GUIDELINES FOR MITIGATION OF COMMUNICATION ISSUES IN GLOBAL SOFTWARE DEVELOPMENT

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Guidelines For Mitigation of Communication Issues in Global Software Development

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Candidate of **Master of Science in Software Engineering (MSSE)** at the National University of Modern Languages do hereby declare that the thesis **Guidelines for Mitigation of Communication Issues in Global Software Development** submitted by me in partial fulfillment of MSSE degree, is my original work, and has not been submitted or published earlier. I also solemnly declare that it shall not, in future, be submitted by me for obtaining any other degree from this or any other university or institution. I also understand that if evidence of plagiarism is found in my thesis/dissertation at any stage, even after the award of a degree, the work may be cancelled and the degree revoked.

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ABSTRACT

Guidelines for Mitigation of Communication Issues in Global Software Development

Within the last several years, Global Software Development (GSD) has a significant impact on the business and software industries. Many software development companies enjoy the benefits of GSD, including cost reduction, cheap labor, and skilled workers around the clock, but these companies also posed some problems because of GSD. These problems affect the long-term survival of GSD projects. One of the GSD's major problems is communication amongst the various team members of the companies. As a result, the purpose of this research is to determine the communication issues that can affect on GSD and propose a mitigation strategy for the solution of the identified communication issues A systematic literature review (SLR) is carried out to determine communication issues in GSD, and then a mitigation strategy is proposed as a solution to these problems. After that, an online survey is conducted to validate the communication issues that can affect on GSD finds through SLR. Then a focus group conducted to validate the mitigation strategies that can be given for communication issues. The results of our research are to be helpful for GSD based companies in context of communication related issues. Our research is to be fruitful for the researchers that can find the solution of coomunication related issues in GSD.

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LIST OF ABBREVATION

DSD	-	Distributed Software Development
EBSE	-	Evidence Based Software Engineering
GSD	-	Global Software Development
GSE	-	Global Software Engineering
ICTs	-	Information and Communication Technologies
IEEE	-	Institute of Electrical and Electronics Engineers
IT	-	Information Technology
KT	-	Knowledge Translation
LR	-	Literature Review
OSDO	-	Offshore Software Development Outsourcing
OTS	-	Off-The-Shelf Element
RCM	-	Requirement Change Management
RCMRM	-	Requirements Change Management Readiness Model
RE	-	Requirement Engineering
SE	-	Software Engineering
SLR	-	Systematic Literature Review
SMS	-	Systematic Mapping Study
SPI	-	Software Process Improvement
SPIIMM	-	Software Process Improvement Implementation and Management Model
TMS	-	Transactive Memory System

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First of all, I wish to express my gratitude and deep appreciation to Almighty Allah, who made this study possible and successful. This study would not be accomplished unless the honest espousal that was extended from several sources for which I would like to express my sincere thankfulness and gratitude. Yet, there were significant contributors for my attained success, and I cannot forget their input, especially my research supervisors, Assoc. Prof. Dr. Basit Shahzad, who did not leave any stone unturned to guide me during my research journey.

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DEDICATION

This research is dedicated to my beloved parents and teachers throughout my career in education, whose good examples taught me to work hard for my goals, not only to love me unconditionally.

CHAPTER 1

INTRODUCTION

1.1 Overview

Software Engineering (SE) is a field of engineering concerned with the creation of software product based on empirical concepts, techniques, and processes. SE produces a system that is both fast and dependable [1].

Global software development is a field in which software development activities can occur in a system where teams are dispersed around the globe. GSD, on the other hand, faces a unique combination of challenges that threaten to deny its advantages. Physical isolation between teams, less time overlapping, linguistic and cultural issues have the ability to negative effect on team members. Communication, collaboration, and control are three major problems in GSD as a result of these concerns. Communication among the internationally scattered team is seen as the most important difficulty among them. According to the Holmes research, the additional cost incurred due to a breakdown in communication is estimated to be over 32.5 billion euros. Projects produced in the GSD setting take 2.5 times longer than co-located projects owing to inadequate communication amongst dispersed team members. In addition, the lack of facial expression communication among team members reduces the intensity of communication. Consequently, software engineers find it difficult to begin contact with other developers who are located in different locations when working on dispersed projects. As a consequence of the absence of communication across the dispersed members of the team, there is an insufficient degree of awareness and trust, which has an impact on work performance and project development. Furthermore, it is estimated that inadequate communication is to blame for 77 percent of the organization's managerial problems. The most of the software businesses have failed to enjoy the advantages of GSD, and as a consequence of a loss of communication

between team participants, the project's expected quality has declined. As a consequence, lack of communication is regarded as a key risk factor in the failure of GSD-produced software projects [2].

Software development that is examined from several perspectives, such as geographically, social, and culturally, is referred to as global software development (GSD) or global software technology (GSE). Several software businesses are now distributing their work globally to take benefit of cheap costs, high productivity, availability to qualified people, market accessibility, and other factors. When compared with single-site software development, GSD has a number of advantages, including lower costs and a more experienced workforce. However, GSD also confronts a number of obstacles. Three variables influence GSD: temporal, geographical, and socio-cultural distances. Communication, collaboration, and controls are three problems that GSD encounters as a result of historical, geographical, and socio-cultural differences. Requirements vary often over the software development life cycle in GSD, and the mechanism for handling these variations is called as Requirements Change Management (RCM). Applying the RCM process is highly difficult because of communication problems [3].

GSD offers advantages such as reduced market life, higher production, 24-hour production, cheaper specialists, accessibility to locals' expertise, and greater productivity. In addition to the benefits, GSD suffers from communication problems associated the software with development process. As a collocated development team, Agile methodologies are often meant to encourage tight collaboration among members of the development team. Facial expression communication is the most effective way of conveying data in a development team, which is a problem with GSD. The most prevalent way to agile software development is the Scrum process, which is an incremental process characterized by reliability, reactivity, and flexibility. Scrum is a very well agile strategy for project management because of its flexible methodology, which is based on collocated, rapid, and personal communication [4].

In global software development, teams from various locations collaborate on the same project. This allows businesses to save money by contracting out development work for low-cost countries, as well as time by employing methods such as the Sun's path. Software engineers communicate and have meetings in order to promote collaborative efforts on initiatives. Communication, particularly unstructured communication, is critical for any GSD team's

success. Communication and cooperation among developers is difficult due to cultural differences. The number of organizations distributing their systems and processes globally is increasing, and such movement is making a substantial impact about how items are conceived, developed, produced, tested, and delivered to customers. GSD may take many shapes. Communication, collaboration, job allocation, project explanation and follow-up, and organization are all hampered by distance (both in time and space). GSD has become more prominent as a result of advancements in communication technologies and instruments [5].

We may offer a mitigation strategy/technique for communication issues in global software development based on the findings of this study. The goal of this study is to use a systematic literature review (SLR) to determine various communication issues in GSD, and then to offer a mitigation approach to address the issues found in the literature.

1.2 Literature Review

This section discusses the approaches used by various researchers to solve communication issues within the GSD. The authors [2] says in the last several years, the idea of global software development (GSD) has been grown popularity within the commercial and software industries. On just one side, many software development companies profit from GSD, including lower costs, lower labor costs, 24-hour availability, and qualified personnel. These companies, on the other side, are confronted with a number of difficulties as a result of GSD. These difficulties represent a major danger to the GSD projects' long-term viability. One of the most difficult difficulties in GSD is communication amongst scattered team mates. As a result, the authors attempt to determine communication problems in GSD as well as assess the effect of these problems in the GSD context.

The authors [3] discuss that communication is an important issue and is becoming increasingly complex as part of Requirement Change Management (RCM). Throughout the RCM procedure in GSD, the authors will examine numerous communication issues, their sources, adverse effects, and mitigation methods for minimize the determined communication issues. Through SLR, the authors identified a total of 31 risks, 31 reasons, and their negative

impact 29. In total, 10 best practices were identified that reduce the identified communication risks.

The researchers [4] discuss Geographic distance is used to describe the dispersion of GSD members, which causes communication issues. The authors attempt to assess the influence of Scrum techniques on reducing communication issues over long distances. They also offer some mitigation strategies supported by study participants. This study shows that Scrum has the advantage of reducing GSD communication distances. This study serves as a resource reference for other investigators that want to validate and build on present Scrum knowledge, such as how it may be utilized to reduce GSD communication issues caused by geographical distance. Based on geographical distances among groups and restricted personal contacts, the authors identify one of the reasons that generate communication limitations. Limited facial expression interactions decrease informal relationships, which can contribute to decreased collaboration, knowledge lost, and trust. The proposed method may be used to tackle this problem, making the communication procedure easier and more effective. The suggested framework is a theoretical effort that must be experimentally confirmed and verified.

The authors [5] identify various communication problems that usually cause serious problems for GSD project developers, clients, and testers. They looked at important communication barriers, such as language differences, cultural differences, time patterns, cognitive aspects, etc. They also proposed some measures to resolve these problems. The decision recognized the use of ontologies as mediators in communication, modeling, the study of human cognitive and ecological characteristics, and the communication of cultural models.

The authors [6] identify GSD coordination challenges and threats and how to mitigate them. Based on SLR articles published between 2001 and 2011, they identify six issues, 50 related threats, and 52 related problems. The authors compiled a list and classified threats and methods associated with each problem. They conduct a survey and show that the listed problems and related threats are also considered by the researcher and that no other problems and threats are proposed. Their results can be used to solve coordination problems by applying appropriate methods against specific problems.

The authors [7] provide extensive knowledge of the success of KT GSD settings. This is accomplished through gaining a greater information of Knowledge Translation (KT) problems and mitigating solutions, both from a theoretical and practical standpoint. Considering the findings of both SLR and interviews, the author has identified 60 different challenges and 79 mitigating solutions. There are three types of mitigation aims and techniques: 2PT factors are a notion that combines people, architecture, and technological aspects. Several problems and mitigating methods for project elements and staff have been identified, highlighting the complex interaction between project-related concerns and GSD personnel. In the transmission of information, the technical component acts as a middleman. They argue that efficient project and people management, as well as technical aspects, are important for efficient knowledge transfer to GSD initiatives.

The authors [8] summarizes that Communication is the main challenge, that gets more complicated when employing requirement change management (RCM). Their research is focused on determining the many variables that are influenced by RCM for GSD. The information is evaluated using mathematical approaches, and assumptions are formed and a framework layout is offered. According to the creators of various software development firms, the multi-regression approach is used to examine assumptions and determine if they are accepted or not accepted.

The authors [9] tries to develop and suggest a framework for efficiently and sensibly managing RCM (Requirement Change Management) utilizing the CBR (Cased Based Reasoning) approach. CBR assessed the suggested framework using experimental research to solve changes in requirements based on past experiences and information. The experimental investigation showed that the suggested framework enhanced requirement change management in GSD more substantially than existing techniques for managing requirements change in a globally distributed setting.

The authors [10] says that in GSD context, there are several challenges and complicated activities. One of these is the Requirement Change Management (RCM) method. Recent research has revealed that the RCM method is extremely ambiguous and, for a variety of circumstances, cannot be employed effectively in the environment of GSD. The research focuses at limitations to the RCM process in GSD in order to tackle this issue. Firstly, they use

literature to determine any barriers to the RCM process in the GSD context. After screening and examination, 57 challenges are completed, which are divided into 9 primary groups. Following that, we performed experimental research to determine how the industry felt about each issue.

The authors [11] discuss that communication is an important issue and is becoming increasingly complex within the framework of Change Management Requirements (RCM) within the GSD. The authors discuss communication issues in the RCM process, including their origins, harmful acts, and mitigation procedures that may be performed to decrease communication issues. A systematic literature review protocol (SLR) was created and is still being used. Conventional bibliographical research gives more extensive and complete findings than SLR (common literature review).

The authors [12] provide a framework for RCM in globally disparate software development systems, as well as detail how to identify communication issues, their sources, and consequences during RCM in GSD systems. The suggested RCM framework aims to improve awareness of GSD's function, objectives, and actions, especially from the perspective of change management systems.

The authors [13] said that communication during the RCM process at GSD was evaluated based on several factors related to geographic, sociocultural, and spatial distances. These variables have a detrimental influence on communication, which was investigated. To investigate the detrimental impacts of various variables on communication, the authors provided a framework and nine case studies. Seven cases were found to be supported, while two were found to be disapproved. This demonstrates that two factors (loss of trust, loss of cultural understanding) had no effect on communication, whereas the other seven elements had a significant impact.

The authors [14] identifies the communication issues that affect the performance of GSD projects. The authors further provide a framework that takes into consideration important aspects such as temporal distance, geographical distance, cultural limitations, behavioral issues, and social communication. According to their findings, group members' communication with GSD projects is also influenced by social interaction and attitude problems.

The authors [15] says that existing empirical facts of issues in a specific GSD environment, as well as mitigation techniques to tackle these issues in the literature and industry, and to build a framework that aids in the mitigation of GSD issues. According to earlier studies, incorporating agile methods into global software development is both beneficial and harmful. The authors of this research looked at the advantages and disadvantages of utilizing agile methodologies in GSD.

The authors [16] try to investigate the different agile techniques accessible to minimize the issues of global software development (GSD) identified in the literature. A collection of 24 articles have been identified as useful resources, and the information from these texts is utilized to demonstrate how agile approaches may be utilized to address identified GSD issues. As a result, this paper may be used by GSD authors and agile professionals to find the most up-to-date agile tools for resolving GSD challenges. This research provides researchers and practitioners who seek to understand how Scrum, the most commonly used agile method in GSD, provides background information on finding various Scrum practices and a list of GSD tasks that can be minimized by using them.

Now we can conclude our findings from this literature. We conduct a literature review and from previous studies we can identified 8 major communication issues that can affect on global software development and those 8 major coomunication issues involve:

i. Geographical Distance issues.
ii. Temporal Distance issues.
iii. Socio-cultural Distance issues.
iv. Team Member’s Attitude issues.
v. Technical related issues.
vi. Team related issues.
vii. Organizational and Architectural issues.
viii. Customer related issues.

1.3 Problem Statement

Now a days, it is common for software companies to develop software using global software development (GSD). GSD faces some significant challenges and one of the prominent challenges is communication among the stakeholders. From contemporary studies it can be identified that communication issues arise geographical distance, temporal distance challenges, socio-culture distance challenges, team member's attitude challenges, technical challenges, team challenges, organizational & architectural challenges and customer related challenges have their existence in global software development. The existing literature provide a very few works on mitigation strategies related to communication issues in global software development. As a result, the goal of this research is to give a plan for resolving these challenges in global software development [17].

1.4 Research Questions

The major goal of this study is to look at previous research, critically evaluate current software communication risk management, and determine how various communication issues influence global software development.

RQ 1: What are the communication issues that can affect on Global Software development?

RQ 2: What are the mitigation strategies for identified communication issues in Global Software Development?

1.5 Aim of the Research

Our research will cover the gap of identification of communication issues and their respective factors that can affect on global software development and its mitigation plan will help to overcome those issues.

1.6 Research Objectives

The objectives of our research are:

1. To provide a guideline for mitigation of identified communication issues in global software development.
2. Propose a mitigation strategy that can help to resolve the communication issues in GSD.

1.7 Research Methodology

A systematic literature review [18] involves several discrete activities. The processes of a systematic review are broken down into three primary sections in this article: explaining the research, conducting the research, and reporting the research.

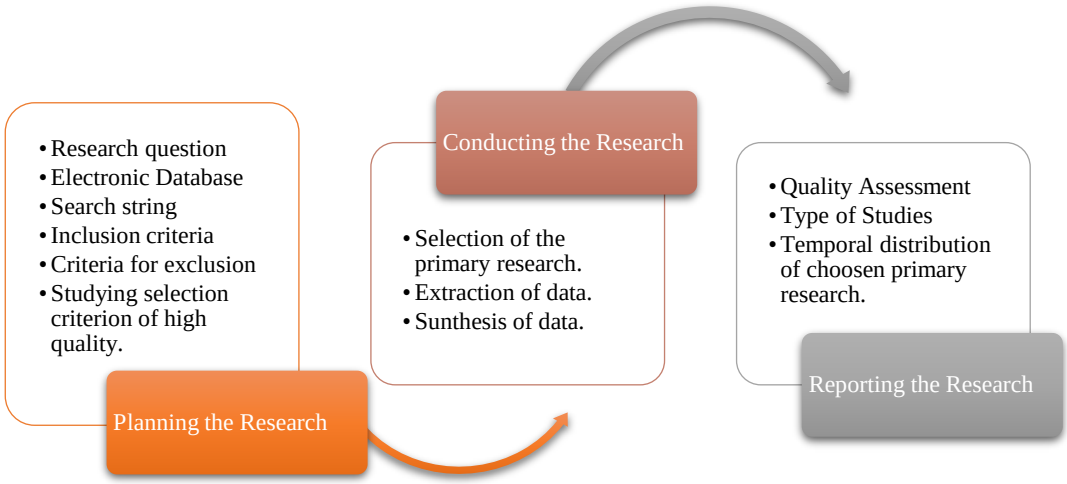


Figure 1.1: Steps of a Systematic Literature Review

After its debut in 2004, SLR has growing popularity in the field of software engineering as a way to study further about a specific domain. A systematic literature review is defined as

“a method of assessing and understanding all existing research related to a certain research question, topic area, or phenomena of interest”. EBSE stands for Evidence Based Software Engineering considers SLR to be a practice. In the fields of education, social policy, and psychiatry, the EBSE research method is used Kitchenhams' criteria were followed in order to conduct out this SLR [18].

1.7.1 Electronic Database

The electronic databases that we can used in this study are given below:

1. IEEE Xplore
2. Wiley Online Library
3. Google Scholar
4. Semantic Scholar
5. Research Gate
6. Science Direct

1.7.2 Search String

The mentioned search strings were used to find relevant previous studies:

- *“Communication issues” OR “Communication problems”*
- *“Global software development” OR “GSD”*
- *“Communication issues in GSD”*
- *“Communication challenges in GSD”.*

1.7.3 Inclusion Criteria

Papers written in English, as well as chosen papers that must be released in a conference or journal, are included. Studies that discussing communication issues and global software development are included and studies that answering the research questions are included.

1.7.4 Exclusion Criteria

Studies which are not in English language and not fall in inclusion criteria will be excluded from research.

1.8 Thesis Organization

The next chapters of this thesis are structured as follows:

Chapter 2 explains the literature review in which all of the details are explained with details and related studies. Bibliometric analysis is given in this chapter in which all the details of related studies are added. This will help to support the thesis.

Chapter 3 will present methodology of the thesis. This section explains mixed method research was conducted and described qualitative and quantitative research. Survey design guidelines were followed to do quantitative analysis. The survey design guidelines and all survey steps are described. Focus group is conducted for qualitative analysis so all the steps of focus group are briefly discussed in this section.

Chapter 4 discusses and analysis results in which all of the results from survey and focus group are added. These results are further evaluated one by one. Chapter 5 will provide the results. A comparative analysis among both methods is done to find the justified result. Chapter 6 will give summary of contributions and discussion of overall thesis. It also includes the limitations and the future work.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

In this section first we can conduct a literature review and then bibliometric analysis on literature review and then discussion on bibliometric analysis and at the end summary of this paper can be written.

2.2 Literature Review

This Chapter discusses the approaches used by various researchers to solve communication problems within the GSD.

The authors [19] said that Geographic difference, communication and cooperation, time, culture, respect, work allocation, requirements collection, and collaboration are all problems that global software development faces. The researchers evaluated geographic boundaries and communication challenges in GSD, as well as their interconnections, and offered answers and suggestions for resolving these issues, which are critical to the project's success. The researchers conducted a thorough literature research, summarized the findings, and conducted comparison research depending on this research. Other experts will be ready to utilize the findings of this paper to come up with fresh approaches to these problems.

The authors [20] said that with the progress of knowledge and communication technologies, global software development (GSD) has reached its peak in the last century . In

recent research, the researchers utilized an SLR approach to come up with a list of nine key success factors (CSFs) for GSD suppliers in the software integrating procedure. The researchers performed an experimental investigation utilizing a questionnaire survey in the GSD sector to confirm the outcomes of the SLR. The researchers' outcomes from the industrial survey are generally in line with the SLR results. Furthermore, the ranks of the various CSFs differed between the two variables (SLR and Survey).

The authors [21] summarizes that in the GSD procedure, the virtual team encounters a variety of problems and difficulties. The researchers concentrate on the communication variables that have been emphasized in the literature amongst virtual teams. Communication issues include time distances, geographic distances, socio-cultural variations, training opportunities, technical barriers to communication, communication inside the growth cycle, personal communication abilities, and linguistic disparities. The researchers attempt to investigate communication variables and associated difficulties that frequently arise amongst virtual teams in global software development. The data were collected around through several industries. The outcomes show that some of the most significant aspects linked to communication issues play a role in the GSD's performance.

