion in a certain time period, there is a high chance of the employee leaving his/her employer for another one. Due to the Finnish culture having a higher

uncertainty avoidance value, Finnish workers are more likely to work for a longer period of time with the same employer. The changing of an employer will most likely be a sign of wanting to learn something new rather than wanting to reach a higher-level job.

The study did not take into account whether people felt like they were not getting promoted fast enough. However, since employee turnover does cause loss of knowledge, it would be beneficial to keep the employees in the project or try to make the process of knowledge transfer, on behalf of the leaving worker, more efficient. Although it does take more time for new people to absorb and fully understand new knowledge, than for an old employee to use the knowledge he or she has known for a long period of time.

As a collectivist country Indian workers are able to act more cohesively. Finland is a highly individualistic country, thus making it harder to Finnish workers to form strong bonds with each other. This is evident in the workplace culture. For Indian project workers visiting Finland, it can be a huge culture shock to notice how little their Finnish counterparts communicate with each other on a personal level daily. Finnish people value their free time and like to spend it with their closest friends. It is normal to have hobbies, which they engage after working hours. Indians do not have this kind of a Finnish concept of free time. As a result, Indians tend to bond with their fellow workers. Whereas in Finland, the bond between team members is a lot looser.

Due to the individualistic upbringing, Finnish people may thus be more likely to have their independent goals at work. However, according to the results, it was evident that there is a common goal. So even though team members may have their own individualistic goals, the common goal is evident and it is the target in the end. Common goal is also related to long-term orientation. Due to Finland being a short-term orientated country, Finns are more likely to expect short-term results. According to the result, this however does not affect to the goals. Even though Indians tend to seek for long-term results, the two teams have been able to create common goals that both teams are targeting at.

Finland is an extremely feminine country, whereas India presents itself more as a masculine country. It is rare to see women in high power decision-making jobs in masculine cultures. However, software development is a men-empowered field of occupation even in feminine countries. Thus, the number of women working in software development is a lot smaller than men, and consequently, there are fewer women in high power decision-making jobs. Nevertheless, there were women working in executive level in Finland as well as in India in this particular case study project. Therefore, this can be considered as a sign of IDC adopting itself to a more feminine culture. Cultural femininity and masculinity also effects to the way one sees their work. For masculine Indians, work is important as itself. Whereas for Finns work is merely a mean to earn a living, thus enabling to do other things in life with the help of the earned money. This combined

with Indians tendency to find leisure time as less important, may make Indians more efficient in their work.

As already mentioned in the previous subchapter, language is a problem, but the biggest problem of communication is the cultural context. English language has an official status in India. Since India is a large country with multiple official and unofficial languages and dialects, people have to use English as a way to communicate with each other. Indian English has developed its own words, which is common when the same language is spoken in different geographically dispersed locations. Since Finnish people usually have more experience in the British and American English, Indian English may have its own ways of expressing certain things. And obviously Finns way of speaking English also has its peculiarities too. This combined with cultural varieties in communication are likely to cause some misunderstandings here and there.

All in all, cultural differences are noticeable and the workers in the project are aware of these differences and try to adjust themselves in respect of others. The main challenges that the difference of the two cultures brings are mostly related to language and communication. Despite the differences, the two cross-cultural virtual teams have managed to work together in creating a common goal, mutual trust, and a good team spirit. Interacting with people from another culture has increased the desire to learn new things about the foreign culture.