The authors [22] says that in today's software business, building software through Global Software Development (GSD) has become extremely common. Pakistan is a hub for acquiring and designing projects from other nations, particularly Afghanistan. The major goal of this article is to describe and analyses numerous communication issues that might negatively impact a project, as well as to provide management advice for medium-sized software firms operating in Pakistan with Afghan clients to overcome these communication barriers. First start, we did a literature review to assess different communications challenges and determine if any standardized communications management advice for medium-sized software firms had been actually provided. The next stage of the research report is supplier guidelines, which involve interviews and focus group discussions with key stakeholders and employees of software companies with Afghan clients. We developed communication management principles depending on those interviews and conversations in order to solve communication issues and limitations while dealing with Afghan clients. As a consequence of the literature review, we discovered that communication issues such as language and cultural differences were one of the primary reasons for project failings. We recommend that software companies operating in

Pakistan obey specific structured organizational guidance to resolve communication problems that straightforwardly impact on the project.

The authors [23] say Global software development (GSD) has been more prominent in the IT sector over the last few centuries. The term "global software development" refers to a procedure in which firms create software in several places. IT businesses use GSD to gain the benefits of multi-site production, lower operating costs, and reach a wide number of talent workers. Considering its numerous benefits, GSD has a number of disadvantages. To deal with these problems, a lot of research have looked into disciplined methods and standards. These researches are conducted in numerous countries throughout the worldwide, although never within Malaysia. In Malaysia, there is still a lack of studies on the usage of software techniques as a result of GSD. As a result, the current study examines previous GSD literature and recommends more research in this field in the Malaysian environment. We outline our long-term researching approach for Malaysian software companies that specialize in GSD and project outsourced. The outcomes of this study will help researchers better comprehend software process tendencies in Malaysia, and the GSD factors that impact process selections. In addition, the current research provides a basic framework for process decision.

The authors [24] say that in the recent century, most worldwide firms have used distributed software development. New problems arise as a result of the impacts of dispersed development that are not present in collocated software development. For more than a century, the Software Engineering community explored the difficulties, which mostly comprised of communication, coordination, and control procedures. However, the majority of recent research were empirical in nature and did not address all of the industry's issues. This research examines GSD problems through a thorough literature analysis that includes historical, geographical, and socio-cultural elements. This research aims to create a framework for detecting difficulties which may occur during the GSD project's 2007-2017 period. The study results consequences for professionals and future research are discussed towards the end of the paper.

The authors [25] said that the present era is represented by global software development. Team members are geographically dispersed and work in various time zones, yet they interact and share data in real time, despite of physical barriers or time differences. Numerous organizations have software development procedures that traverse country and continental

borders. Participants of a team work across geography, time, and organizational barriers, with the use of webs of communication technologies. Various researchers employed soft computing approaches to produce resilient solutions at affordable prices in various software development processes such as software dependability, quality, repair, efforts, and various project management tasks. Numerous existing research papers on the application of soft computing to software development domains have been examined in this study, as well as future research prospects.

The authors [26] said that Software development by a worldwide distributed team is a current phenomenon that is not only expense but also produces the finest project outcomes, reducing risk and boosting rate of return. This is readily accomplished by guaranteeing that production output is maintained, regardless of the time or geographical borders. As more and more firms embrace technology as a key strategy, this transformation is occurring across the board. All of this is feasible thanks to modern technology, which does not compromise quality, coding methods, or project management approaches. We looked at a number of studies (from 2008 to 2018) and examined the information for soft computing to provide a solid basis for upcoming advancements.

The authors [27] said that Global software engineering is becoming increasingly popular in the software development business because of its various benefits. The major motivations of this trend are mobility, faster development, and expected cost reductions. Conventional software development has given way to global software development (GSD). In the software business, global software development is a common and significant activity. GSD's developers are scattered across multiple sites and countries, generating a host of problems due to geographical, social, and cultural barriers.

The authors [28] said that as contemporary businesses seek better and quicker ways to build software, and also approaches to engage reliability and investment criteria enforced by consumers, investors, and authorities, globalization is a key driver. As a consequence of these needs, global software development (GSD) has established a “standard” way of doing business. Working in GSD usually demands the participation of multi-cultural teams. A loss of understanding of differences in culture might result in confidence difficulties or lost chances. Because the research on cultures in GSD is either outdated or contradictory, professionals must

read a significant number of papers to have a comprehensive grasp about how to handle multi-cultural employees. The purpose of this research is to demonstrate how to improve team spirits by enhancing cultural awareness, minimizing potential conflict, and exploiting diversity. We did a comprehensive literature analysis of the GSD literature to address our study question, "How can cultural differences be handled, detected, and conveyed to a GSD team?" “Provide such a cultural knowledge base,” “understand and start making team members aware of cultural differences,” and “Strategies responses to mitigate instances of language differences” are just a few of the 12 unique techniques that businesses may employ, according to a production of solutions found in nineteen studies. These adaptable cultural practices go a long way toward addressing the problem of managing multi-cultural development teams, as well as supporting one of GSD's issue aspects of embracing cultural differences.

The authors [29] said that internationally dispersed software development teams encounter a number of problems in their working due to temporal, geographical, and socio-cultural differences. This research paper looks into the relationship between agile approaches and these three dimensions in global software development. Interviews and secondary data analysis were used to gather information. The findings demonstrate that the three distances have an impact on agile methods, and the case team makes changes as a result, agile approaches decrease communication, management, and collaboration difficulties, they have an influence on the three dimensions. Non-agile coping methods, such as specific communication techniques, can also help to mitigate the consequences of various distance.

The authors [30] said that the increased complication created by global distance in Global Software Development (GSD) necessitates methods to relieve collaboration problems, minimize computational complexity, and enhance management. How the organization, sharing, and prioritization of development activities is critical to project success. While there is considerable support for architects working with GSD in the literature, rules are far from full. The GSD Architectural Practice Framework is presented in this paper, and it incorporates the viewpoints of software designers operating in a dispersed context. In-depth interviews with designers from seven GSD organizations revealed a complexity of challenges and methods. We observed that developing software for distributed teams involves a proper analysis of approaches that enhance comprehension and compliance to specified architectural concepts across multiple sites. Scrum was utilized to help with communication, while Continuous

Integration was used to help with synchronization concerns. Teams, on the other hand, strayed from the Strategies, resulting in disagreements. A balance must also be established between the Scrum team's personality style and the need to enforce architecture design decisions across multiple locations. This research outcomes aid in a greater understanding of design processes in GSD companies. Our GSD Architectural Practice Framework offers a uniform set of notifications, with the majority of them including recommendations.

The authors [31] say Requirement implementation is a difficult phase of software engineering. It gets increasingly challenging in GSD, there is a need in the GSD framework for successful factors to be considered during Requirement Engineering (RE). In this study, success variables are discovered and assessed using a systematic literature review (SLR). Various research approaches, including as case studies, interviews, questionnaires, surveys, and experiments, are used to examine the highlighted factors. The proposed variables are examined across kingdoms, software business sizes, and time periods. The outcomes of SLR will help vendors properly execute rules.

The authors [32] said that it's difficult to describe and manage needs modifications in Global Software Development (GSD). Although researchers have concentrated on requirements change, GSD is currently learning about the Requirements Change Management (RCM) methodology. The purpose of this paper is to identify the factors that influence RCM's efficacy in the environment of GSD. We identified 23 success characteristics in GSD projects that influence RCM using the Systematic Literature Review (SLR) approach. According to the outcomes of the SLR, main factors that impact RCM in a GSD project include changing impact analysis, changing knowledge, management support, RCM processes expertise, RCM standard, progression measurement, updating specifications, and lowering project failure probability. A comparative of customer and supplier business success criteria is given. We also offer a methodology for categorizing the discovered success criteria for implementing the RCM procedure. We believe that the framework will assist GSD firms in effectively managing change in GSD projects.

The authors [33] says Due to temporal, organizational, socio-cultural, and physical distances, global software development (GSD) suffers numerous fundamental problems. Because GSD affects several different functional units, like nation, organization, and group, it's

important to understand and recognize GSD concerns at all of them. The purpose of this research is to revisit GSD issues and categories them at the national, corporate, and team divisions. It will enable software businesses to enhance their procedures and administration at director level by assisting research in looking into GSD concerns at these stages.

The authors [34] says global software development (GSD) has been a prominent software development concept in previous years. While considerable studies have been done on GSD management, there is currently a scarcity of GSD governance research, which represents a number of issues that must be resolved. A detailed mappings study was conducted in this paper with the objective of identifying the major themes covered in GSD governance material as well as emphasizing the particular research shortages that already remain in this field. We were ready to identify new concerns that required to be tackled as well as possible solutions as a result of this. The results indicate a lack of research in crucial areas such as technology, the environment, humans, and information, all of which provide substantial promise for upcoming strategies while also pointing to new GSD governance research opportunities.

The authors [35] said because of developments in knowledge and communication technology, the direction in software development has shifted beyond local to global software development (GSD). Considering the advantages of GSD, suppliers encounter problems when integrating elements created by multinational teams working in isolation. The proposed study's goal is to compile a list of significant problems (CBs) that hinder the integration process at any point. To achieve the aim, we conducted a systematic literature review (SLR) and acquired data from 88 articles published in 6 electronic repositories. A total of 16 obstacles were discovered, with 10 of them being classified as CBS. “Lack of Communication,” “Lack of Proper Documentation,” “Lack of Compatibility,” and “Architecture Mismatch” are among the top obstacles.

The authors [36] says implementing the concepts of global software development, the most of businesses are globalizing their software development operations. The number of advantages received by the software market is the driving force behind the implementation of GSD. GSD organizations, on the other hand, confront a variety of problems, including those connected to software process improvement (SPI). The purpose of this study is to determine

and categories the success factors that might affect SPI initiatives in GSD companies. The success criteria were extracted from the literature using the systematic literature review (SLR) technique. To support this research, the SLR steps of ‘explaining, conducting, and reporting the review' were followed. There were 15 success variables discovered and categorized into six primary groups. Management commitment, employee engagement, roles and duties, communication, and resource allocation are among the essential success elements of SPI, according to the authors. The commonalities and variations between the success variables defined by client-vendor organization and organization size were also mentioned in this study. Since the highlighted variables reflect significant areas of processes improvement, they can help with the execution of the SPI programmes in both customer and supplier GSD organizations.

The authors [37] said that the core concern is for software development activity to be done in a spread geographical region by a team, a person, or an organization. Sadly, due to the international industry and the international scope of many businesses, a globally virtual workforce is necessary. Through knowledge and, communication technology worldwide virtual team members are progressively immersed in worldwide corporate settings beyond geography, time, and organizational barriers. Communication, cooperation, and information sharing are the most crucial factors in the operations of a worldwide virtual team. This paper's goal is to respond to two research issues. The first study topic is to determine the elements that influence the performance of worldwide virtual teams. To address the first research question, a comprehensive literature review was carried out. The second study question concerns the relative importance of various factors impacting worldwide virtual team performance, as measured by their impact on worldwide virtual team performance. To respond the second study question, 103 developers and IT managers from 8 IT firms completed an online survey. The data were examined using the Statistical Package for Social Science (SPSS 22). This study looked into cultural disparities, language barriers, time zone differences, company size, technical challenges, a loss of trust, inadequate training, and ICT difficulties. Furthermore, the data revealed that a lack of adequate training has the greatest impact on the effectiveness of worldwide virtual teams Team size, on the other hand, has the smallest impact on the success of worldwide virtual teams.

The authors [38] said that Global software development (GSD) is now being used by businesses to build high-quality software at a cheap cost, but it confronts a number of barriers that make development processes more complicated. The most of GSD issues revolve on the requirement for change management. RCM is essential for completing software projects successfully. The purpose of this research is to utilize a systematic literature review (SLR) to identify the best practices in the RCM process and to validate them using a questionnaire survey of industry experts. SLR recognized 46 best practices, which were then confirmed by industry experts. We have furthermore classified the found practices in the areas of consumer and supplier GSD businesses in addition to provide a comprehensive understanding of RCM best practices in the environment of both types of GSD firms. Moreover, we conducted a comparison of SLR and questionnaire survey data and observed a significant positive correlation between the ranks of both data sets ($r_s = 0.522$, $p=0.003$). The relevance of the identified best practices was also investigated using 50 percent practice criterion. This paper's results provide a framework that may be beneficial in aiding GSD organizations in solving RCM challenges in the GSD environment.

The authors [39] said that it's difficult to describe and manage needs changes in Global Software Development (GSD). While researchers have concentrated on requirements change, GSD is still learning about the Requirements Change Management (RCM) methodology. The purpose of this paper is to identify the factors that influence RCM's efficacy in the setting of GSD. We identified 23 success factors in GSD projects that impact RCM using the Systematic Literature Review (SLR) approach. A comparative of success characteristics found in client and vendor businesses is presented. We also offer a methodology for categorizing the discovered success criteria for implementing the RCM procedure. We think the framework will help GSD companies effectively manage requirements change in GSD initiatives.

The authors [40] describe an investigation on the effectiveness of interaction-based metrics to predict cohesiveness in worldwide software development projects. Six software development initiatives involving students from various nations were analyzed for messages. These connections' commonalities and quantities will be calculated and evaluated. Personal and group analyses of the assessed measurements will be conducted. Likewise, content characteristics based on communication categories will be utilized to enhance task cohesiveness

level detection in virtual learning teams. Lastly, temporal contact similarity metrics will be produced to evaluate its worldwide predictive power.

The authors [41] said that nowadays, the majority of professional software applications, IT systems, and services are produced by internationally distributed teams, projects, and businesses. Proactively manage Global Software Engineering (GSE) has become a critical success factor for both organizations and individuals. Despite this, more than 50% of all distributed initiatives fail to meet their goals and are discontinued. This article compiles academic and industrial experiences in order to enhance information and technology transfers. It is predicated on a review of ten years of studies, business cooperation, and experiences presented in the IEEE International Conference on Software Engineering (IGCSE) series of conferences. Our findings indicate that GSE is a discipline with a strong connection to business, and that a significant portion of IGCSE papers deal with the transmission of Software Engineering principles and approaches to the world scale. As per our results, academicians and researchers are most concerned in partnerships and teams, processes and organization, sourcing and supplier relationship management, and successful factors. In addition to evaluating prior conferences, we look at current GSE movements in order to stimulate future research and business cooperation.

The authors [42] said the Offshore software development outsourcing (OSDO) has become a more prominent Global Software Engineering (GSE) approach for businesses who wish to focus on ongoing improvement and customization at a reduced cost to deliver high-quality software faster. OSDO, but at the other side, wasn't without risks, and software development organizations face a number of challenges, including geographical divergence, cultural and language challenges, communication and collaboration concerns, and a loss of information and communication technologies, to mention a very few. A research survey was conducted in the OSDO business to explore numerous communication and collaboration difficulties, as well as their mitigation strategies in OSDO partnerships. Data was gathered from 42 professionals in the outsourcing industry using a questionnaire survey. The critical challenges that OSDO distributors encounter in their collaboration procedures with their subcontractors' clients include different cultures, geographic distribution, differences in language, loss of ICT/technological cohesion, loss of credibility, and loss of interpersonal communication. In addition, we've identified 75 strategies that can contribute to a reduction of

these key difficulties. Recognizing these challenges and how to address them will assist OSDO suppliers in developing communication and collaboration approaches for their OSDO engagements with their customers.

The authors [43] said that How global software development (GSD) operations are organized has an impact on information exchanges across members of the team. The first is represented in governance decisions, while the latter is represented in a transactive memory system (TMS), a group-wide cognitive system for capturing, storing, and retrieving information. We would like to know how various governance decisions (such company policy, team dynamics, and work assignments) affect the design of transactive memory systems and the activities that take place within them. Our study takes a qualitative methodology. We use an online survey to collect quantitative data in order to uncover transactive memory systems. We investigate transactive memory structures using social network analysis techniques and build a hidden components model to measure transactive memory processes. Interviews are used to support and verify our findings, as well as to investigate the GSD governance mechanisms of the collaborating initiatives. Three variables influence property choices and governance designs: corporate strategy, team composition and structure, and position allocation. Our results suggest that different governance choices have varied effects on transactive memory systems. Utilizing offshore insourcing as a business plan, for example, results in tightly linked clustered data, which leads to more developed transactive memory processes. We also observed that within the functionality and deployment of GSD teams, there are border spanners who have a better understanding of the network's activities and become significant members inside their networks. According to a fascinating relationship between job distribution and the makeup of the core level, the method activities are split across dispersed teams is a hint of where information lives. We explain how to examine at GSD governance choices and how they influence transactive memory systems using an analytical method. Our method may be used by both professionals and academics to enhance global software team interaction as a cause-and-effect method.

The authors [44] said that With the epidemic of COVID-19, many businesses are faced with the task of transitioning to virtual work. Suddenly, a large quantity of team members must cooperate electronically instead of physically. Moving to virtual cooperation, on the other hand, is a unique demand not only for the team, as well as for virtual leadership effectiveness. Let

more significant attempts to investigate virtual leadership, there is still a paucity of study on virtual team leadership. We address this gap by presenting the outcomes of a comprehensive literature review conducted by five independent researchers in order to locate the widest variety of outcomes feasible, with an emphasis on variability. As a conclusion, our research may be used as a springboard for a more thorough examination of virtual team leadership.

The authors [45] said that the software is created by a team of globally distributed workers in global software development (GSD). Many international project development companies do not examine their project management capacity to handle such projects. The purpose of this paper is to provide a global project management readiness framework to help businesses analyses and measure their GSD project management preparation in order to improve their project management abilities. To create GLOB, three systematic literature reviews (SLRs) were conducted. For each SLR, an experimental study involving GSD practitioners was conducted to verify the SLR outcomes in a real-world scenario. We discovered 45 factors that might have a positive or bad impact on global project management readiness. There was a total of 305 quality standards for global project management discovered. The outcomes of the SLRs and empirical analysis were used to construct GLOB. Two case studies were conducted to put GLOB to the test in a real-world scenario. The case study's results indicate that GLOB can be used to evaluate a corporation's project management readiness for global initiatives. GSD practitioners are able to understand the abilities and limitations of current project management methods, and also how to strengthen weak areas in GLOB.

The authors [46] said that GSD (global software development) is becoming more common. When firms expand into new marketplaces across the globe, acquiring businesses in other countries, and recruit qualified engineers in new locations, projects must be stretched out. As projects are becoming more spread and include external stakeholders such as outsourcing companies, conventional top leadership monitoring and control becomes more difficult. How can businesses ensure that all parties in a software development project are acting in accordance with the project's strategy vision and objectives? The Worldwide Teaming Model is a greatest and suggestion-based architecture for global software development. As a consequence, it can be used to organize GSD procedures for Software Development Governance. To discover governance problems, a case study of a small group involved in Global Software Development was conducted. The Global Teaming Model was then used to develop governance strategies to

address the shortcomings. The recommendations in the Global Teaming Governance Model would improve a variety of aspects of the team's relationships with other teams within the company. The Global Teaming Model is a software development governance model that businesses may adopt to manage the globalization of existing construction projects.

The authors [47] said that to directors of global software development (GSD) procedures in organizations, poor software quality of the product has been a concern. Managers of these systems have had to deal with issues that have impacted customer pleasure and had severe social implications for community security, company economic condition, and global economic sustainability. The purpose of this qualitative exploratory multiple case study was to see if managers at Canadian GSD companies had a consistent understanding of how to meet software product quality goals and enhance customer satisfaction. The research was developed on Deming's 14 quality management principles. The properly picked sampling included thirty professionals who served as GSD directors in Canada. Semi-structured interviews over the cellphone and via audioconference, and also a review of related papers, were used to obtain information. The data analysis demonstrated eight concepts: establishing a clear meaning and work precepts, improving worker abilities, developing people management strategies, promoting autonomy and individual's work development, establishing life cycle and advancement strategies, identifying difficulties and developing alternatives, and concentrating on product design. The research 's findings have the potential to significantly affect social transformation by giving techniques and process enormous to GSD organizational executives. This information provides good administration and business practices for improving software production reliability and client satisfaction, establishing monitoring systems, maintaining a technological edge, and avoiding global software project losses.

The authors [48] said that the software development industry is rapidly changing, and numerous software development firms are seeking to expand globally. A phenomenon known as Global Software Development has led to the development of this trend (GSD). The multiple benefits that software globalization delivers are the driving force behind it. Besides these benefits, software firms confront a variety of challenges. Communication is one of these challenges, which is a huge problem in GSD and becomes considerably more complicated during the Requirements Change Management (RCM) process due to three factors: geographic, culturally, and temporal disparities. A framework is used in this research to demonstrate the

effect of these aspects on communications during the RCM approach in GSD. Communication is the essential function of cooperation, as it enables team members to share information. Three GSD groups participated in pilot research. Data was gathered using a quantitative research approach. According to the study results, these three issues have a significant detrimental influence on GSD's communication process.

The authors [49] said that Coordination, control, and communication are key problems when developing software in a remote development environment. Agile methodologies, which include constant interaction and self-organization among remote locations, are becoming much more popular in global software development to overcome these difficulties (GSD). We'd like to give you a comprehensive overview of what has been documented on the successful adoption of agile approaches in GSD from 1999 to 2016, and also the most widely utilized agile methodologies and stated distributed scenarios. We'd also like to figure exactly in which there are important research questions and shortcomings in the agile GSD area. We enhance a previous systematic literature review, which focused on studies conducted between 1999 and 2009, to the years 2010–2016, and conduct both quantitative and qualitative analysis. The majority of the cases we looked into were globally in scope and involved complex distributing circumstances employing Scrum or a mixture of Scrum and other approaches. Scrum/Extreme Programming are the more prominent agile methodology. Scrum is now at the core of agile GSD implementations in 2010–2016, with eight Scrum-based practices between the 10 leading agile practices being used in GSD, in comparison to 1999–2009, when four Extreme Programming strategies are amongst the top ten greatest frequently utilized agile practices. Agile GSD is a growing subject of research from 2010 to 2016, with higher inputs and a broader variety of publishing types and approaches than it was from 1999 to 2009. Moreover, experts must also provide extensive experimental background data of their studied circumstances in order to improve the generalization of their conclusions and allow the prospective building of better frameworks to promote the implementation of agile methodologies in GSD.

The authors [49] said that the Considering the increasing requirement for its expansion and charter of rights as conversational education has become an essential issue of career development and, quite broadly, a way to integrate our societal inequalities, the conversational aspect is still only periodically demonstrated in the quality of Russian higher education. The evolution of higher education necessitates the search for ways to control students'

communication ability. The solution to this problem will improve the reliability of upcoming high experience at a time when new communications countries are increasingly evolving, as well as create the conditions for personal and professional achievement. The research presented in this paper is based on the idea that the interconnectedness of areas of expertise that make up the foundation of intercultural communication is evaluated through the sequence analysis of different stages of intercultural competence growth and the role of an intercultural competence invention algorithm for university students.

The authors [50] said that In the recent decade, most worldwide firms have used distributed software development (DSD). New problems arise as a result of the impacts of dispersed development that are not present in collocated software development. Over the course of a decade, the Software Engineering community explored the issues, which mostly comprised of communication, collaboration, and management procedures. The most of contemporary study, on the other hand, was factual in character and didn't even address all of the company's problems. This paper presents GSD challenges as a thorough review paper with historical, geographic, and cultural elements. This research aims to create a framework for detecting concerns that may occur during the GSD project's 2007-2017 period. The study's consequences for professionals and continued studies are discussed towards the end of this article.

The authors [51] tries to assist GSD organizations in analyzing and improving their SPI processes, a software process improvement implementation and management model (SPIIMM) was developed. A rigorous systematic literature review (SLR) was done to evaluate the key successful factors, significant challenges, and appropriate SPI practices. An empirical assessment of the business was conducted with 111 SPI specialists using a survey questionnaire to verify the SLR's conclusions. The resulting CSFs and CBs were divided into five mental ages based on the execution development model, software outsourcing provider preparation model, and competence development model interface. Each maturity level had its own set of CSFs and CBs for assessing and improving an organization's SPI-related maturity. To assess the efficacy of the proposed approach, three case studies were undertaken. According to the results, SPIIMM can give a comprehensive framework for monitoring and enhancing SPI operations in GSD organizations.

The authors [52] tries to assist GSD organizations in developing a ready model for requirements change management readiness model (RCMRM). A Systematic Mapping Study (SMS) was conducted to identify primary research related to RCM in the GSD initiatives. 109 main studies were chosen using SMS, and 73 RCM practices that were discovered., which have been used to develop the RCMRM's projected readiness stages. Firstly, two case studies at two GSD organizations were undertaken to verify the RCMRM. The RCMRM was revised substantially based on the aforementioned research participants' suggestions and thoughts. Two separate GSD organizations further verified the revised version of RCMRM. As per the results of the second scenario, RCMRM is efficient in determining the readiness of the RCM procedure in the environment of GSD.

The authors [53] said that Communication, coordination, and control difficulties plagued distributed software development teams on a regular basis. Teams are dealing with these difficulties as a result of socio-cultural, geographical, and temporal distance between them. As a result, the study's goal is to discover what happens when dispersed Scrum teams run into issues. There are numerous typical GSD problems or concerns, such as difficulty holding face-to-face meetings, increased coordination expenses, and difficulty communicating vision and strategy, to name a few. The goal of this research was to find out whether there were any other regularly occurring Global Software Development (GSD) difficulties or obstacles. In addition, to learn about mitigation methods and procedures used by Scrum practitioners in the industry (distributed software environment).

The authors [54] stated as well as the use quantity of software are increasing with the increase of breakthroughs in ICTs, leading to higher software security. Get around this, software companies split down the things into individual parts, which are then generated in-house, outsourced, or purchased as off-the-shelf (OTS) elements.

Now we can write all the literature in a table and after the table we can conclude our literature review in a single paragraph in the form of discussion.

2.3 Bibliometric Analysis

In this section we can make a summary of our literature in a table form. In table 2.1 we can write Author name and Passing year of the papers and paper title and Findings of the paper and limitation of every paper and future work and at the last Colum of the table we can write in methodology that can a researcher used in their research paper.

Table 2.1: Bibliometric Analysis

No	Author & Passing Year	Paper Title	Issues/ Findings of the paper	Limitations	Future work	Methodologies
1	Yasir Hassan Shah, Mushtaq Raza and Sami UlHaq, March 2012	Communication Issues in GSD [5].	Identified the number of communication difficulties that frequently generate severe problems for GSD project developers, clients, and testers.	Only 15 papers added as a reference in literature.	Videoconferencing can help GSD team members communicate more effectively and overcome language difficulties. To improve the GSD environment's communication issues solution.	Literature Review
2	Mod Nath Acharya and Nazam Aslam, 2012	Coordination in Global Software Development - Challenges, associated threats, and mitigating practices [6].	The problems and risks to coordination in GSD, as well as the strategies to reduce them, are identified.	The response can be taken from all respondents experienced or not.	Creating and verifying the framework, as well as classifying the risks and practices depending on the practitioner's position.	Survey
3	Srinivas Nidhraa, Muralidhar Yanamadalaa, Wasif Afzal, Richard Torkar, 2012	Knowledge transfer challenges and mitigation strategies in global software development—A systematic literature review and industrial validation [7].	To create a knowledge base that will allow for effective KT in GSD contexts. This is achieved through a comprehensive understanding of KT issues and mitigation strategies, in both the research and in the business. Depending on research and interviews with business experts, it also examines the similarities and differences in concerns and solutions.	Search limited to March 2011 therefore only have one primary study in 2011.	Investigators and operators should focus on the 2PT factors when working with KT issues in GSD.	SLR & Interviews

4	Arif Ali Khan, Shuib Basri, and P.D.D. Dominic, 2012	A Proposed Framework for Requirement Change Management in Global Software Development [12].	To give the RCM architecture to the GSD so that they can adequately manage the required changes. Determine the multiple communication issues, their causes, and outcomes in the research and in case studies conducted in different GSD organizations during the RCM process. Describe the various ways used in the research and in GSD organizations to reduce communication issues.	Limited Systematic Literature Review (SLR) done in this study.	Several strategies for mitigating communication issues found mostly during RCM in GSD programs will be presented.	Case study
5	Arif Ali Khan, Shuib Basri, P.D.D. Dominic and Fazal E. Amin, 2013	Communication Risks and Best Practices in Global Software Development during Requirements Change Management: A Systematic Literature Review Protocol [11].	To determine the likelihood of communication issues during RCM in GSD. Different communication problems and mitigation approaches were investigated using SLR.	Strategic planning, design and analysis, coding, and testing are the only functional areas targeted in GSD initiatives.	After the SLR, an empirical study of the GSD business will be required to verify the results of the literature and to identify additional communication issues and mitigation techniques.	SLR
6	Arif Ali Khan, Shuib Basri and Fazal-e-Amin, 2014	A Survey Based Study on Factors Effecting Communication in GSD [13].	In GSD, communication is a huge issue, and it became even more complicated during the Requirements Change Management process (RCM). We are able to determine various factors that could seriously affect communication during the RCM process by investigating the GSD business.	Limited GSD organizations involved for questionnaire and targeted the only technical staff of the organizations.	Determine if the dependent variable input is likewise trustworthy for further communication evaluation.	Online approach (Survey) & self-administrated questionnaire

7	Arif Ali Khan, Shuib Basri, 1P.D.D. Dominic, 2014	Communication Risks in GSD during RCM: Results from SLR [55].	Completing a literature study to identify numerous communication problems, their reasons, and negative consequences that arise during the RCM process in GSD. Explore possible mitigation strategies utilized to mitigate the indicated problems through the literature.	Lack of Research gaps.	In the GSD field, empirical research will be performed to confirm the findings from the literature and to discover further communication issues and mitigation methods.	SLR
8	Mohd Shameem, Bibhas Chandra, 2015	Communication-related issues in GSD: An Exploratory study [14].	Identify the various communication-related issues that have been influenced by the development of the GSD initiative.	Primarily information from Indian software development industries is gathered, and information from a limited number of software projects is obtained.	Build on this research by placing the reasons in the proposed framework to the proof. Data can be collected from a wide range of software projects being occurring in different countries.	Survey
9	Sumit Sharma, Pawanpreet Kaur, Upinder Kaur, 2015	Communication Understandability Enhancement in GSD [15].	From both the research and business perspectives, to evaluate previous empirical data about issues encountered in a given GSD context, as well as mitigation approaches to address these issues, and to develop a framework that helps in mitigating these GSD issues.	Only the English language is used for communication.	To solve communication translating challenges, multicultural collaboration features and NLP (Natural Language Processing) can be applied.	SLR & Interviews
10	Areej Al_Zaidi and Rizwan Qureshi, 2015	Global Software Development Geographical Distance Communication Challenges [56].	To see how scrum methods may help with communication problems caused by geographical distance.	To begin, just four of the twelve GSD difficulties found in the literature were investigated. the research did not make a direct comparison between scrum and conventional methodologies.	To verify, adapt, and expand the framework as a reference, perform case studies in an industrial environment.	SLR

11	Muhammad Ilyas and Siffat Ullah Khan, 2017	An Empirical Investigation of the Software Integration Success Factors in GSD Environment [57].	Try to verify the outcomes of the suggested nine key success factors (CSFs) in the software integrating approach for GSD vendors utilizing the systematic literature review (SLR) method.	A very low response from respondents of the survey. Not give accurate answers from respondents.	CSFs can help GSD vendors improve their productivity by efficiently integrating their software components.	Survey & Questionnaire
12	Abdulaziz Alsahli, Hameed Khan and Sultan Alyahya, 2017	Agile Development Overcomes GSD Challenges: A Systematic Literature Review [16].	To assess the many agile methodologies presented in the literature to mitigate numerous Global Software Development (GSD) problems, with a focus on Scrum and associated practices because it has been the most commonly used in the GSD context.	Only focus on Scrum model.	To examine how each agile technique may be used effectively in a GSD environment to reduce the associated challenges.	SLR
13	Babur Hayat Malik, Saeed Farooq, Muhammad Nauman Ali, Nasir Shehzad, Sheraz Yousaf, Hammad Saleem, 2018	Geographical Distance and Communication Challenges in Global Software Development: A Review [58].	To determine which factors, have a bad influence on communication efficiency and performance.	This study did not validate.	Organize a survey to verify the research.	SLR
14	Muhammad Umair, Munam Ali Shah, Muhammad Hamza Sarwar, 2019	Barriers of Requirement Change Management Process in the Context of Global Software Development [10].	In the GSD context, to identify any RCM process problems. Then acquire business approval for these problems. Finally, evaluate these problems using statistical approaches.	Use only email communication for respondent response.	There is no related research work that remains to be done on this problem.	Survey

15	Ghana Ammad, Uzair Iqbal Janjua, Tahir Mustafa Madni, Muhammad Faisal Cheema, and Ahmed R. Shahid, 2019	An Empirical Study to Investigate the Impact of Communication Issues in GSD in Pakistan's IT Industry [59].	To detect and assess the communication issue in GSD, as well as the effect of these issues in the GSD environment. The present study aims to cover a gap in the literature and provide an appropriate knowledge of the influence of various communication problems in GSD.	The number of people in the population of the chosen respondent was fairly limited. The framework has not been empirically tested to determine the impact of the highlighted concerns.	The impact of communication issues on project success can be investigated in GSD. Moreover, mitigating strategies of communication challenges considerations can be found for more research.	SLR & Survey
16	Arif Ali Khan, Jacky Keung, Shahid Hussain, Mahmood Niazi, Suzanne Kieffer, 2018	Systematic literature study for dimensional classification of success factors affecting process improvement in global software development: client-vendor perspective [35].	The success factors that may have an impact on SPI operations in GSD organizations are determined and categorized.	Study not validated.	To validate the found success factors and their categories in an industry empirical study. Investigating new sorts of success factors in the GSD sector through empirical study. Identify the most effective ways for coping with the documented success factors. To determine significant barriers in GSD's execution of system change programmes.	SLR
17	Ali Yahya Gheni, Yusmadi Yah Jusoh, Marzanah A. Jabar, Norhay Mohd Ali, 2016	Factors affecting global virtual teams' performance in software projects [36].	To determine the elements that influence the efficiency of global virtual teams. What is the ranking of the factors impacting the efficiency of global virtual teams in terms of their impact on global virtual team efficiency?	The greatest impact on the success of global virtual teams is an inadequacy training, the smallest team size.	Ongoing study should be performed to improve the effectiveness of global virtual teams in global software projects, taking into account all of the aspects highlighted in this research article.	Survey

18	Muhammad Azeem Akbar, Jun-sang, Nasrullah, Arif Ali Khan, Muhammad Shafiq, and Fazal-e-amin, 2019	Towards the Guidelines for Requirements Change Management in Global Software Development: Client-Vendor Perspective [37].	Conducting a systematic literature review (SLR) to identify the top practices in the RCM approach and verifying them using a questionnaire survey of business experts. To assist GSD organizations in tackling RCM concerns in the GSD environment by developing a framework.	We were unable to access all of the accessible electronic libraries. The utilized resources are adequate to generalize the outcomes of our investigation, as according prior SLR research. Finally, due to the huge number of articles on RCM and GSD, some important literature may have been neglected.	The theoretical grounding of the identified RCM best practices provides researchers with a body of material to employ in future GSD studies. The identification of best practices will help researchers because it will allow them to concentrate on additional research in its most significant areas of RCM in the GSD field.	Questionnaire & Survey
19	Natalya Lukyano, Yury Daneykin, Natalia Daneikin, 2015	Communicative Competence Management Approaches in Higher Education [49].	The research described in this study is based on the assumption that the interconnectivity of areas of expertise that constitute the basis of communicative expertise is calculated by the sequencing of perseverance of the algorithm of communicative expertise creation for university students.	It only implication in Russian specific state.	The most effective technology for educating upcoming experts in the practical skills of communication with a collaborator and the development of an upcoming expert and private life journey.	SLR
20	Muhammad Azeem Akbar, Jun Sang, Nasrallah, Arif Ali Khan, Sajjad Mahmood, Syed Furqan Qadri, Haibo Hu, Hong Xiang, 2018	Success factors influencing requirements change management process in global software development [38].	Identify the factors that influence RCM's performance in the environment of GSD.	The content consistency of this analysis may be compromised because the majority of the chosen research papers did not explore the key drivers of the observed success criteria.	We want to perform an empirical investigation in the future to confirm the outcomes of this research and to investigate the extra success element of RCM.	Systematic Literature Review

21	Alberto Castro-Hernandez, 2016	Content and temporal analysis of communications to predict task cohesion in software development global teams [39].	In the environment of Global Software Development (GSD), to determine which traits are most suggestive of a team's cohesiveness. To explore if assessing group communication efforts using a combination of collaboration, content, and temporal features can improve group cohesion forecasts.	Low literature validity.	From the author's perspective, no future research can be recommended.	Questionnaire & Survey
22	Christof Ebert, Marco Kuhrmann, Rafael Prikladnicki, 2016	Global Software Engineering: Evolution and Trends [40].	Proactively manage Global Software Engineering (GSE) has considered a critical success factor for both corporations and experts. Considering this, almost 50% of all dispersed efforts failed to reach their objectives and are terminated. To combine educational and business expertise in favor to facilitate the dissemination of knowledge and technology.	We cannot pretend to offer the complete perspective because we did not consider additional articles in our analysis, such as journal articles or conference articles written at other places, because we only looked at the ICGSE publishing group. Another restriction is that we based our analysis purely on research and a few open debates.	Add journal articles or conference papers from other places, and then conduct more research.	SLR
23	Rafiq Ahmad Khan, and Siffat Ullah Khan, 2017	Empirical Exploration of Communication and Coordination Practices in Offshore Software Development Outsourcing [41].	To look into numerous communications and coordinating issues in OSDO links, as well as how to overcome them.	Only a small number of people responded to the survey and questionnaires.	In the coming, the model will aid OSDO suppliers in detecting, evaluating, and resolving communication and coordination issues in outsourcing relationships.	Survey & Questionnaires

24	Raoul Vallon, Bernardo José da Silva Estácio, Rafael Prikladnicki, Thomas Grechenig, 2017	Systematic literature review on agile practices in global software development [48].	To provide a comprehensive review of what has been written on the successful application of agile approaches in GSD from 1999 to 2016, as well as to identify the most widely utilized agile methodologies and distribution situations. We also wish to learn about research possibilities and shortcomings in the field of agile GSD.	Because most writers did not investigate on specific practices in precise detail, it is impossible to determine whether an agile practice has been successfully adopted. 19 papers were excluded because the study did not have access to the full content at the moment of the research.	Better frameworks are being developed to help GSD implement agile techniques.	SLR
25	John Noll, Sarah Beecham, Ita Richardson, Clodagh Nic Canna, 2016	A Global Teaming Model for Global Software Development Governance: A Case Study [45].	How can companies guarantee that all stakeholders engaged in a software development project's actions are associated with the project's strategic vision and targets?	In a private corporation, there is only one team. It's part of a bigger picture, and the bigger picture isn't about Software Development Governance.	We want to implement the lacking Global Teaming Model ideas at PracMed as component of a bigger software procedure improvement effort, of which this study is a component	Case Study
26	Arif Ali Khan, Jacky Keung, Shahid Hussain and Kwabena Ebo Bennin, 2015	Effects of Geographical, Socio-cultural and Temporal Distances on Communication in Global Software Development during Requirements Change Management [47].	In the GSD RCM process, presents a framework that highlights the effects of different factors on communication. Communication is a crucial aspect of collaboration since it allows team members to exchange data.	The survey data collection environment was restricted to a single nation.	In the hereafter, the proposed framework for research study can be validated with a bigger sample size. Finding mitigating methods that could lessen the influence of the observed variables in future research is crucial. For future study studies, other factors that may influence the effective communication must be explored.	A Pilot Study

27	Anna Zeuge, Frederike Oschinsky, Andreas Weigel, Michael Schlechtinger, Björn Niehaves, 2020	Leading Virtual Teams – A Literature Review [43].	With the emergence of COVID-19, many businesses are faced with the task of transitioning to virtual employment. Despite significant attempts to investigate virtual leadership, there is still a deficiency of study on virtual team leadership. To close this gap, five independent scientists undertook a systematic literature review to map the largest possible spectrum of data, paying specific emphasis of the results.	Because the examined literature covers numerous areas of research and hundreds of papers, the literature review technique does not provide a thorough summary of the virtual teams' work.	In relation to established internet methods of communication, (VR) may offer a divergent engagement, in which the software is permitted to send more or alternative information based on the use case. The experts want to use cutting-edge VR equipment and software to examine concepts such as media interaction and confidence.	SLR
28	Christina Manteli, Bart van den Hooff, Hans van Vliet, 2014	The effect of governance on global software development: An Empirical research in transactive memory systems [42].	To find out how different governance decisions affect the architecture of transactive memory systems and the activities that arise within them.	Demonstrate the accuracy and authenticity of our findings, as well as make recommendations for further changes.	In global software development study, the use of transactive memory technologies and social connections should be enhanced and extended significantly.	Online survey & Interviews
29	Patrick Enabudoso, 2020	Organization Global Software Development Challenges of Software Product Quality [46].	To see if executives at Canadian GSD companies have a clear understanding of how to meet software production excellence objectives and enhance customer satisfaction.	Regarding corporate record limitation rules, it is hard to retrieve performance records for evaluation. The survey comprised 30 people from six different Canadian organizations. The majority of interviewees offered only a few papers to support up their claims.	Evaluate how each vendor and client organization manages software product quality and customer expectations individually.	Case study