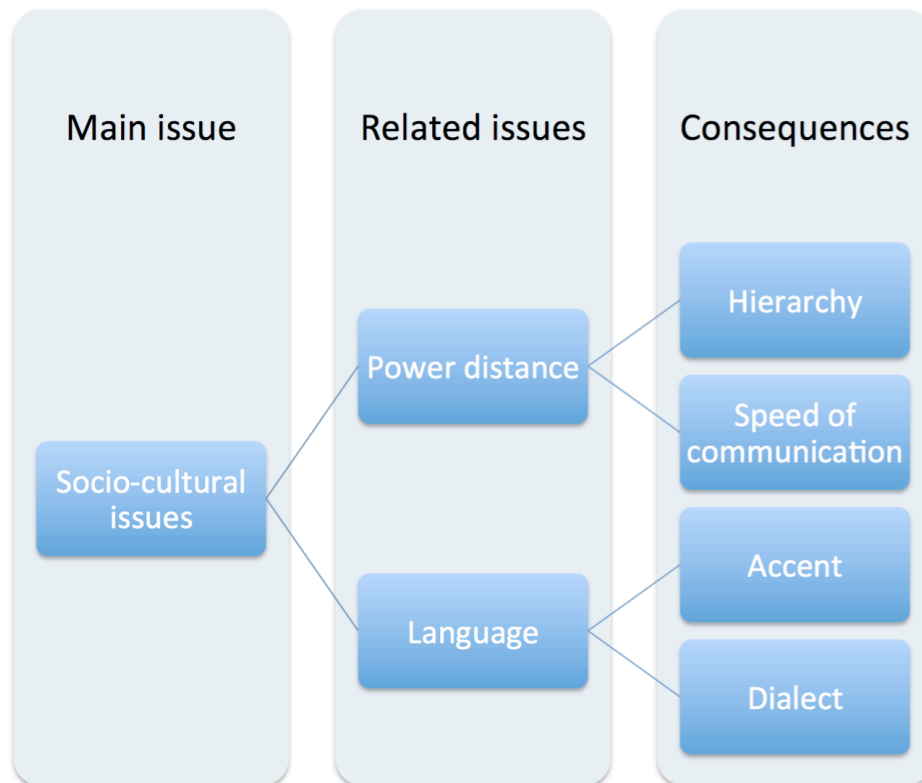


Figure 10. Socio-cultural issues found in case study.

Socio-cultural challenges in this case study project were power distance and language. The socio-cultural issues are depicted in figure 10. The power distance can be seen in hierarchy, which is high in India and low in Finland. This kind of a high hierarchy can cause slowness in the speed of communication and also corrupt the final message. Language related difficulties are caused by difference in accents and dialects that are due to geographical distance and cultural influence.

6.4. How to reduce the effect of challenges

Chapter four presented 11 knowledge sharing practices that are useful in global software development projects. These were collected from the studies of Christiansen [2007] and Zahedi *et al.* [2016]. The practices were alignment of IT infrastructure, usage of novel techniques, incentives and motivation, flexible communication structure, emphasis on spoken language skills and cultural knowledge, social ties, clarification of work structure, transactive memory system, frequent and synchronous communication, rotating people between shores, and usage of documentation. This chapter will go through each of these practices to discover the practices that should be followed more carefully in order to reduce the effects of the challenges discovered in this case study project.

Based on the results it is evident that IT infrastructure is aligned and techniques used are novel. The project uses standardised and novel tools and platforms, which contribute to the success of knowledge sharing. Furthermore, it was clear that the two teams were able to have trust with each other and share common project-related goals. Hence, the project has been successful in building social ties between team members despite the geographical distance and lack of face-to-face communication. Site visitations are one way of investing in social practices and knowledge transfer, and it is evident that the company has a large financial input on making site visitations possible and regularly having someone on the other side sharing their knowledge and expertise. Documentation was also mentioned to be a success.

One way to enhance knowledge sharing is to give incentives to employees. Another way is to motivate team members to share their knowledge with their fellow team members. According to the survey results, the employees felt that they had been motivated to communicate with the other team members. Incentives to knowledge sharing are also evident in the form of site visitations, that not only are beneficial for the project, but also give a chance for the employees to travel to another country and experience its culture. All in all, out of the 11 knowledge sharing practices six practices (alignment of IT infrastructure, usage of novel techniques, incentives and motivation, social ties, rotating people between shores, and usage of documentation) were followed adequately enough for them to not interfere negatively with the success of the project.

According to the results, high hierarchy is noticeable in India and this effects the way Finnish team members must work in order to share their knowledge with India. Since flat communication [Boden *et al.*, 2010] or even removal of hierarchies [Nicholson and Sabav, 2004] makes information flow

better, it would be beneficial to try to get to as low hierarchy as possible when it comes to sharing information. This obviously can be difficult at first since hierarchy is the result of cultural influences. However, gradually moving towards a lower hierarchy could possibly speed up the process of information flow.

Language was one of the biggest hurdles in the project. Even though a vast majority of survey respondents declared having excellent or very good language skills, it might be good to offer employees a possibility to participate in English courses. Since written English skills are usually better, spoken English courses could be useful even though most communication happens through writing. It would also be beneficial to learn about the other culture since culture has a huge impact on the way people act and communicate. By understanding the cultural background of fellow team members, it is possible to have a deeper understanding on why someone is behaving in a certain manner and how communication is impacted by the culture one has been raised in.

The survey results revealed that it was unclear who works on the other side. Fast employee turnover increases the amount of uncertainty about the work structure. Knowledge does not get transferred fast and smoothly if people are not aware of whom they should contact. This is probably the biggest hurdle that interferes with communication smoothness. It should be made clear, who knows what. This kind of a transactive memory system is a key to fast knowledge sharing. One way to keep track of who works on the other side is to have frequently updated documents that include at least all the names and work titles of the team members. In addition, information of employees leaving and joining the team should be communicated throughout the hierarchy levels making sure everybody gets the information. The employee documentation is also extremely beneficial for this, as long as the documents are kept updated.