30	Mahmood Niazi, Sajjad Mahmood, Mohammad Alshayeb, 2020	GLOB: A global project management readiness framework [44].	Propose a global project management readiness framework (GLOB) to help organizations assess and measure their GSD project management readiness in terms of improving management capabilities.	Only five datasets were used to generate the answers. Search engines for online libraries get their own set of criteria for finding information. Only medium-sized businesses were studied.	GLOB was put to the test in medium-sized companies. We didn't put GLOB to the test in both big and small businesses. If we proceed to analyses GLOB in startups and enterprises, we would be generalizable its application. GLOB was also evaluated in organizations that adhere to the PMBOK standards.	Case study
31	Hassan Khalid, Farhat-ul-amin and Kokab Khushboo, 2017	Root Causes for the Failure of Communication in GSD [8].	To determine which variables are influenced by RCM for GSD.	Only software developers from various regions in Pakistan were considered in the targeting group.	Need to conduct a survey to gather feedback from customers on the many challenges that arise when operating on GSD assignments. A new framework must be developed that appropriately provides the particular solution.	Questionnaire
32	Muhammad Arif Shah, Rathiah Hashim, Adil Ali Shah, Umar Farooq Khattak, 2016	Communication Management Guidelines for Software Organizations in Pakistan with clients from Afghanistan [60].	To evaluate a variety of communication challenges that can have a bad effect on a project, as well as to give action plan for medium-sized software firms operating in Pakistan with Afghan customers, and to overcome the communication issues that these firms encounter when collaborating with customers.	Only executives, staff, and other partners from software companies with customers from Afghanistan in KPK were interviewed and a group discussion was held.	In the coming, we will investigate limitations and communication guidelines from the viewpoints of other countries in order to provide recommendations for global offshore initiatives.	Interviews

33	Arif Ali Khan, Shuib Basri, P.D.D. Dominic, 2012	A Propose Framework for Requirement Change Management in Global Software Development [12].	To establish a framework for RCM in globally diverse software development systems and to describe the identification of communication issues, their origins, and effects during RCM in GSD systems.	Data collected from only two organization for case study.	For eliminating communication concerns observed during the RCM in GSD projects, several approaches will be advised.	Case study
34	Antonio Manjavac Aurora Vizcaíno, Francisco Ruiz, Mario Piattini, 2020	Global software development governance: Challenges and solutions [61].	To explore the key issues raised in GSD governance literature, as well as the present study gaps in the domain.	Insufficient resources, a shortage of understanding between offshore teams, and intercultural variances.	The current state of GSD governance has been evaluated from a research standpoint, finding knowledge gaps related to COBIT objectives and aspects as well as outlining challenges that should be considered in upcoming research.	SLR
35	Marcelo Marinho, Alexandre Luna, Sarah Beecham, 2018	Global Software Development: Practices for Cultural Differences [62].	To demonstrate how to build team spirit by increasing cultural understanding, avoiding possible conflict, and harnessing diversity.	Only a small number of search phrases or targeting libraries are available.	Analyze the result of this studies to a specific company with the goal of determining changes that may be done to increase the company's intercultural performance.	Survey
36	Asim Iftikhar, Shahrulniza Musa, Muhammad Alam, Mazliham Mohd Su’ud, Syed Mubashir Ali, 2018	Application of Soft Computing Techniques in Global Software Development: state-of-the-art Review [63].	I read a lot of articles (from 2008 to 2018) and studied the data for soft computing to build a solid base for upcoming projects.	Due to the fact that fewer investigators have used SVM with ACO, there is a study void in this domain.	Approaches like Evolutionary Algorithms, Irregular Set Theory, Firefly Algorithm, and Lion Optimization Technique have never been used in GSD, indicating a huge research need that could be filled in the next.	A Pilot Study

37	Asim Iftikhar, Sharulniza Musa, Muhammad Alam, Mazliham Mohd Su'ud, Syed Mubashir Ali, 2018	A Survey of Soft Computing Applications in Global Software Development [64].	Existing studies publications on soft computing applications in software development areas, and also future studies topics, are reviewed.	Limited research gaps.	Few investigators use Bayesian Networks, Irregular Set Theory, and Ant Colony Optimization, which sets up research possibilities in the ahead.	SLR
38	Outi Sievi-Korte, Ita Richardson, Sarah Beecham, 2019	Software Architecture Design in Global Software Development: An Empirical Study [65].	To provide GSD staff with a better understanding of design procedures. Our GSD Architecture Practice Framework offers a consistent collection of cautions, with the majority of them supported by suggestions.	In this study only targeted scrum team.	Not specify further research work in future.	Case study
39	Nazish Saleem, Dr. Sanjay Mathrani, Dr. Nazim Taskin, 2019	Understanding the Different Levels of Challenges in Global Software Development [66].	GSD issues will enable software businesses to enhance their procedures and management at these levels by assisting academia in looking into GSD issues at operational levels.	Limited research paper included in literature.	Empirical research will be undertaken to confirm the difficulties mentioned in the literature and to examine new challenges at various levels.	SLR
40	Asif Riaz Khan, Rehan Akbar, Doris Wong Hooi Ten, Mobashar Rehman, Kiran Adnan, 2017	Review of Global Software Development (GSD) Trends in Malaysia and Future Directions [67].	The advantages of GSD have been underlined. The present paper reviews previous GSD work and publish suggestions for further GSD studies in the Malaysian environment.	In Malaysia, there has been some literature research, but not in the perspective of GSD.	Highlight the influence of GSD on Malaysian firms, as well as how GSD influences the behavior. The research also highlights the causes and GSD factors that contribute to a modification or decision in software process usage.	Literature Review

41	Muhammad Ilyas, Siffat Ullah Khan, 2017	Software Integration Challenges for GSD Vendors: An exploratory study using a systematic literature review [68].	To compile a list of major problems (CBs) that are limiting the integrating procedure at any given time.	A few of the articles we used during information gathering did not state exactly why they believe a variable to be a problem that could compromise content consistency. Case studies and self-experience reports were used in several of the investigations, which could jeopardize external validity.	As per the study, because to the extensive utilization GSD, the level of the limitations "Breakdown in Communication," "Lack of Appropriate Documents," "Inappropriate Unit Testing," and "Shortage of Funds, Information, and Talent" has increased in the second century.	Case Study
42	David Marcell Szabo and Jan-Philipp Steghofer Chalmers, 2019	Coping Strategies for Temporal, Geographical and sociocultural distances in Agile GSD: Case Study [69].	This case study investigates the relationship between agile methodologies and these three dimensions in global software development. Data was provided through interviews and analysis of secondary data.	Focus only on agile development.	In future research, it would be helpful to measure the results vs. the expenses of the distance-agile link in areas such as communication, management, and collaboration.	Case Study
43	Sadia ali, Naila Iqbal, Yaser Hafeez, 2018	Towards Requirement Change Management for Global Software Development using Case Base Reasoning [9].	Using the CBR (Cased Based Reasoning) technique, design and propose a framework for handling RCM (Requirement Change Management) efficiently and effectively.	Only 27 papers included as a reference.	Improve tracing linkages in GSD as a consequence of requirement modifications during the requirement engineering, and also their impact on requirement engineering projects. This study will also support in the development of RCM processes in cloud and federated cloud contexts.	Experimental Study

44	Yusmadi Yah Jusoh, Rozi Noor Haizan Noor, Bashar Amir Mahmood, Mustafa Thamir Wafeeq, Mohamed Abdullahi Ali, Muhammad Nur Baihaqi Jusoh, 2018	Communication Management in Global Software Development Projects [70].	Analyze the elements that influence communication and discover the difficulties that arise often amongst virtual teams in global software development.	Limited amount of target population selected in this study.	Future study work will not be specified.	Survey & Questionnaires
45	Muhammad Yaseen, Zahid Ali, 2019	Success Factors during Requirements Implementation in Global Software Development: A Systematic Literature Review [71].	In the framework of GSD, to address success aspects during Requirement Engineering (RE). To determine the elements that contribute to GSD's success during RE.	In other articles, the procedures were not explicitly specified, and the majority of the techniques we used to identify our components were self-reported experiences summaries, SLRs, or literature reviews.	In the long term, we hope to provide a list of critical topics, as well as examples and responses. A commercial assessment of these factors, as well as the identification of some fresh stuff, will be part of our future studies. The survey will also help to identify some cutting-edge industrial practices. The mission is to establish a requirement implementation model (RIM), and this project would be the first step in the right direction.	Systematic Literature Review (SLR)
46	Murat Doguş KAHYA, Çagla ŞENELER, 2018	A Literature Review on Challenges in Distributed Software Development [72].	To provide a roadmap for potential difficulties in the GSD project years of 2007 to 2017.	Limited SLR	The goal of this article was to provide a baseline for future researchers dealing with existing GSD problems.	SLR

47	Arif Ali, Jacky W, Fazal-E-Amin, M. Abdullah-Al-Wadud, 2017	Toward a Model for Software Process Improvement Implementation and Management in Global Software Development [51].	To develop a software project plan, planning and control model that will assist GSD businesses in analyzing and improving their SPI activities.	The important success elements, crucial hurdles, and practices may have been viewed variously by survey participants.	Build an SPIIMM software techniques to help a corporation in assessing their current SPI intelligence level and identifying the most key success factors and challenges to SPI projects.	Survey & Questionnaire & Case studies
48	Md. Shoaib Rehman, Arijit Das, 2015	Mitigation Approaches for common issues and challenges when using scrum in Global Software Development [53].	To learn what to do when dispersed Scrum teams run into issues. Additional often occurring Global Software Development (GSD) difficulties or obstacles may be found by searching. In addition, to learn about mitigation methods and procedures used by Scrum practitioners in the industry.	In this study use only a scrum model.	Future interest in doing case studies and/or interviews to determine mitigation solutions for the remaining GSD concerns from the perspective of Scrum teams.	Interviews
49	Muhammad Azeem Akbar, Sajjad Mahmood, Zhiqiu Huang, Arif Ali Khan, Mohammad Shameem, 2020	Readiness model for requirements change management in global software development [52]	To create a requirement, GSD organizations should use a change management readiness model (RCMRM). A Systematic Mapping Study (SMS) was done to determine essential research relevant to RCM in the GSD initiatives.	The focus of this research is on RCM in the environment of GSD.	In the long term, we intend to do empirical investigation with experienced professionals using a questionnaire survey to explore more RCM approaches. We also intend to establish an RCMRM for specific sorts of GSD enterprises. For this reason, we will conduct a customer and supplier analysis of a particular RCM methods.	Case studies

50	Muhammad Ilyas, Siffat Ullah Khan, 2016	Practices for Software Integration Success Factors in GSD Environment [54].	Make a list of 116 practices for executing the fundamental success aspects of software acquisition. GSD providers may be able to link their software systems faster and effectively if they focus on these quality standards.	Because of our restricted resources and technological limitations, we only examined five online databases.	We plan to conduct a questionnaire survey in the software engineering industry beside each other experimentally verify our practice conclusions. Our aim is to give GSD suppliers with a software integration model (SIM) that will assist them in properly integrating the software elements supplied by GSD organizations.	SLR

2.4 Discussion

From table 1.1 we can identify some communication issues that can affect on Global Software Development and also identified some factors that can arise the communication issues that affect on Global Software Development. The details of coomunication issues and factors that arises these issues can be seen in summary section.

We can detail discussion on bibliometric analyses that can be done in table 1. We can conduct a literature review and find 50 relevant paper that can be based on my study abstract, title and keywords. We can find papers from the years 2012 to 2020 and if we can set in range, we can divide in two intervals e.g., we can say that from 2012 to 2015 we can find 15 relevant paper and from 2016-2020 we can find 35 relevant papers. So, in general we can say that our literature is mainly based on 5 recent years. Detail of number of papers can be displayed in table 2.2.

Table 2.2: Research Paper Year wise analysis

Published Paper Year	**No. of Papers**	**Published Paper Year**	**No. of Papers**
2012	5	2013	1
2014	3	2015	6
2016	6	2017	8
2018	9	2019	7
2020	5		

2.5 Summary

In this chapter first of all we did literature review on communication issues that affect on global software development. We find eight major communication issues that affect on global software development by reviewing 50 research papers from the literature review which are Geographical distance, Temporal distance, Socio-cultural distance, Team Member's Attitude, Team related issues, Technical related issues, Organizational and Architectural issues and Customer Related issues.

We also reviewed the factors that can arise these 8 communication issues that affect on GSD. The factors can be displayed in chapter 4 of this document. We also identified some mitigation strategies that can help to resolve the eight communication issues that can affect on global software development.

CHAPTER 3

METHODOLOGY

3.1 Overview

Methodology is a comprehensive, theoretical study of the methods adopted in an area of investigation. It comprises a theoretical evaluation of a collection of procedures and ideas related to a certain area of research. Keywords like paradigms, theoretical model, phases, and quantitative and qualitative techniques are commonly used. Since it does not aim to provide conclusions, a methodology differs from a strategy. Rather, it lays the theoretical groundwork for selecting which strategy, set of processes, or best practices should be employed to address a specific issue, such as computing a specific result.

3.2 Research Strategy

The words re and search make up the word research, which has two syllables. Search is a verb that indicates to look into something extensively and carefully, to examine and evaluate something, or to discover anything. re is a prefix that means again, afresh, or over again. They create a word that describes a methodical, systematic, and patient research into an area of knowledge in order to establish realities or concepts.

"Research is a systematic investigation that use accepted scientific technique to solve problems and generate new, broadly applicable knowledge."

A research method is a set of detailed plans for conducting an investigation. A research method supports an investigator in the planning, execution, and monitoring of a project. While research methods are beneficial on a broad level, they must be reinforced with research methodologies that can help direct study work on a more specialized level. Interviews, questionnaires, and statistical methods are all instances of research methodology that show an investigator how to collect and understand data. A research strategy is a rising plan, whereas a research technique is a methodology or tool for achieving a specific task.

In this research, first of all we will identify the coomunication issues and factors that arise these communication issues that can affect on GSD and then we will evaluate those issues through survey in the form of questionnaire and then we will be giving mitigation Strategies to overcome those communication issues through focus group.

To respond to questions, research entails gathering, analyzing, and interpreting data. Research is a set of processes for gathering and analyzing data in order to gain a better knowledge of a subject or situation [73].

In general, there are three types of research methods that are given below:

1. Qualitative Research
2. Quantitative Research
3. Mixed Method Research

3.2.1 Qualitative Research

Qualitative research is a situated action in which the investigator is situated in reference to the surrounding environment. It's a set of interpretive and material programs that enable people see the universe. These actions have a significant global influence. They turn their surroundings into a series of representations, including fieldwork observations, interviews, talks, photographs, recordings, and self-memo. During that level, qualitative research necessitates an interpretive, genuine perspective to the environment. This means qualitative

researchers examine items in their naturalistic environments, attempting to comprehend or view things through the spectacles of the meanings people attribute to them [74].

Qualitative researchers are concerned in understanding how individuals build meaning, that is, how they generate knowledge of their environment and their interactions in it. Qualitative research is described as study that employs methods such as observational research or case studies to create a narrated, comprehensive depiction of a location or event. Sociologists who criticize positivism in support of interpreting sociology frequently employ these methods [74].

Effective techniques include grounded theory, ethnography, action research, phenomenological research, and narrative research. They share some characteristics, yet their objectives and perspectives are significantly distinct.

Every methodological approach employs one or more data collection techniques. Some of the most commonly utilized qualitative approaches are as follows:

- ✓ Observations: making detailed observational notes on what you've observed, heard, or encountered.
- ✓ Interviews: are one-on-one encounters in which you ask questions from people.
- ✓ Focus group: The goal of a focus group is to ask any questions and start a discussion between a group of people.
- ✓ Surveys: are used to send questionnaires with open-ended queries.
- ✓ Secondary research: comprises compiling information that previously exists, such as texts, images, audio or video recordings, and so forth.

3.2.1.1 Advantages

In qualitative research, participant opinions and viewpoints are often kept, however this may vary as new study topics emerge. Qualitative research can be used for a variety of goals, including:

- ✓ Flexibility: The data collection and analyzing process can be changed when fresh ideas or patterns appear. They aren't planned ahead of time.
- ✓ Natural settings: Data is collected in a realistic or workplace context.
- ✓ Detailed reports of human perspectives, emotions, and opinions can be used to develop, evaluate, or improve systems or services.
- ✓ Generation of new ideas: Open-ended responses help researchers to explore new challenges or opportunities that they might not have thought about sometimes.

3.2.1.2 Disadvantages

Investigators must address both actual and conceptual limits when analyzing and evaluating data. The following are some disadvantages of qualitative research:

- ✓ Unreliability: Qualitative research is often inaccurate due to unforeseen factors that affect data in the real world.
- ✓ Subjectivity: Because the researcher is heavily involved in analyzing and comprehending data, qualitative research cannot be replicated. The investigator chooses what is important and what is not during data processing, resulting in multiple perceptions of the same data.
- ✓ Limited generalizability: to get complete information on physical conditions, small samples were immediately used, due to the limited generalization. Generalized findings are hard to reach, even thorough analytic approaches, because the information may be biased and non - representative of the greater population.
- ✓ Labor-intensive: Regardless of the fact that automation can be used to organize and record massive amounts of text, analysis of the data is often examined or completed physically.

3.2.2 Quantitative Research

Quantitative research methods are study approaches that systematically evaluate phenomenon and their relationships using numbers and everything quantified. It's used to find answers to questions concerning the relationships between quantifiable factors in order to understand, anticipate, and manage a phenomenon [75].

In descriptive research, you only need an overall picture of your research elements. Correlational research investigates the relationships among the elements in your study. You conduct an experiment to determine whether there is a cause-and-effect relationship between elements.

Statistics can be used to properly evaluate assumptions or predictions in both correlational and experimental study. The outcomes of these two types of studies can be extended to a bigger population because of the sampling method used. While gathering quantitative data, you'll commonly require to use operational definitions to translate complex ideas (like mood) into observable behavior values (like self-ratings of feelings and energy levels).

Descriptive study is the umbrella term for quantitative research methodologies. This form of study entails determining the features of a phenomena that has been seen, as well as examining relationships between two or more things.

3.2.3 Mixed Method Research

Mixed methods research is a conceptual and practical combination of qualitative and quantitative data. It stressed the importance of traditional quantitative and qualitative research, but it also introduces a strong third paradigm that frequently produces the most comprehensive, detailed, and effective research outcomes [76].

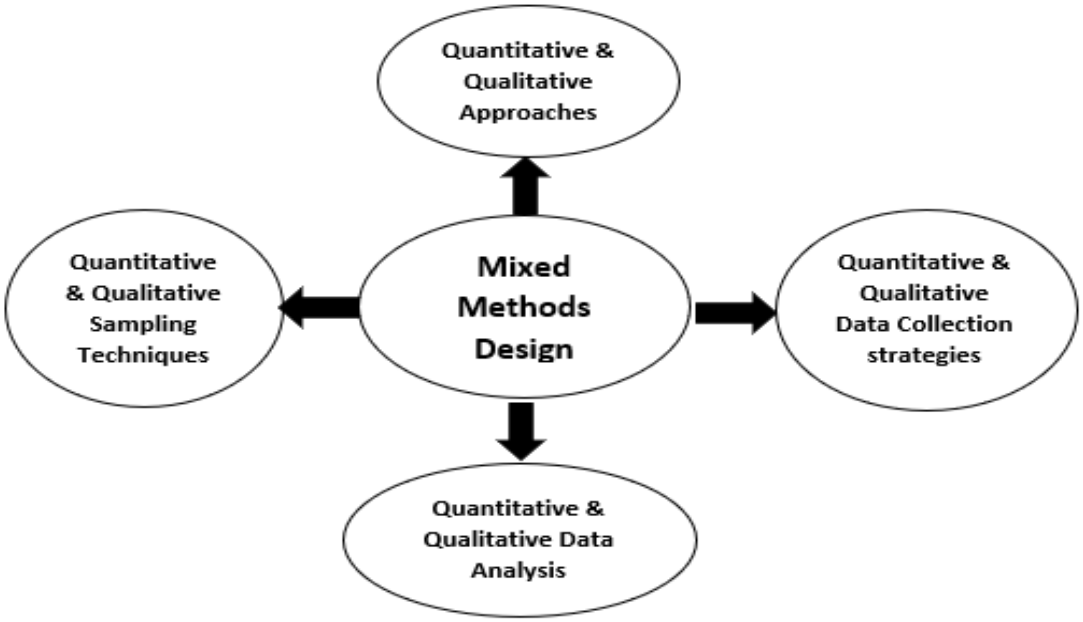


Figure 3.1: Operational Framework Mixed Method Research [77].

The steps for conducting a mixed method research study can be displayed in figure 3.2.

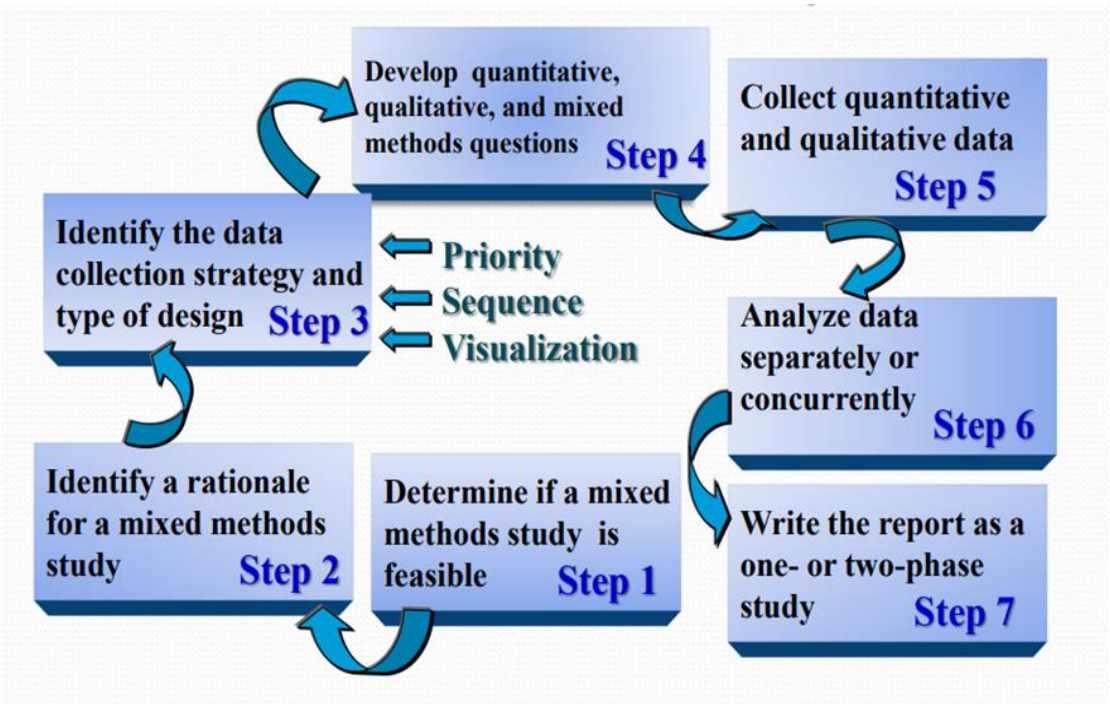


Figure 3.2: Steps for conducting a Mixed Method Research

A mixed method research is a means of collecting, analyzing, and "combining" quantitative and qualitative research and approaches in one study to properly understand a research problem. To make the most of every approach, you must be conversant with both quantitative and qualitative research [78].

According to Creswell and Clark, research questions best suited for mixed methods are those in which I one source of data is inadequate, ii) outcomes need to be clarified, iii) explorative analyses need to be generalized, iv) a second method is required to supplement the primary method, v) a theoretical stance is required, and vi) an overall objective of the research can be better addressed with different techniques [79].

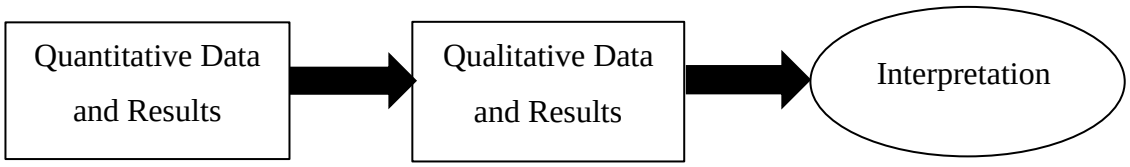


Figure 3.3: Process Diagram of Mixed Method Research

This technical presentation gives an outline of how quantitative and qualitative empirical research methodologies may be integrated to form the mixed-methods family of empirical software engineering approaches.

We will take a questionnaire from quantitative research in the form of a survey in mixed methodology, and then we will analyses the results in the form of a focus group.

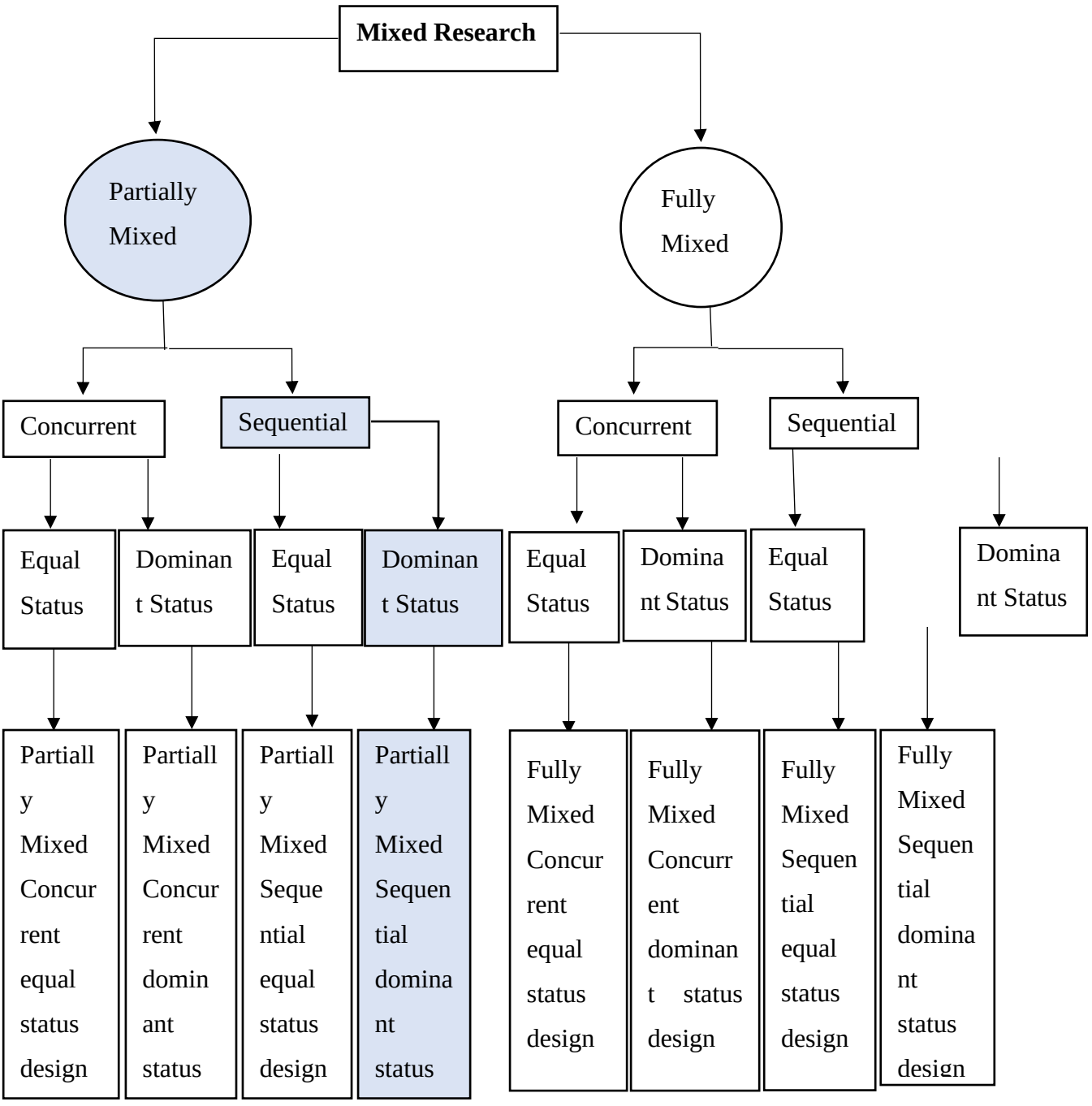


Figure 3.4: Mixed Method Research

3.3 Research Methodology

Research methodology refers to the real "how" of any specific research. It's essentially how an investigator approaches a study in a systematic manner in order to obtain reliable and consistently outcomes that meet the study's aims and targets.

- ✓ How did the researcher come to the following findings, for example:
- ✓ What information should you collect? (and what information to discard)
- ✓ Who should I ask for it? (this is known as "sampling design" in research)
- ✓ How do you obtain it? (also known as "data collecting techniques")
- ✓ What is the best way to assess it? (also known as "data analysis methods")

Figure 3.5 shows the process of research methodology in this study. Step 1, focus on systematic literature review. SLR is a type of literature review that gathers secondary information, critically assess science studies, and summarizes qualitative and quantitative results using systematic procedures. Their purpose is to produce a complete and thorough assessment of existing data on a particular research subject.

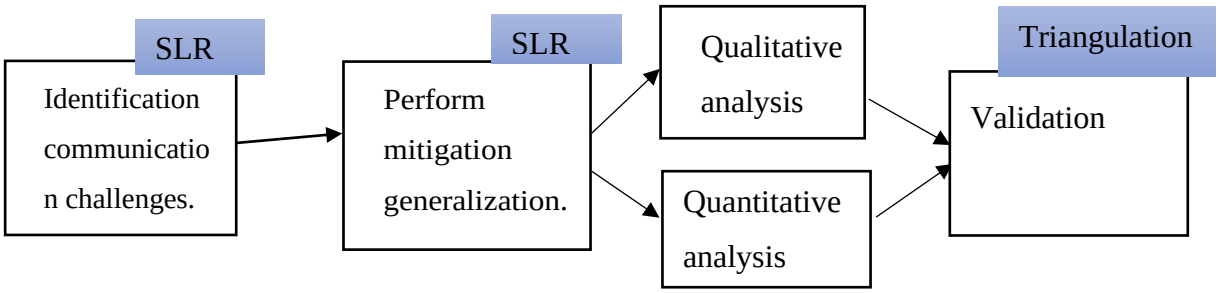


Figure 3.5: Summary of Research Methodology

To begin, a review process is created to perform this SLR. The review procedure is depicted in Figure 1. There are seven research phases in the review protocol:

- ✓ Research inspiration and formulation of research question
- ✓ Search string creation
- ✓ Electronic database selection for research activity
- ✓ Research paper collecting
- ✓ Study selection (inclusion and exclusion)
- ✓ Quality assessment criteria determination, and finally
- ✓ Data Analysis and synthesis

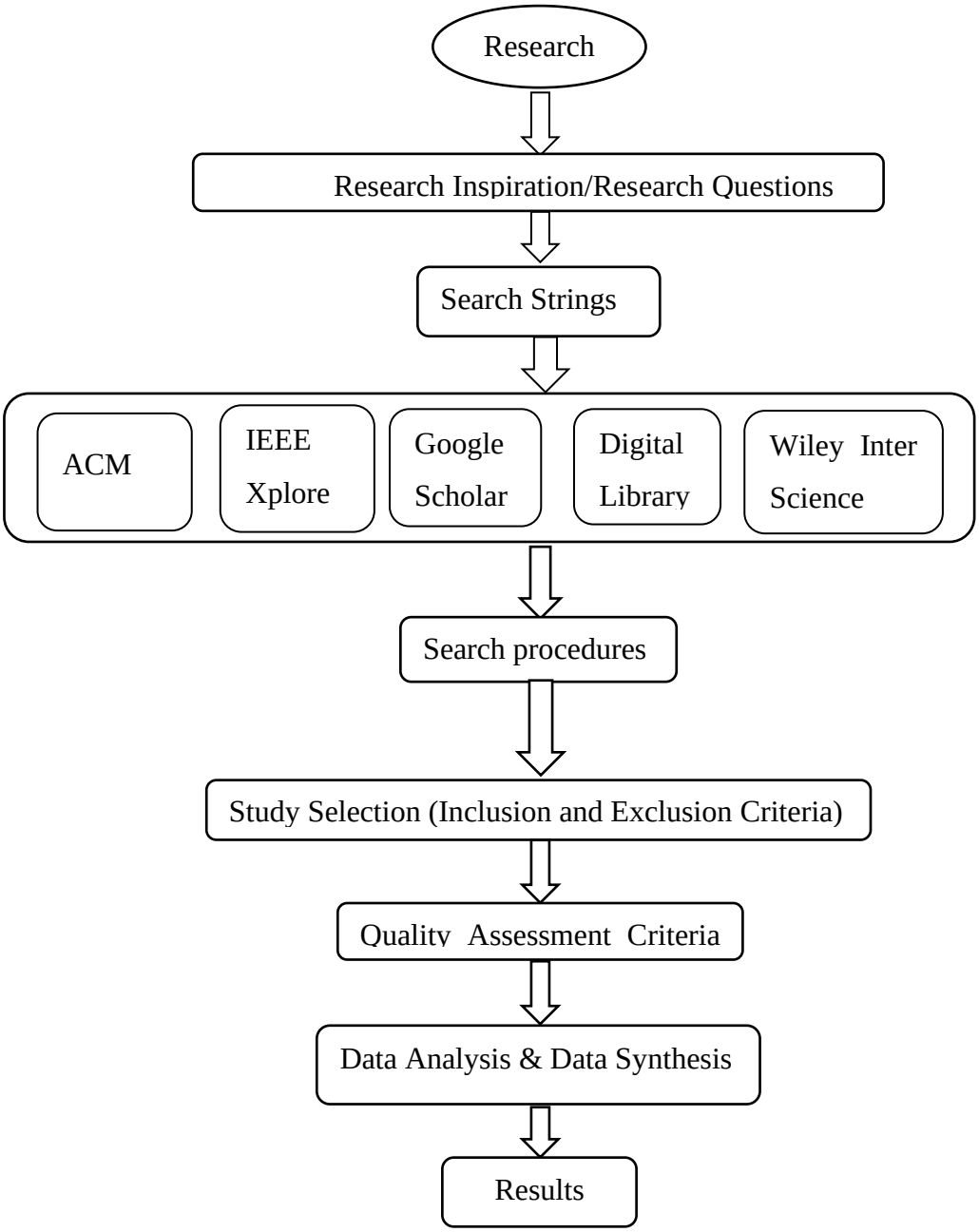


Figure 3.6: Review Protocol

Many recent studies have been highlighted in the literature and are associated with numerous communication issues and mitigation measures in global software development. With the research target in mind, the research questions are generated.

While reviewing previously research findings in a topic, the research questions serve in determining the purpose of the analysis. The following keywords are intended to assist in the discovery of all relevant studies for a certain topic. Important technical terminology from prior studies are used to build the search queries. Figure 2 shows how multiple electronic platforms were used to learn about the study. Examine protocol 33 literature that is related to the area of the focused concern. Seven electronic databases are used to look for research publications. Electronic databases explored include ACM, IEEE Xplore digital library, Google search, and Wiley inter sciences. During the search procedure, many research works are obtained; nevertheless, only the relevant research papers must be filtered out. The research process is simplified in order to obtain the most relevant papers, which are then filtered using pre-determined inclusion and exclusion criteria. The quality evaluation criteria (QAC) are used to assess the research effort's adequacy.

3.3.1 Research Motivation

The literature indicates that a lot of work was done on communication issues in GSD, but there are a lot of areas that need to be reviewed in order to mitigate communication issues in GSD, and we will be addressing the recommendations for mitigation of communication issues in GSD [4].

Existing strategies are still unable to capture all of the necessary and significant parts of GSD communication. It is necessary to do an SLR in order to determine all of the communication difficulties in GSD. This SLR will support in the discovery of solutions and mitigation methods for GSD communication issues [2].

This study offers a comprehensive strategy to resolving communication issues discovered by SLR in global software development (GSD). In addition, characteristics that are essential but are not addressed by existing methodologies are discussed.

3.3.2 Research Questions

The major goal of this study is to provide a guideline for tackling recognized communication issues in global software development and to propose a mitigation strategy for overcoming the above problem in GSD. This study also aims to identify any existing communication issues that may arise in GSD. This study also aims to identify any existing communication issues that may arise in GSD.

The following is a summary of the main problems or research questions that are explored in this research.

RQ 1: What are the communication issues that can affect on Global Software development?

RQ 2: What are the mitigation strategies for the identified communication issues in Global Software Development?

3.3.3 Search String Procedure

To find relevant studies, the search is carefully done. Five internet databases were used to gather the research papers. Among the databases examined were IEEE Xplore, Digital Library, ACM, Google Scholar, and Wiley InterScience. The search strings are depending on the research questions and cover a wide range of topics related to the issue. A list of keywords is used to search online repositories for the information. The search phrases are utilized in a number of methods to find all associated studies. Kitchenhams [17] offers advice on how to construct relevant keywords. Moreover, various search strategies, including a mix of Boolean operators and advanced search choices, are employed to enhance the search procedure more durable. The search terms used to find similar research studies are listed below.

- ✓ “Communication issues” OR “Communication problems”
- ✓ “Global software development” OR “GSD”

- ✓ “Communication issues in GSD”
- ✓ “Communication challenges in GSD”

To search the available literature, simple search keywords are employed. These keywords are derived from previously published research in reputable publications.

3.3.4 Study Inclusion and Exclusion Criteria

In GSD, the primary focus is on communication issues. The support for empirical facts in the particular topic is used to classify research projects. The criteria for completing research work are stated below.

3.3.4.1 Inclusion Criteria

In order to keep this study, the titles, abstracts, and keywords of research papers are used to define the inclusion criteria.

- ✓ Papers that are authored in English.
- ✓ Papers addressing GSD communication difficulties.
- ✓ Papers on GSD communication challenges and how to solve them.
- ✓ Papers must be accepted for publication at a conference or journal.
- ✓ Papers published in GSD in the topic of communication difficulties between 2012 and 2021.
- ✓ Papers that have the potential to address one, more than one, or a portion of the question (s).

3.3.4.2 Exclusion Criteria:

The following performance factors serve as exclusion criteria:

- ✓ Studies conducted that are not published in English
- ✓ Simple articles that are uploaded on websites
- ✓ Studies that are repetitive
- ✓ Papers that are unable to address the research questions

3.3.5 Quality Assessment Criteria

The quality assessment criteria (QAC) were created to measure the quality of basic research studies. The QAC is based on a collection of research questions that are used to evaluate a study's effectiveness. Each study is assigned a score based on the research questions [37].

Quality evaluation guidelines in the form of a questionnaire were created by Dyba et al. The major purpose of these evaluation criteria is to find and incorporate the most important research papers in the SLR.

3.3.6 Data Synthesis

The data synthesis section summarizes the findings based on information gathered from primary investigations. Both quantitative and qualitative data analysis techniques are utilized for data synthesis. This SLR contains information on GSD communication difficulties. A preliminary examination of the methodologies and stated elements will help in the resolution of all the research issues.

The RQ1 will help in determining the communication issues in GSD.

The RQ2 focuses on provide a guideline for mitigation of these communication issues in GSD.

3.4 Research methods

Research methods are defined that will be follow in study. In this study we use two research methods that are:

1. Survey
2. Focus Group

3.4.1 Survey

A comparison of large and small groups utilizing samples chosen from the target population to assess comparable occurrence, dispersion, and interconnections is known as survey research. The ultimate goal of questionnaire survey is to learn more about a large population by surveying a representative sample of it; thus, it is also known as a descriptive or normative survey [80].

The focus of the research study generally determines the type of survey method used. If the research needs a large number of thoughts and actions, a cross-sectional survey may be effective. If a researcher's purpose is to compare differences in beliefs and practices over time, a longitudinal survey would be the appropriate approach [56].

Survey research entails posing questions to a set of people and analyzing their responses in order to understand more about them. Follow these six steps to create a successful survey [81]:

i. Decide who will take part in the survey.
ii. Select the survey method (mail, internet, or in-person).

iii. Create the survey questions and layout.
iv. Make the survey available to the public.
v. Review the replies.
vi. Summarize the outcomes

Surveys are a flexible data collection technique that can be used in a wide range of projects.

3.4.1.1 Sample size

The sample size for our study will be systematic sampling SRS, which involves selecting a sample of n units from a previously sorted sampling frame made up of N units using a sequence initiated by a randomly picked unit i. The following units are determined by combining the intervals k (the result of integer division between N and n). If there are 200 people in the population then the sample size is 50, for example, k=4. If i=3, the first ten units 3, 7, 11, 15, 19, 23, 27, 31, 35, and 39 will be included in the sample.

Our study sample size will be 250–270 eligible respondents in order to get answers to all of our questions.

3.4.1.2 Respondent Profile for Survey

In Software Engineering surveys, Kasunic [59] offers a list of fundamental qualities that may be used to elicit the key features on defining the target audience. Furthermore, we recommend categorizing them as dependent (" D," generally linked to participants' backgrounds) or independent (," I," typically containing demographical qualities) from the study setting, and we will choose our audience based on the following criteria.

- ✓ Email
- ✓ Gender

- ✓ Age
- ✓ Name
- ✓ Education
- ✓ Company name
- ✓ Designation
- ✓ Work Experience
- ✓ Project Nature

3.4.1.3 Survey Medium

The following media will be used to conduct our survey:

- ✓ Social Media
- ✓ LinkedIn, WhatsApp etc.
- ✓ In person

3.4.1.4 Survey Instruments

A survey instrument is often a highly significant questionnaire that needs specific attention. This section contains recommendations for developing internal and survey questions as well as designing survey questionnaires. Internal questions are open-ended inquiries that are then transformed into survey questions. Internal inquiries reveal the main aim or goal of the investigation. The survey's recommendations and findings are directly influenced by the quality of the questionnaire used. The quantitative collection of a population's behavioral and attitudinal traits, which enables for reliable data interpretation, is a major strength of survey research [82].

3.4.1.5 Response Format

The respondents' responses will be gathered in a variety of ways, including the following:

- ✓ Google Form
- ✓ Survey monkey

3.4.1.6 Justification of Survey

To begin we will identify the communication issues and factors that arise the communication issues in GSD through systematic literature review and then we will list down all of communication issues as well as the mitigation Strategies to overcome those communication issues, using a survey-based questionnaire that will be distributed to industry and professional respondents. As a result, the survey helps in the validation of the findings from the literature study by confirming them with professionals and industry experts.