The results also revealed that most communication happens through the use of writing, especially using Skype messaging and e-mail. According to Christiansen [2007], this kind of communication can lead to misunderstandings, which is in line with the results. There should be more motivation to guide the employees to use synchronous communication, with the ability to speak instead of writing, whenever possible. In order to gain more from vocal communication, spoken English lessons are good rehearsal for this. It should also be made sure that there are enough frequent team meetings in order to have a chance to regularly give updates on who is doing what and how are things progressing.

To sum up, there were six knowledge sharing practices that could be improved: flexible communication structure, emphasis on spoken language skills and cultural knowledge, clarification of work structure, transactive memory system, and frequent and synchronous communication. In addition to these, it would be beneficial to provide technological knowledge, and possibly even a glossary of technological terms, to those who come from a non-technological background. This can

ease communication with not only the distributed team members but also with collocated team members. In addition, it would be beneficial to encourage the Indian team members to ask more freely if they have any questions. Since in the Finnish culture it is okay to ask if someone is unsure of something.

7. Discussion

This chapter will present how expectations of the outcome were met and the limitations related to this thesis and future work related to the subject of GDS.

7.1. Expectations of the outcome

In this case study organization, some of the known GSD challenges were affecting negatively on the project and some were not. I was expecting to get similar results as in the previous studies on this subject. However, I was surprised that social aspects, such as trust, were found to be the biggest factor for the success of a software project in the survey results. Also, I was not expecting language and accent to be such a significant factor in GSD success in this particular case study. The reason for expecting language to have only a small effect was that English is one of the two official languages in India and Finnish people tend to have good skills in English.

All in all, the results were mostly presumable although there were some assumptions that were not fulfilled. The data collected were able to give answers to all the four research questions although the “*what*” questions were emphasized more than the “*how*” questions. The aim of this study was not to find new challenges related to GSD but rather to find the known GSD challenges evident in this particular case study organization. The findings of this research suggest that there are certain common factors that have a significant effect on the success of globally distributed software projects.

7.2. Limitations and future work

Even though the research reached its aims, there were some unavoidable limitations. Since the research relied partly on quantitative data, the survey answer rate could have been bigger in order to get more statistically significant results. Since the answer rate was quite small and the “no opinion / don’t know” option was chosen regularly, it was not meaningful to make calculations on the statistical significance of the results. For this reason, analysis was based merely on paying attention to frequencies, and not focusing on the significance of each result. However, factor analysis was used to ease combining all the questions into fitting categories, even though it is usually better to use when the sample size is at least 50.

As has already been mentioned, the “no opinion / don’t know” opinion was chosen quite often. This opinion was chosen by four respondents (13%) all the way to even nine respondents (29%) 34 times out of 53, which leads to questions of whether these people did not actually have an opinion or whether the question was formulated improperly, and thus, was difficult for the respondents to fully understand the meaning of the question. Four survey participants (13%) had been working in the project for less than three months. This could explain 13 percent of the “no opinion / don’t know” answers, since most of the questions required knowledge and experience in order to be able to

choose a fitting option. It may also be that some of the respondents, who already had experience in the project, did not have a lot of experience in working and communicating with the foreign team members, thus explaining why they did not have an answer to all the questions.

The qualitative part was executed before the quantitative survey due to reasons of using this master's thesis subject in another university course. However, it would have been more useful to conduct the survey before the interviews, since the survey results could have been used in the interview sessions. Furthermore, all interviewed project workers as well as 21 of 31 survey respondents were Finnish. Therefore, the results may be more impacted by the opinions of the Finnish employees in the project.

Nonetheless, the research was able to gather a small amount of data to implicate which are the common GDS challenges that are causing problems in this particular case study project. In the future it would be beneficial to gather data from a larger sample size. The data should include about half of both Indians and Finns. It might be useful to measure whether Indians and Finns have the same opinions. Another future endeavour could be to investigate how a low hierarchy or no hierarchy at all would benefit the transfer of knowledge.

8. Conclusions

The aim of this study was to investigate how socio-cultural factors and knowledge sharing affect to the success of global software development in this particular case study project. Four research questions were invented in order to figure out the impact of these two aspects:

- 1) *What* socio-cultural factors affect to the success of global software development?
- 2) *How* do socio-cultural factors affect to the success of global software development?
- 3) *What* aspects related to knowledge sharing affect to the success of global software development?
- 4) *How* does knowledge sharing affect to the success of global software development?