3.4.2 Focus Group

Focus groups and pilot studies are the most typical forms of survey instrumentation evaluations. A focus group is a sort of qualitative research in which a set of people are surveyed about their thoughts, opinions, beliefs, and attitudes concerning a topic or initiative that has gotten little notice. It is usually made up of people who represented survey researchers as well as survey respondents. It evaluates instruments and assists in the discovery of missing or unnecessary questions, as well as uncertainties. Questions are asked in focus groups in an active group format, often face to face, with respondents free to talk to one another [83].

In focus groups, the investigator or moderator must convene a group of people (usually 7–8) and give them survey questions. It allows participants in focus groups to give longer responses and discuss a topic with others. A focus group can also be utilized to gather data for

survey questionnaire design, such as which topics are important to a sample of the population, how people comprehend a topic area, and how they view questions. It provides a qualitative understanding of the topic under investigation, which is subsequently assessed in a survey study.

3.4.2.1 Respondent Profile for Focus Group

The focus group respondent profiles will be based on the following.

- ✓ Educational Experience
- ✓ Professional Experience
- ✓ Subject Matter Expertise

3.4.2.2 Sample size

Our focus group will have a sample size of 7–10 eligible respondents in order to receive responses to all of our questions.

3.4.2.3 Medium

The following media will be used to conduct our survey:

- ✓ Zoom

3.4.2.4 Justification of Focus Group

To begin we will identify the communication issues and factors that arise the communication issues in GSD through systematic literature review and then we will list down all of communication issues as well as the mitigation Strategies to overcome those communication issues, using a survey-based questionnaire that will be distributed to industry and professional respondents. After that, we'll have a focus group with subject matter experts to triangulate the mitigation strategy for overcoming the coomunication issues in GSD.

3.5 Verification and Validation

The communication issues that might impact global software development that we will discover from the literature review will be discussed in this section. We will verify them by conducting a survey of experts and industry representatives.

Then, using triangulation, we will validate those communication issues and the mitigation strategy by holding a focus group.

3.5.1 Quantitative Validation

Quantitative validations are used to quantify communication issues that have an impact on GSD. We'll use triangulation to validate the focus group results in this section.

3.5.2 Qualitative Validation

To measure communication issues that affect GSD, qualitative validations are used. In this section, we'll conduct verification to confirm the findings of the literature review and survey.

3.6 Summary

In this part, we have gone through the research methods in great depth. In this section, we've discussed our research approach, including how we'll conduct our study utilizing a mixed research methodology that combines qualitative and quantitative research approaches. We detailed the survey and focus group techniques, sample size, respondents' profile for survey, Survey Medium, Survey Instrument (Questionnaire), Response format, Justification for Survey, Focused Group, Respondent's profile for focused group, Sample Size and justification of focus group, So, in this chapter, we've covered all of the research activities and strategies that will be used to carry out our research.

CHAPTER 4

DATA COLLECTION AND ANALYSIS

4.1 Overview

Survey research is defined as a study of broad and smaller groups using samples drawn from the target population to determine relative incidence, distribution, and interrelationships. We will be using survey-based questionnaire for data collection method. The survey will be distributed to the respondents and each response will have evaluated it. Using the software, the responses will be validated and evaluated. The questionnaire will be adapted with changes implemented according to the requirement. Moreover, the adapted changes are tested for validity and the instruments items were selected only after the they will be validated [84]

To conduct the current study, we used SRS (Simple Random Selection) sampling technique as the sampling technique. 258 respondents were contacted and asked to voluntarily participate in the study. We will collect the data from team members and managers in middle, and upper management of organizations. The technique is consistent with the previous studies. We contend that the participants chosen for this study are typical of our target demographic. We first explained our goal of the study and why we are conducting this current study in the software industry. We then asked the respondents to voluntarily participate in the survey. We will calculate the response rate of the study by comparing voluntarily involved and non-involved respondents [85].

4.2 Survey Results

The survey consists of three major sections i.e.

- ✓ Section 1 have Demographic Information of respondents
- ✓ Section 2 related with 1st research question i.e., RQ-1 What are the communication issues that can affect on Global Software development?
- ✓ Section 3 relates with2nd research question i.e., RQ-2 What are the mitigation strategies for identified communication issues in Global Software Development?

4.2.1 Section 1; Demographic Information

The demographic information contains the following information of the respondents.

- ✓ Email
- ✓ Name
- ✓ Age
- ✓ Gender
- ✓ Education
- ✓ Company Name
- ✓ Designation
- ✓ Work Experience
- ✓ Project Nature

But we can explain here some of the demographic information of the respondent.

4.2.1.1 Gender

The below table 4.1 indicates the occurrence of the respondents by gender. Out of the total 258 respondents, 183 or 70.9% were male and 75 or 29.1% were female.

Table 4.1: Gender Analysis

Gender	Respondent (258)	Percentages
Male	183	70.9%
Female	75	29.1%

The graphical representation of gender analysis can be show in figure 4.1.

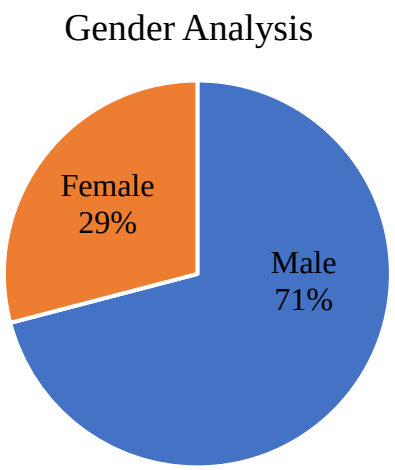


Figure 4.1: Gender Analysis

4.2.1.2 Education

The below table 4.2 indicates the occurrence of the respondents by education. Out of the total 258 respondents, 6 or 2.3% have PhD Qualification, 92 or 35.7% were Masters

Qualification, 152 or 58.9% have Bachelors Qualification, 6 or 2.3% have Diploma Holders and 2 or0.8% have High School Qualifications.

Table 4.2: Education Analysis

Education Qualification	Respondent (258)	Percentages
PHD	6	2.3%
Masters	92	35.7%
Bachelors	152	58.9%
Diploma Holders	6	2.3%
High School	2	0.8%

The graphical representation of education analysis can be shown in figure 4.2.

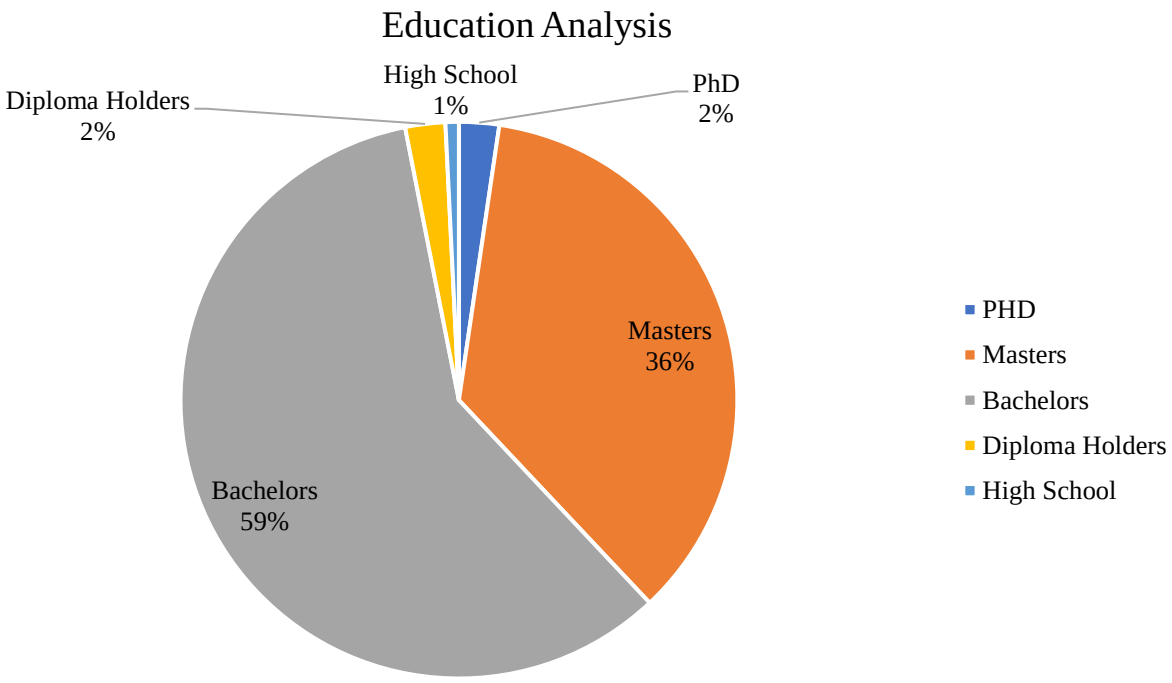


Figure 4.2: Education Analysis

4.2.1.3 Work Experience

The below table 4.3 indicates the occurrence of the respondents by their professional experience. Out of the total 258 respondents, 22 or 8.5% have Less than one year experience, 74 or 28.7% have 1 - 3 years' experience, 65 or 25.2% have 4 - 7 years' experience and 97 or 37.6% have more than 7 years' experience.

Table 4.3: Work Experience Analysis

Work Experience	Respondent (258)	Percentages
Less than 1 year	22	8.5%
1 – 3 years	74	28.7%
4 – 7 years	65	25.2%
More than 7 years	97	37.6%

The graphical representation of work experience analysis can be shown in figure 4.3.

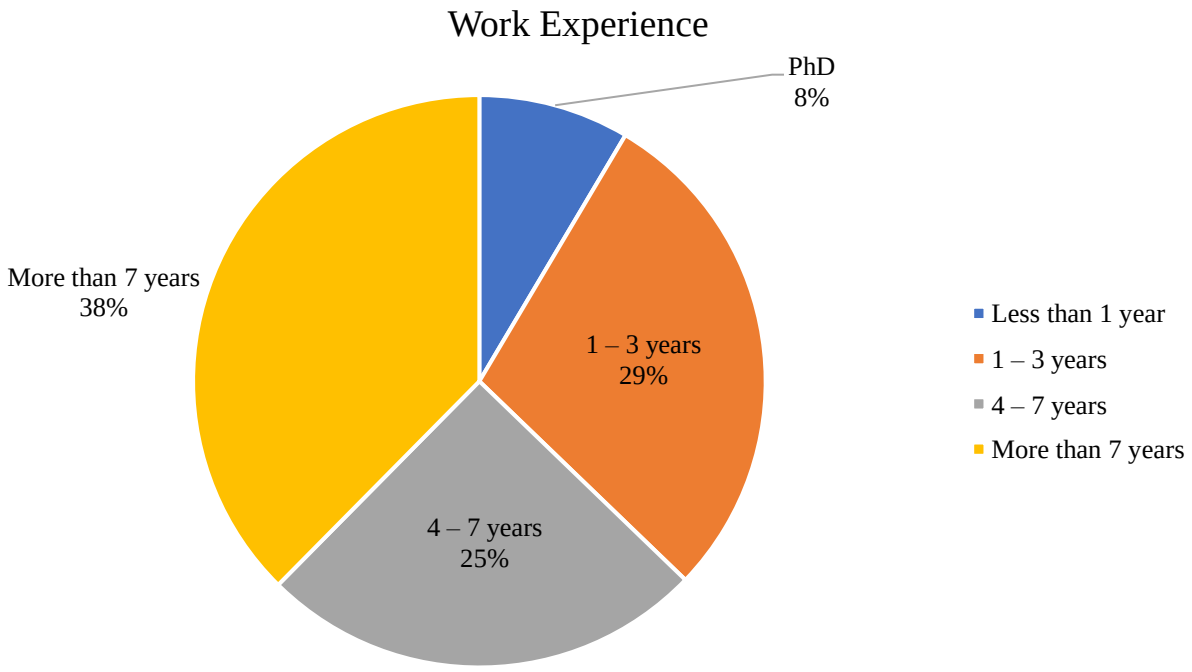


Figure 4.3: Work Experience Analysis

4.2.2 Section 2; Research Question 1

We can collect data from respondent and analyze them. First of all, we identified that 8 major communications and their 35 respective factors that ca cause these major issues. 8 major issues and their respective 35 factors can be displays in given below table 4.4.

Table 4.4: Major issues with their respective factors

Major Communication Issues	**Factors that arise these communication issues**
Geographical Distance [86]	1. Lack of face-to-face meetings [87] 2. Lack of trust [88] 3. Lack of informal communication [89] 4. Loss of data during transfer [56] 5. Increased cost and effort to initiate contact [90] 6. Lack of interpersonal relationships / Conflict Management [91] 7. Increase in Logistics for travelling [92]
Temporal Distance [93]	1. Time zone differences [94] 2. Reduced opportunities for synchronous communication [95] 3. Delayed in response/feedback [96] 4. Improper selection of Technology [70] 5. Less time overlapping [97] 6. Reduced communication frequency [98] 7. Inadequate communication [99]
Socio-Cultural Distance [100]	1. Cultural differences [101] 2. Language difference/ Poor business language skills [102] 3. Lack of mutual understanding [103] 4. Different project background [104]
Team Member's Attitude [105]	1. Inability to see the Problems [106] 2. Inability to Effective Communication [107]

Technical Issue [108]	1. Connectivity issues that hinder communication [109] 2. Limited infrastructure, tools, and Techniques [110] 3. Low quality of telecommunication bandwidth [111] 4. Lack of ICT /technological cohesion [112] 5. Technical incompatibilities [113]
Team Issues [114]	1. Lack of Coordination among team members [115] 2. Difficulty in distribution of team or task [116] 3. Insufficient knowledge transfer [117] 4. Large Team size [118] Loss of team spirit [119]
Organizational & Architectural Issues [120]	1. Lack of uniform processes [121] 2. Lack of management commitments [122] Lack of appropriate architecture [123]
Customer Issues [124]	1. Lack of customer involvement [125] Miscommunication of customer requirements [126]

Then we look at how many people can respond Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree to each issue on the Likert scale [62]. We can use a Likert scale with values ranging from “2 to -2.

Table 4.5: Assign values of Likert scale from "2 to -2"

Likert Scale	**Assign Values**
Strongly Agree	2
Agree	1
Neutral	0
Disagree	-1
Strongly Disagree	-2

After that we can represent all values in table form multiply Likert scale values in given below form

- ✓ Strongly Agree responses multiply with 2 (Strongly Agree * 2)
- ✓ Agree responses multiply with 1 (Agree * 1)
- ✓ Neutral responses multiply with 0 (Neutral * 0)
- ✓ Disagree responses multiply with -1 (Disagree * -1)
- ✓ Strongly Disagree responses multiply with -2 (Strongly Disagree * -2)

Then we can calculate weighted values as sum of all values

Total = [(Strongly Agree * 2) + (Agree * 1) + (Neutral * 0) + (Disagree * -1) + (Strongly Disagree * -2)]

And all of the computations may be written in table as well as the total values by adding all of the values in a row, as seen in the table 4.6.

Table 4.6: Results of responses from survey

No	Factors	SA (2)	A (1)	N (0)	DA (-1)	SDA (-2)	Total (258)
1	Geographical Distance	174	135	0	14	10	285
2	Temporal Distance	236	86	0	-29	-10	283
3	Socio-cultural Distance	186	104	0	-25	-10	255
4	Team Member's Attitude	190	111	0	-31	-4	266
5	Technical issues	214	94	0	-23	-10	275
6	Team issues	198	106	0	-19	-8	277
7	Organizational & Architectural issues	206	109	0	-19	-10	286
8	Customer issues	218	99	0	-17	-16	284
Geographical Distance							
1	Lack of Face-to-Face Meetings.	246	89	0	-25	-8	202
2	Lack of Trust.	162	128	0	-21	-10	259
3	Lack of Informal Communication.	166	130	0	-18	-12	266
4	Loss of Data during transfer.	228	99	0	-28	-4	295
5	Increased cost and logistics of holding face meetings.	188	97	0	-45	-8	232
6	Lack of interpersonal relationships.	208	89	0	-29	-6	262

7	Increase effort to initiate contact.	194	92	0	-44	-14	228
Temporal Distance							
1	Time zone differences.	230	73	0	-28	-14	261
2	Reduced opportunities for synchronous communication.	206	80	0	-35	-10	241
3	Delayed in response / feedback.	218	99	0	-25	-8	284
4	Improper selection of Technology.	234	79	0	-35	-16	262
5	Less time overlapping.	224	84	0	-29	-18	261
6	Reduced communication frequency.	204	91	0	-29	-8	258
7	Inadequate communication.	194	83	0	-46	-12	219
Socio-cultural Distance							
1	Cultural differences.	210	96	0	-35	-6	265
2	Language difference/ Poor business language skills	202	95	0	-26	-14	257
3	Lack of mutual understanding.	218	91	0	-24	-10	275
4	Different project background.	256	81	0	-28	-8	301
Team Member's Attitude							
1	Inability to see the Problems.	166	66	0	-45	-22	165
2	Inability to Effective Communication.	224	81	0	-32	-14	259
Technical issues							
1	Connectivity issues that hinder communication.	224	81	0	-37	-8	260
2	Limited infrastructure, tools, and Techniques.	220	93	0	-33	-22	258
3	Low quality of telecommunication bandwidth.	202	107	0	-35	-10	264
4	Lack of ICT /technological cohesion.	216	91	0	-29	-22	256
5	Technical incompatibilities.	212	64	0	-47	-26	203
Team issues							
1	Lack of Coordination among team members.	228	89	0	-39	-10	268
2	Difficulty in distribution of team or task.	210	96	0	-41	-12	253
3	Insufficient knowledge transfer.	212	71	0	-58	-20	205
4	Large Team size.	208	98	0	-19	-18	269
5	Loss of team spirit.	246	79	0	-41	-6	278
Organizational & Architectural issues							
1	Lack of uniform processes.	272	56	0	-60	-4	264
2	Lack of management commitments.	214	92	0	-25	-14	267
3	Lack of appropriate architecture.	174	67	0	-55	-22	164
Customer issues							
1	Lack of customer involvement.	232	81	0	-34	-8	271
2	Miscommunication of customer requirements.	242	87	0	-38	-10	281

4.2.3 Section 3; Research Question 2

We can find mitigation strategies by conducting SLR and then we can validate our finding from SLR by conducting a survey. The appropriate mitigation strategies can be found through SLR can be shown given below:

Table 4.7: Appropriate Mitigation Strategies

Appropriate Mitigation Strategies	
Geographical Distance Related Issues	**Temporal Distance Related Issues**
1. Adopt Latest Technologies such as videoconferencing, Data Conferencing and web-based technologies. 2. Promote Synchronous (video) and Asynchronous (text) Communication. 3. Central data Sharing Point (Central Version Control System). 4. Onsite Management visits and Traveling Steering Groups. 5. Interact with team regularly and establish a Strategies for Trust building. 6. Increase frequency of communication among team members. 7. Early identification of Dependencies and their management and early estimation of cost and effort. 8. The teams should focus strongly on formal as well as informal communication modes to share feedback/project progress.	1. Presentation of Agile Customer. 2. Periodic meeting and use of instant messenger. 3. Allow Flexible hours and allocate tasks to respective team to increase productivity. 4. Be online and stay connected with their office management. 5. Adopt Agile Practices such as SCRUM (daily & schedule meeting). 6. Use RAD tools to ensure frequent deliveries. 7. Schedule training workshops on how to use synchronous and asynchronous communication tools effectively. 8. Use high bandwidth technology and voice communication. 9. Teams should coordinate and setup meeting time that is convenient for all the teams involved from different geographical regions.
Socio-Cultural Distance Issues	**Team Member's Attitude Issues**
1. Arrange trainings on cultural awareness. 2. Forigen Language course and Appoint language translation. 3. Friendly Interaction between team members and mutual respect for each other. 4. Using Agile methods to reduced cultural distance and increase Project Manager domain knowledge. 5. Present Cultural liaisons and Eliminate Ambiguity.	1. Use of Effective communication tools and techniques. 2. Encourage training of remote team members in order to build effective communication and resolve behavioral issues between team members. 3. Ensure Project Manager can understand the problem faced by lower-level staff.

6. Common communication language should be adopted by all the team members that can be understood by all.	
Technical Related Issues	**Team Related Issues**
1. ICT training sessions for new employees. 2. For IT service management, conform to ISO standards and the ITIL framework. 3. Upgrade IT infrastructure. 4. Use high quality of telecommunication bandwidth and teleconferencing. 5. Adopt Distributed Agile methods such as Distributed Pair Programming & Urgent Requests.	1. Define role and responsibilities of all members clearly. 2. SCRUM meetings to verify that everyone on the team is on the same page. 3. Provide personnel bonuses and incentives to boost team spirit. 4. To increase cooperation, break down large projects into smaller, manageable tasks. 5. Arrange daily status meeting and send status updates electronically. 6. Information/knowledge transfer seminars for new employees. 7. Issues regarding team members should be brought in the notice of team leader for further resolution.
Organizational & Architectural Related Issues	**Customer Related Issues**
1 Creating a consistent development environment across all locations. 2 All stakeholders are aware of process. 3 Keep adequate records for any frequent changes. 4 Create an organizational hierarchy model that is understood by all employees. 5 Encourage both horizontal and vertical mobility inside the organization.	1. Project Outcome & delivery dates awareness. 2. Set up a meeting with the customer to involve them in the entire process. 3. Conduct a customer survey to learn more about their needs and enhance operations. 4. Use prototyping tools to extract more consumer requirements. 5. Follow requirement engineering process (Elicitation, Analysis, Documentation & Validation).