The research was based on one case study project. In this project, software development was distributed between Finland and India. The hypothesis was that this study would reveal the same results as previous studies in this area have, so that socio-cultural factors and knowledge sharing do have an impact on the success of GSD. However, temporal distance would not play be a significant role since the distance between Finland and India time-wise is quite small, only a couple of hours. The findings of this study suggest that the hypothesis was right.

The study revealed factors that contributed both positively and negatively to the success of global software development. The main interest was to investigate the factors that had a negative impact and to give advice - based on previous studies - on how to eliminate the negative impact of these factors. Despite having some limitations such as a relatively small sample size, the study was able to find the factors that had a negative (and positive) impact on the success of the case study project and the qualitative data enabled to gather evidence on *how* these factors impact to the project.

The evidence from this study suggests that there are seven knowledge sharing challenges that impact negatively to the success of the project. These were employee turnover, hierarchical structures, gap in education and technological knowledge, shortcomings in maintaining group awareness, distance, lack of openness, and linguistic distance. In addition, there were six knowledge sharing challenges that are known to have a great impact on the success of GSD. However, in this case, these six affected positively to the success of this case study project. These were cost of knowledge sharing, low priority perception, limitations of tools, shortcoming in utilising existing tools, documentation problems, and lack of trust and rapport.

In addition, two major socio-cultural challenges related to this particular case study project was found: power distance and language. Both of these had a negative impact on the success of the project. However, these two were also related to the knowledge sharing challenges (power distance

as hierarchical structure, and language as linguistic distance). As a result, there were a total of 13 challenges that had an impact on the success of this GSD project. Out of these 13, seven had a negative impact and six had a positive impact on the success of the project.

In conclusion, it is evident that this study has shown that both socio-cultural factors and knowledge sharing do have an impact on the success of GSD projects. In addition it can be concluded that temporal distance does not have a great affect to this project, although there were some mentions of the time difference causing hours when Indians were unable to contact their Finnish team members. However, this was not considered a significant problem for most of the survey respondents.

On the basis of the findings, it can be suggested that this case study project could benefit from seven knowledge sharing practices. These practices are flexible communication structure, emphasis on spoken language skills and cultural knowledge, clarification of work structure, transactive memory system, frequent and synchronous communication, providing technological knowledge to new joiners, and encouraging asking questions. With the help of these practices, the negative impacts of five challenges (hierarchical structures, linguistic distance, shortcomings in maintaining group awareness, and gap in education and technological knowledge, lack of openness) could turn positive.

The negative effects of a hierarchical structure could be diminished by making the communication structure more flexible, as in, lowering the hierarchical structure so that communication could flow more freely. The linguistic distance could be diminished by putting emphasis on spoken language skills and cultural knowledge. This could be done by offering employees spoken English language lessons and cultural lessons. Clarification of work structure and using a transactive memory system would help with maintaining group awareness. In addition, providing newly joined project workers technological knowledge could help those new-joiners that have a gap in education and technological knowledge. And, lack of openness could be diminished with the help of encouraging asking questions.

The two remaining challenges, employee turnover and distance, are somewhat more complicated to solve. As said in the earlier chapters, Indians have a tendency of changing their job more frequently than Finns. One way to tackle this challenge would be to have somewhat regular promotions enabling to climb higher in the organizational structure. However, this can be difficult to make a reality. Distance is also a difficult challenge, but by enabling regular site visitations and encouraging voice conversations over using writing, the effect caused by distance can be somewhat diminished.

From the research that has been carried out, it is possible to conclude that previous GSD studies have been able to gather a comprehensive list of challenges that have a great impact on global

software development projects. The results obtained from this study are in line with the previous findings. Both socio-cultural factors and knowledge sharing have a great impact on the success of GSD. This impact can either be positive or negative, but nevertheless, the impact is there. If the suggested practices will be taken into use, further research on the effects of those practices is desirable, as more tests would be needed to verify whether putting these practices in use have any effect on the success of the project.

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APPENDIX: SURVEY QUESTIONS*Page 1: Background information*

Gender

- Male
- Female

Age

- Under 25
- 25-30
- 30-40
- 40-50
- Over 50

Location

- Finland
- India

First language

- Finnish
- English
- Hindi
- Other, please specify:

How would you rate your English skills?

- Native speaker
- Excellent
- Very good
- Good
- Fair
- Poor

Nationality

- Finnish
- Indian
- Other, please specify:

How long have you been working in [project name]?