4.3 Results from Weightage Values

The Weighted values are those values that we can be calculated after all the data collection through survey. We collect data and enter all the responses in software and then perform analysis on collected data. We can convert all the values in Likert scale as we can represent in table 4.6.

For finding out the accepted or rejected factors we can divide the total values of table 4.6 by total number of respondents and calculate the avg weighted values by applying this formula

Avg Weighted values = Total weighted values / Total respondents (258)

Table 4.8: Average Weighted values

No	Factors	Weightage Values	Avg. Weightage Responses
1	Geographical Distance	285	1.1046511628
2	Temporal Distance	283	1.0968992248
3	Socio-cultural Distance	255	0.988372093
4	Team Member's Attitude	266	1.0310077519
5	Technical issues	275	1.0658914729
6	Team issues	277	1.0736434109
7	Organizational & Architectural issues	286	1.1085271318
8	Customer issues	284	1.1007751938
Geographical Distance			
1	Lack of Face-to-Face Meetings.	302	1.1705426357
2	Lack of Trust.	259	1.003875969
3	Lack of Informal Communication.	266	1.0310077519
4	Loss of Data during transfer.	295	1.1434108527
5	Increased cost and logistics of holding face-to-face meetings.	232	0.8992248062
6	Lack of interpersonal relationships.	262	1.015503876
7	Increase effort to initiate contact.	228	0.8837209302
Temporal Distance			
1	Time zone differences.	261	1.011627907
2	Reduced opportunities for synchronous communication.	241	0.9341085271
3	Delayed in response / feedback.	284	1.1007751938
4	Improper selection of Technology.	262	1.015503876
5	Less time overlapping.	261	1.011627907
6	Reduced communication frequency.	258	1
7	Inadequate communication.	219	0.8488372093
Socio-cultural Distance			
1	Cultural differences.	265	1.0271317829
2	Language difference/ Poor business language skills.	257	0.996124031
3	Lack of mutual understanding.	275	1.0658914729

4	Different project background.	301	1.1666666667
Team Member's Attitude			
1	Inability to see the Problems.	165	0.6395348837
2	Inability to Effective Communication.	259	1.003875969
Technical issues			
1	Connectivity issues that hinder communication.	260	1.007751938
2	Limited infrastructure, tools, and Techniques.	258	1
3	Low quality of telecommunication bandwidth.	264	1.023255814
4	Lack of ICT /technological cohesion.	256	0.992248062
5	Technical incompatibilities.	203	0.7868217054
Team issues			
1	Lack of Coordination among team members.	268	1.0387596899
2	Difficulty in distribution of team or task.	253	0.980620155
3	Insufficient knowledge transfer.	205	0.7945736434
4	Large Team size.	269	1.0426356589
5	Loss of team spirit.	278	1.0775193798
Organizational & Architectural issues			
1	Lack of uniform processes.	264	1.023255814
2	Lack of management commitments.	267	1.0348837209
3	Lack of appropriate architecture.	164	0.6356589147
Customer issues			
1	Lack of customer involvement.	271	1.0503875969
2	Miscommunication of customer requirements.	281	1.0891472868

4.3.1 Cronbach Alpha

Now we can find Cronbach's alpha value [127] from survey data by applying the give formula.

FORMULA OF CRONBACH ALPHA = [(Total no of question / Total no of question - 1) * (1 - (Sum of Variance / Total Variance))]

We can find value of Cronbach alpha [128] that is **0.981626871.** Now we can perform more calculations and find how many major issues are accepted and rejected and how many their respective factors that arises communication issues in GSD are accepted or rejected.

We can express accepted or rejected on behalf of Avg weighted values. We may look at the average weighted value and determine whether it is accepted or rejected. If the average weighted value is larger than Cronbach's alpha value, it is accepted; if it is less than Cronbach's alpha value, it is rejected.

Table 4.9: Accepted or rejected values

No	Factors	Weightage Values	Avg. Weightage Responses	Results
1	Geographical Distance	285	1.1046511628	Accepted
2	Temporal Distance	283	1.0968992248	Accepted
3	Socio-cultural Distance	255	0.988372093	Accepted
4	Team Member's Attitude	266	1.0310077519	Accepted
5	Technical issues	275	1.0658914729	Accepted
6	Team issues	277	1.0736434109	Accepted
7	Organizational & Architectural issues	286	1.1085271318	Accepted
8	Customer issues	284	1.1007751938	Accepted
Geographical Distance				
1	Lack of Face-to-Face Meetings.	302	1.1705426357	Accepted
2	Lack of Trust.	259	1.003875969	Accepted
3	Lack of Informal Communication.	266	1.0310077519	Accepted
4	Loss of Data during transfer.	295	1.1434108527	Accepted
5	Increased cost and logistics of holding face-to-face meetings.	232	0.8992248062	Rejected
6	Lack of interpersonal relationships.	262	1.015503876	Accepted
7	Increase effort to initiate contact.	228	0.8837209302	Rejected
Temporal Distance				
1	Time zone differences.	261	1.011627907	Accepted
2	Reduced opportunities for synchronous communication.	241	0.9341085271	Rejected
3	Delayed in response / feedback.	284	1.1007751938	Accepted
4	Improper selection of Technology.	262	1.015503876	Accepted
5	Less time overlapping.	261	1.011627907	Accepted
6	Reduced communication frequency.	258	1	Accepted
7	Inadequate communication.	219	0.8488372093	Rejected
Socio-cultural Distance				
1	Cultural differences.	265	1.0271317829	Accepted

2	Language difference/ Poor business language skills.	257	0.996124031	Accepted
3	Lack of mutual understanding.	275	1.0658914729	Accepted
4	Different project background.	301	1.1666666667	Accepted
Team Member's Attitude				
1	Inability to see the Problems.	165	0.6395348837	Rejected
2	Inability to Effective Communication.	259	1.003875969	Accepted
Technical issues				
1	Connectivity issues that hinder communication.	260	1.007751938	Accepted
2	Limited infrastructure, tools, and Techniques.	258	1	Accepted
3	Low quality of telecommunication bandwidth.	264	1.023255814	Accepted
4	Lack of ICT /technological cohesion.	256	0.992248062	Accepted
5	Technical incompatibilities.	203	0.7868217054	Rejected
Team issues				
1	Lack of Coordination among team members.	268	1.0387596899	Accepted
2	Difficulty in distribution of team or task.	253	0.980620155	Accepted
3	Insufficient knowledge transfer.	205	0.7945736434	Rejected
4	Large Team size.	269	1.0426356589	Accepted
5	Loss of team spirit.	278	1.0775193798	Accepted
Organizational & Architectural issues				
1	Lack of uniform processes.	264	1.023255814	Accepted
2	Lack of management commitments.	267	1.0348837209	Accepted
3	Lack of appropriate architecture.	164	0.6356589147	Rejected
Customer issues				
1	Lack of customer involvement.	271	1.0503875969	Accepted
2	Miscommunication of customer requirements.	281	1.0891472868	Accepted

The graphical representation of acceptance and rejected factors can be shown below in figure 4.4:

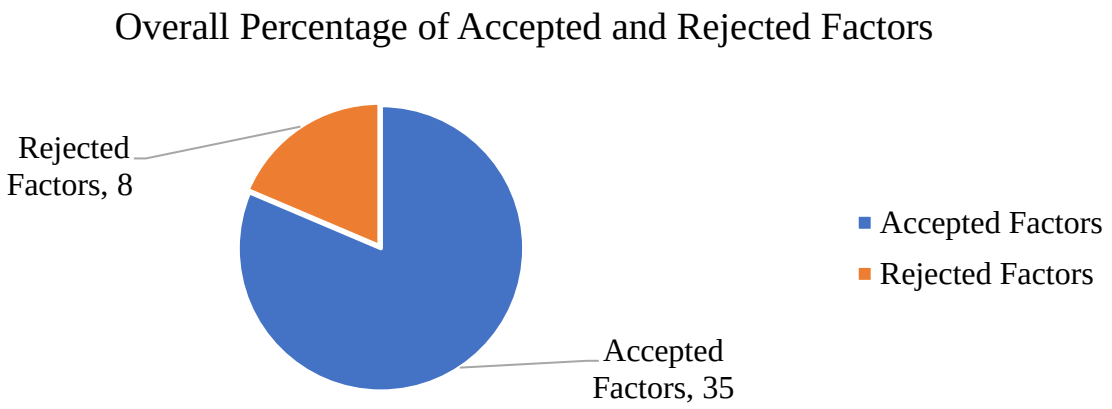


Figure 4.4: Acceptance and Repentance Factors

4.4 Result explanation

After calculate the value of Cronbach alpha [129] we can see that all 8 major issues are accepted and out of 35 arising factors 27 are accepted and 8 are rejected that can be show in figure 4.4.

4.4.1 Low significance factors

The rejected 8 factors that arise the communication issues in global software development are low significance that can be explained in given below:

In Geographical Distance the Increased cost and logistics of holding face-to-face meetings and Increase effort to initiate contact are low significance because in travelling and start of contract have spent a lot of money that can be managed not easily so the respondent can be rejected.

In Temporal Distance the Reduced opportunities for synchronous communication and Inadequate Communication are rejected from respondent because their Avg weighted value is less than Cronbach alpha value.

In Team Members Attitude the Inability to see the Problems are rejected because in a company a manager cannot handle all the problem in a same time so the respondents can reject it.

In Technical Related-issues the Technical incompatibilities are rejected due to no satisfied the technical link between the employee and the company so respondents can be rejected it.

In Team Related-issues Insufficient knowledge transfer is rejected because the knowledge transfer is very difficult task in companies and most of the team members cannot use effective way to transfer knowledge so they can reject it.

In Organizational & Architectural issues the Lack of appropriate architecture is rejected due to many companies' have-not proper architecture to solve the problems so respondents can reject it.

In general, we can write all the low significance factors in a table 4.10:

Table 4.10: Low Significance Factors

Geographical Distance
1. Increased cost and logistics of holding face-to-face meetings **2.** Increase effort to initiate contact
Temporal Distance
1. Reduced opportunities for synchronous communication 2. Inadequate Communication
Team Members Attitude
1. Inability to see the Problems
Technical issues
1. Technical incompatibilities
Team issues
1. Insufficient knowledge transfer
Organizational & Architectural issue
1. Lack of appropriate architecture

4.4.2 High Significance factors

The accepted values are high significance factors because the respondents can agree and strongly agree with these statements so their avg weighted value is greater than Cronbach alpha value so they are accepted and have high significance factors. The high significance factors can be shown in given below table 4.11:

Table 4.11: High Significance Factors

8 Major Communication Issues are Accepted	27 accepted Respective Factors that arise these communication issues
Geographical Distance	1. Lack of face-to-face meetings. 2. Lack of trust. 3. Lack of informal communication. 4. Loss of data during transfer. 5. Lack of interpersonal relationships / Conflict Management.
Temporal Distance	1. Time zone differences. 2. Delayed in response/feedback. 3. Improper selection of Technology. 4. Less time overlapping. 5. Reduced communication frequency.
Socio-Cultural Distance	1. Cultural differences. 2. Language difference/ Poor business language skills. 3. Lack of mutual understanding. 4. Different project background.
Team Member's Attitude	1. Inability to Effective Communication.
Technical Issue	1. Connectivity issues that hinder communication. 2. Limited infrastructure, tools, and Techniques. 3. Low quality of telecommunication bandwidth. 4. Lack of ICT /technological cohesion.
Team Issues	1. Lack of Coordination among team members. 2. Difficulty in distribution of team or task. 3. Large Team size. 4. Loss of team spirit.
Organizational & Architectural Issues	1. Lack of uniform processes. 2. Lack of management commitments.
Customer Issues	1. Lack of customer involvement. 2. Miscommunication of customer requirements.

The graphical representation of Low Significance factors and High Significance factors can be shown in figure 4.5.

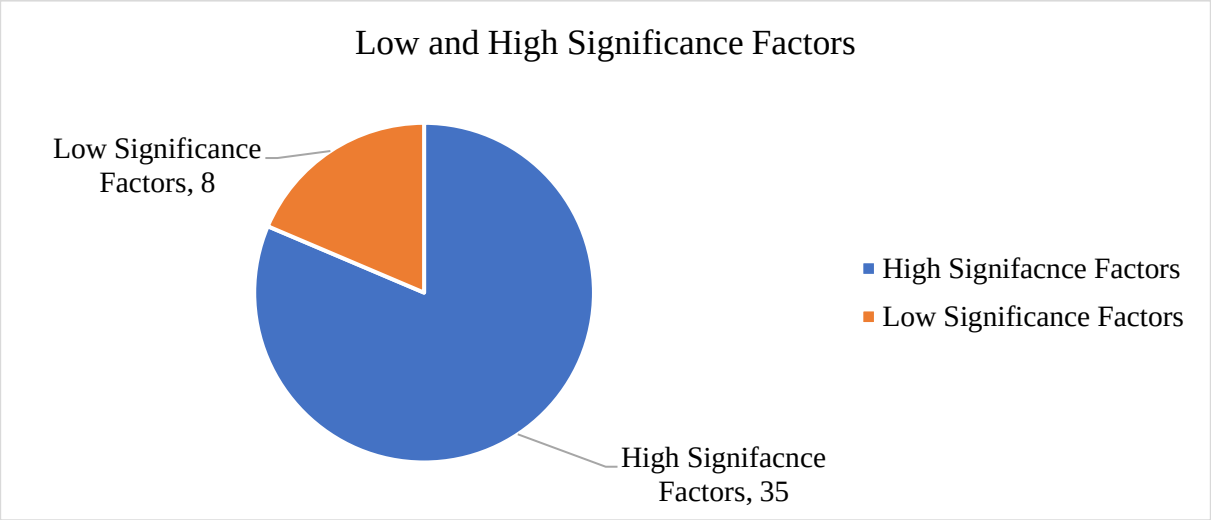


Figure 4.5: Low and High Significance Factors

4.5 Focus Group Results

A focus group is a small group of carefully selected people who participate in open research sessions. Respondents for the research are carefully chosen by the hosting organization to represent the larger community they are seeking to reach.

To generalize the reactions of the overall population, the group can look at new goods, feature improvements, or other areas of interest. A moderator is present during focus group study. Their role is to guarantee that the results are valid and that the conversations are free of bias.

Ernest Dichter, a marketing and psychological expert, developed the term "Focus Group" in 1991. The word referred to meetings with a small number of people with the goal of having a conversation.

In qualitative research, we engage a focus group. A group of 6-10 persons, generally 8, gets together to learn about and examine an innovative product. The group discusses the topic and contributes their thoughts, ideas, information, and insights.

Participants freely communicate their thoughts and are free to persuade others to agree with them. The mediator makes records on the group's conversation and viewpoints. Because the participants of our focus group have an impact on the outcomes, it's critical to choose carefully.

Focus groups have a particular edge over all other types of marketing research. They take advantage of the moderator's ability to communicate with respondents as well as his or her flexibility in moving the debate along. It helps us to glean useful information and perspectives. The group's goal isn't to reach a consensus or agreement on the subject. Rather, it aims to discover and comprehend client views of a brand, product, or services.

We conduct a focus group for validating the following mitigation strategies that we can be identified from literature and conduct a survey on it and final results of survey w.r.t respondent responses are given below:

4.5.1 Tabulation Representation of Appropriate Mitigation Strategies

The mitigation strategies all major communication issues that can affect on GSD can be identified from SLR and then validate from respondent by conducting a survey and after that validate the survey responses by conducting focus group. The survey results of mitigation strategies can be shown in table 4.12.

Table 4.12: Mitigation Strategies according to percentage occurrence

Appropriate Mitigation Strategies	**Respondent Response**	**Percentage 100%**
Geographical Distance Related Issues		
Adopt Latest Technologies such as videoconferencing, Data Conferencing and web-based technologies.	49	19%

Promote Synchronous (video) and Asynchronous (text) Communication.	35	13.60%
Central data Sharing Point (Central Version Control System).	35	13.60%
Onsite Management visits and Traveling Steering Groups.	28	10.90%
Interact with team regularly and establish a Strategies for Trust building.	42	16.30%
Increase frequency of communication among team members.	40	15.50%
Early identification of Dependencies and their management and early estimation of cost and effort.	28	10.90%
The teams should focus strongly on formal as well as informal communication modes to share feedback/project progress.	1	0.40%
Temporal Distance Related Issues		
Presentation of Agile Customer.	28	10.90%
Periodic meeting and use of instant messenger.	52	20.20%
Allow Flexible hours and allocate tasks to respective team to increase productivity.	76	29.50%
Be online and stay connected with their office management.	39	15.10%
Adopt Agile Practices such as SCRUM (daily & schedule meeting).	21	8.10%
Use RAD tools to ensure frequent deliveries.	17	6.60%
Schedule training workshops on how to use synchronous and asynchronous communication tools effectively.	13	5%
Use high bandwidth technology and voice communication.	11	4.30%
Teams should coordinate and setup meeting time that is convenient for all the teams involved from different geographical regions.	1	0.40%
Socio-Cultural Distance Issues		
Arrange trainings on cultural awareness.	37	14.30%
Forigen Language course and Appoint language translation.	42	16.30%
Friendly Interaction between team members and mutual respect for each other.	86	33.30%
Using Agile methods to reduced cultural distance and increase Project Manager domain knowledge.	64	24.80%
Present Cultural liaisons and Eliminate Ambiguity.	28	10.90%
Common communication language should be adopted by all the team members that can be understood by all.	1	0.40%
Team Member's Attitude Issues		
Use of Effective communication tools and techniques.	60	23.30%
Encourage training of remote team members in order to build effective communication and resolve behavioral issues between team members.	79	30.60%
Ensure Project Manager can relate to the problem of lower-level employees.	119	46.10%
Technical Related Issues		
ICT training sessions for new employees.	42	16.30%
For IT service management, conform to ISO standards and the ITIL framework.	51	19.80%

Upgrade IT infrastructure.	70	27.10%
Use high quality of telecommunication bandwidth and teleconferencing.	46	17.80%
Adopt Distributed Agile methods such as Distributed Pair Programming & Urgent Requests.	49	19%
Team Related Issues		
Define role and responsibilities of all members clearly.	37	14.30%
SCRUM meetings to verify that everyone on the team is on the same page.	56	21.70%
Provide personnel bonuses and incentives to boost team spirit.	58	22.50%
To increase cooperation, break down large projects into smaller, manageable tasks.	49	19%
Arrange daily status meeting and send status updates electronically.	32	12.40%
Knowledge/data transfer sessions for new staff.	25	9.70%
Organizational & Architectural Related Issues		
Creating a consistent development environment across all locations.	39	15.10%
All stakeholders are aware of process.	55	21.30%
Keep adequate records for any frequent changes.	59	22.90%
Create an *organizational* hierarchy model that is understood by all employees.	46	17.80%
Promote horizontal as well as vertical mobility across the organization domain.	36	14%
Follow standard document and follow single process will all teams.	23	8.90%
Customer Related Issues		
Awareness of Project Outcomes ad delivery dates.	36	14%
Set up a meeting with the customer to involve them in the entire process.	56	21.70%
Conduct a customer survey to learn more about their needs and enhance operations.	73	28.30%
Use prototyping tools to extract more consumer requirements.	55	21.30%
Follow requirement engineering process (Elicitation, Analysis, Documentation & Validation).	38	14.70%

4.5.2 Graphical Representation of Appropriate Mitigation Strategies

The appropriate mitigation strategies of Geographical distance related issues can be represented graphically in figure 4.6. In this graph we can represent Respondent Response on y-axis or vertical axis and appropriate mitigation plan represents on x-axis or horizontal axis.