- Under 3 months
- 3-6 months
- 6-12 months
- 1-2 years
- 2-4 years
- Over 4 years

What is your role in the project?

- Tester
- Programmer
- Business Architect
- Team leader
- Project manager
- Other, please specify:

Page 2: Communication

In this survey, the term ‘remote team’ has the following meaning: If you are working in India, remote team for you is the team located in Finland, and if you are working in Finland, then remote team for you is the team located in India.

How useful do you find these communication and project management tools when trying to share information with the remote team members?

5 = Very useful, 4 = Somewhat useful, 3 = Not very useful, 2 = Not at all useful, 1 = Don't know

	5	4	3	2	1
Time difference					
Geographical distance					
Cultural differences					
Language					
Common goal					
Team spirit					
Trust					

To what extent do you agree or disagree with the following statements?

5 = Strongly agree, 4 = Agree, 3 = No opinion / Don't know, 2 = Disagree, 1 = Strongly disagree

	5	4	3	2	1
It is easy to share information with the remote team members					
It is fast to share information with the remote team members					
I frequently share my knowledge with my remote colleagues					
I usually get answered quickly when I have asked a question from a remote colleague					
There have been times when I haven't received an answer to my question that I've asked from a remote colleague					
It takes more time to get information from the remote team members than from my own team members					
I have had difficulties in understanding who knows what and who to ask for information					
I have access to needed information					
I find the documentation (specifications, SharePoint tutorials for new beginners etc.) to be adequate					
I feel like there should be more regular team meetings in order to keep track of what the remote team is doing					
I've been encouraged to talk to the remote team members to get the answers I need					
I spend a lot of time interacting with my remote team members					
I have frequent communication with some of my remote team members					
I maintain close social relationships with some of my remote team members					
I feel like I have a shared understanding with the remote team					
There has been a loss of knowledge when a remote team member has left the project					
When a remote team member is leaving, he/she should transfer his/her knowledge more effectively to other team members in order to keep the knowledge in the company					

What kind of challenges have you had in communicating with the remote team members?

Here you can comment and specify your answers.

Page 3: Culture and language

To what extent do you agree or disagree with the following statements?

5 = Strongly agree, 4 = Agree, 3 = No opinion / Don't know, 2 = Disagree, 1 = Strongly disagree

	5	4	3	2	1
I have noticed cultural differences in some situations					
I am aware of the cultural differences and I try to adjust myself in respect of others					
I feel like we have shared values with the remote team					
I feel like we are working on the same goal					
The organization culture is the same as ours in the remote site					
I have to use some other language than my mother language to communicate with the remote team members					
I sometimes have difficulties in communicating with a foreign language					
Sometimes I have not been understood correctly					
Sometimes I have had difficulties in understanding what the other person is trying to say					
I have had difficulties in understanding the other person because of his/her accent					
The language barrier has caused difficulties in communication					
I have to adapt my working hours to be able to work with the remote team					
The time difference reduces time we can communicate with each other					
The distance makes it harder to make regular visits to the remote site					
The distance reduces the amount of communication					
If we were located in the same place, I would rather talk face-to-face than use other communication tools (e.g. Skype messaging)					

Page 4: Social factors

To what extent do you agree or disagree with the following statements?

5 = Strongly agree, 4 = Agree, 3 = No opinion / Don't know, 2 = Disagree, 1 = Strongly disagree

	5	4	3	2	1
We have a good team spirit					
I feel like I can trust the remote team members					
I don't know my remote team members as well as my onsite colleagues					
I know some of my remote team members well					
I have shared a bond with some of my remote team members					
The firm has made an effort to establish relationships between the onsite and the offsite team					
I find site visits (someone from the remote site visiting for a short period of time) useful					
I change my verbal behavior (e.g., accent, tone) when a cross-cultural interaction requires it					
I change my non-verbal behavior when a cross-cultural situation requires it					
I alter my facial expressions when a cross-cultural interaction requires it					
I know the people who are working on the project on the remote site					
I am not told fast enough when a new member has arrived to the remote team					
I know who to contact from the remote site when I need help					

Page 5: Culture, social factors and communication

To what extent do you think the following things have had an effect (negative or positive) on the success of the project you are working on?

4 = To a great extent, 3 = Somewhat, 2 = Very little, 1 = Not at all

	4	3	2	1
Time difference				
Geographical distance				
Cultural differences				
Language				
Common goal				
Team spirit				
Trust				

How have cultural differences (like different customs, religion, perception of time and language) affected your work?

What are the factors that have slowed down the project in your opinion?

Page 6: Final comments

Please feel free to give any additional information on the subject.