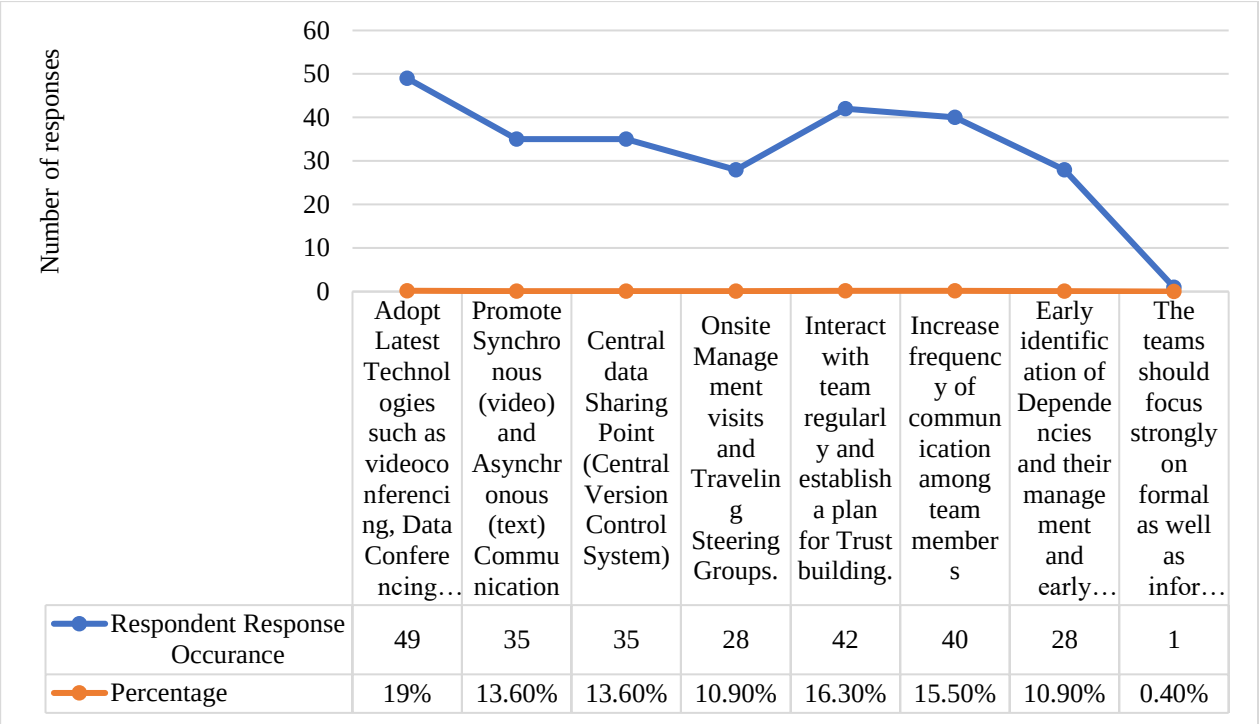


Figure 4.6: Mitigation Strategies of Geographical Distance issues

The appropriate mitigation strategies of Temporal distance related issues can be represented graphically in figure 4.7. In this graph we can represent Respondent Response on y-axis or vertical axis and appropriate mitigation plan represents on x-axis or horizontal axis.

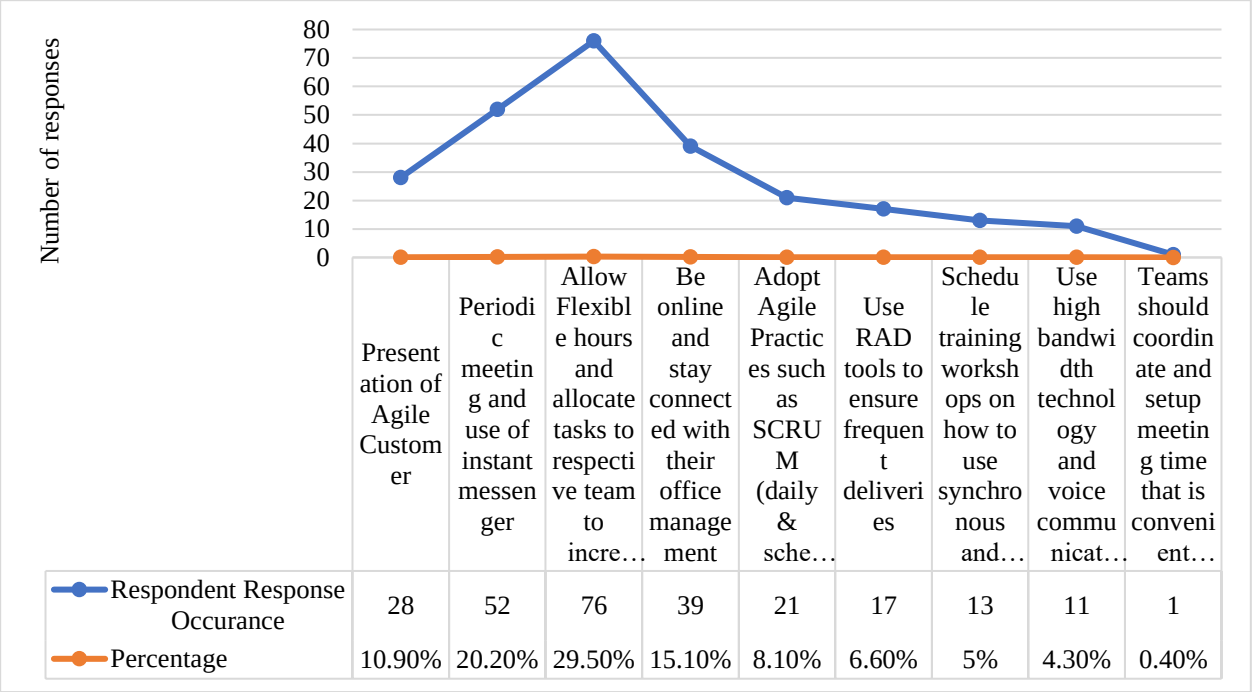
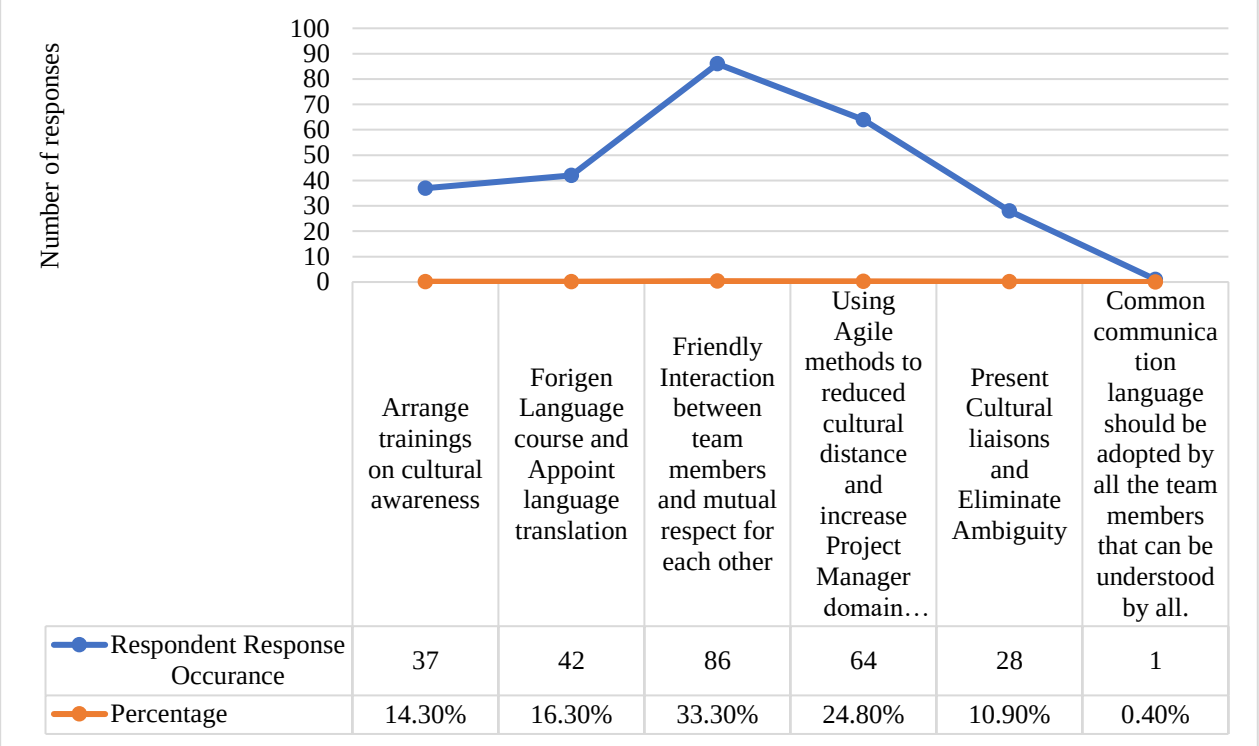


Figure 4.7: Mitigation Strategies of Temporal Distance issues

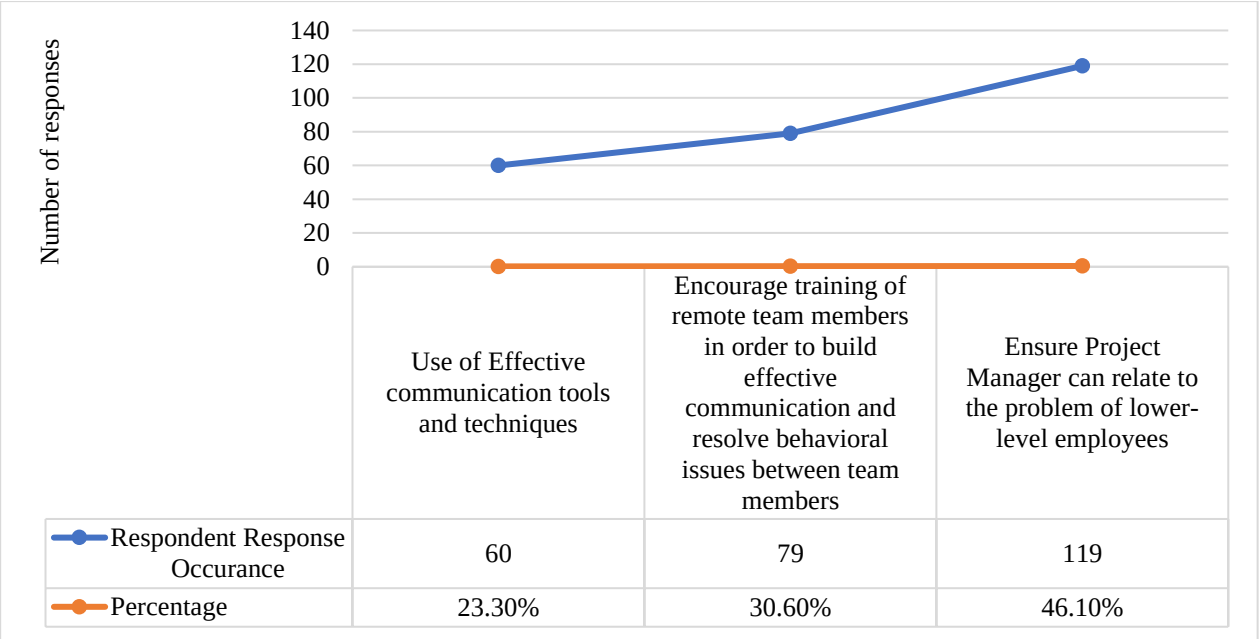
The appropriate mitigation strategies of Socio-Cultural distance related issues can be represented graphically in figure 4.8. In this graph we can represent Respondent Response on y-axis or vertical axis and appropriate mitigation plan represents on x-axis or horizontal axis.



	Arrange trainings on cultural awareness	Forigen Language course and Appoint language translation	Friendly Interaction between team members and mutual respect for each other	Using Agile methods to reduced cultural distance and increase Project Manager domain…	Present Cultural liaisons and Eliminate Ambiguity	Common communication language should be adopted by all the team members that can be understood by all.
Respondent Response Occurance	37	42	86	64	28	1
Percentage	14.30%	16.30%	33.30%	24.80%	10.90%	0.40%

Figure 4.8: Mitigation Strategies of Socio-Cultural Distance issues

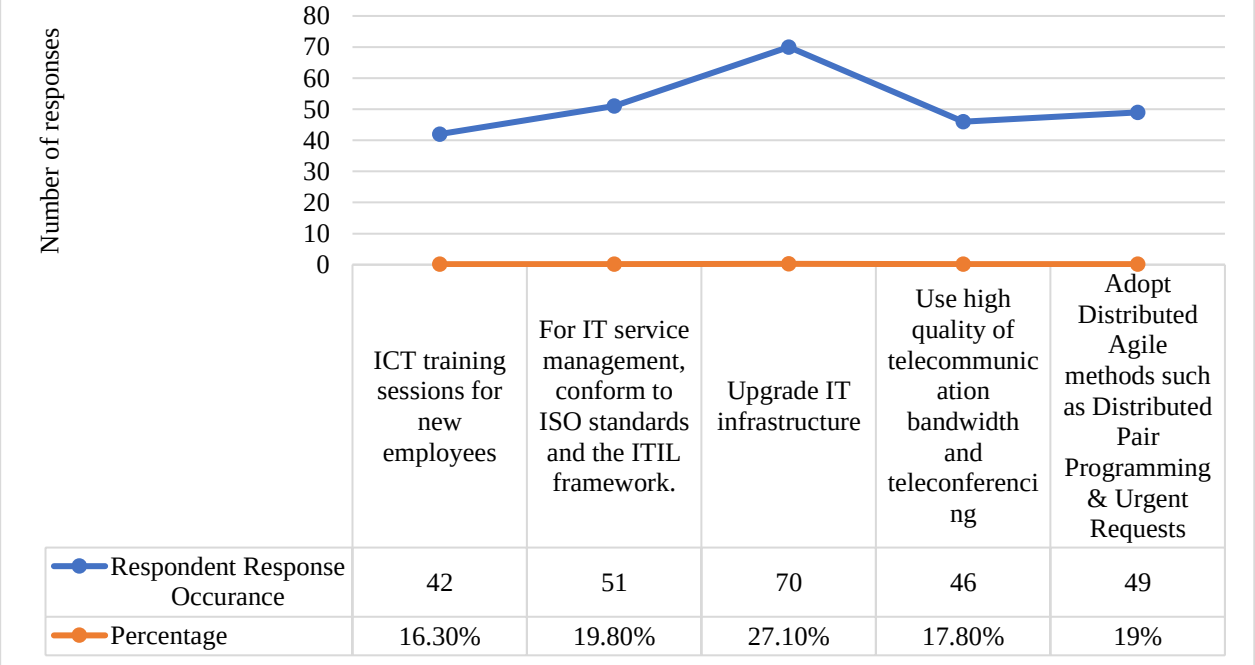
The appropriate mitigation strategies of Team Member's related issues can be represented graphically in figure 4.9. In this graph we can represent Respondent Response on y-axis or vertical axis and appropriate mitigation plan represents on x-axis or horizontal axis.



	Use of Effective communication tools and techniques	Encourage training of remote team members in order to build effective communication and resolve behavioral issues between team members	Ensure Project Manager can relate to the problem of lower-level employees
Respondent Response Occurance	60	79	119
Percentage	23.30%	30.60%	46.10%

Figure 4.9: Mitigation Strategies of Team Member's Attitude related issues

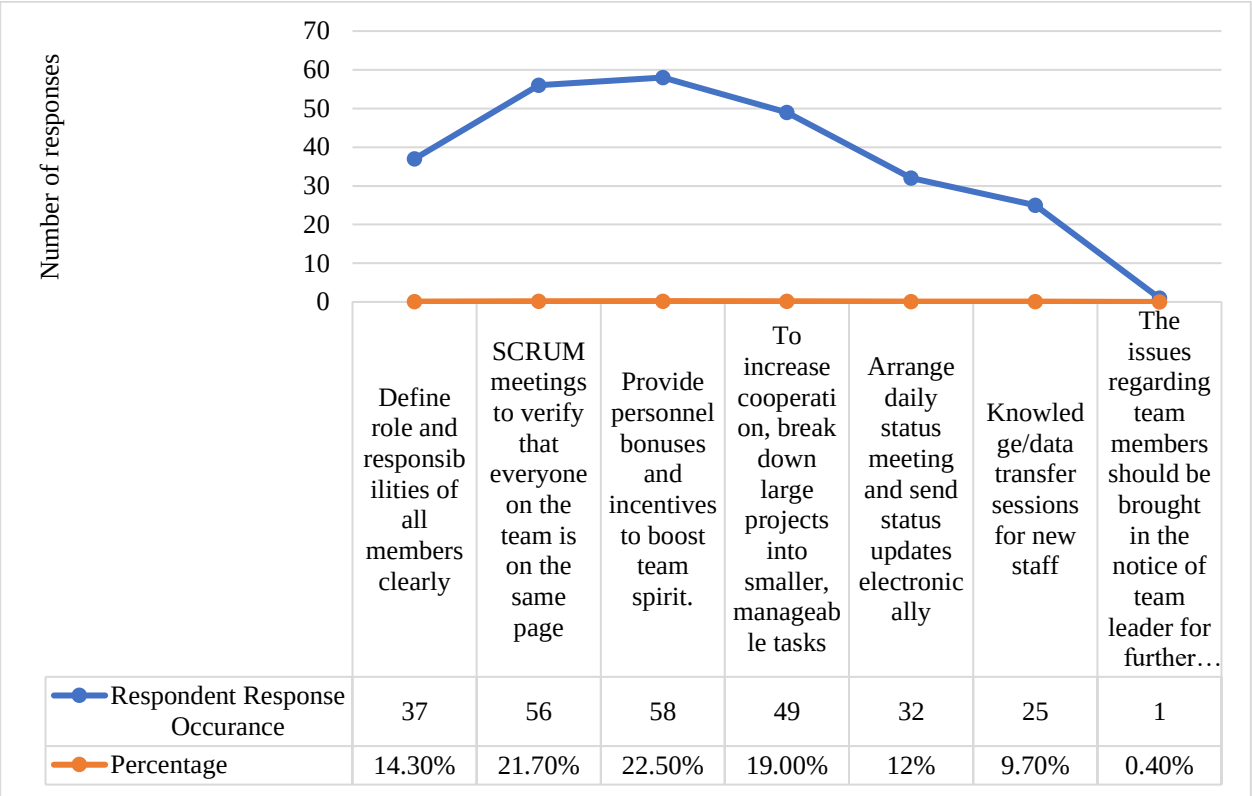
The appropriate mitigation strategies of Technical related issues can be represented graphically in figure 4.10. In this graph we can represent Respondent Response on y-axis or vertical axis and appropriate mitigation plan represents on x-axis or horizontal axis.



	ICT training sessions for new employees	For IT service management, conform to ISO standards and the ITIL framework.	Upgrade IT infrastructure	Use high quality of telecommunication bandwidth and teleconferencing	Adopt Distributed Agile methods such as Distributed Pair Programming & Urgent Requests
Respondent Response Occurance	42	51	70	46	49
Percentage	16.30%	19.80%	27.10%	17.80%	19%

Figure 4.10: Mitigation Strategies of Technical related issues

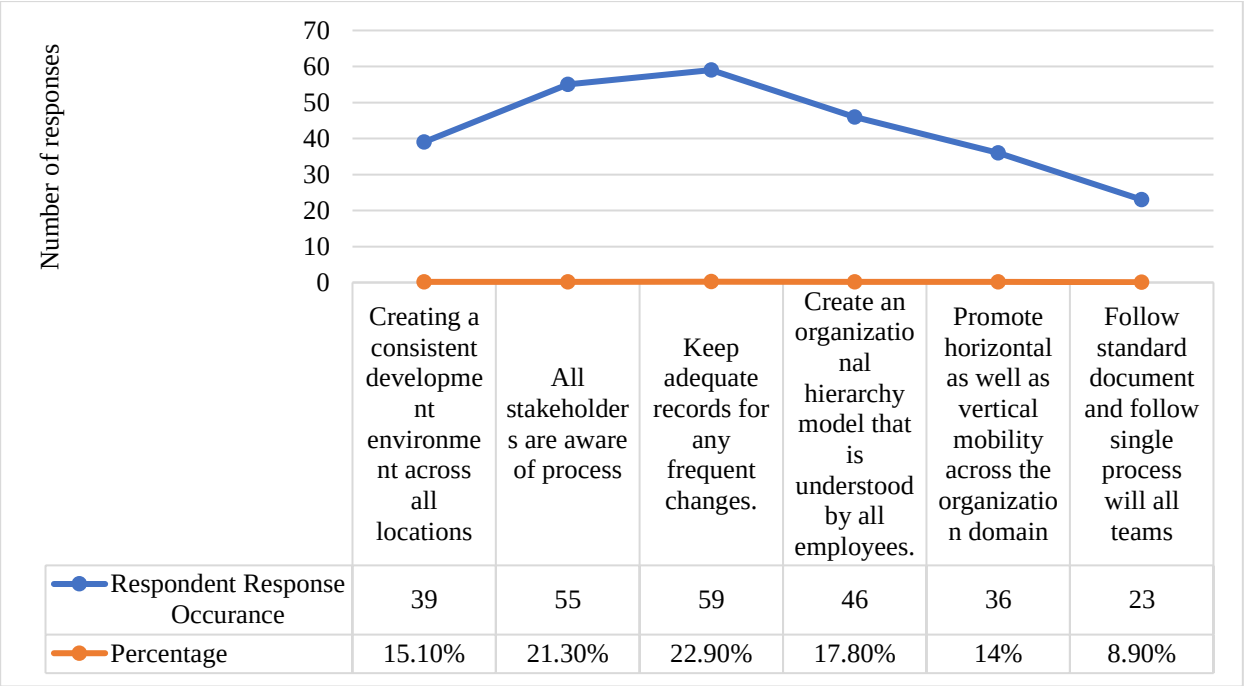
The appropriate mitigation strategies of Team related issues can be represented graphically in figure 4.11. In this graph we can represent Respondent Response on y-axis or vertical axis and appropriate mitigation plan represents on x-axis or horizontal axis.



	Define role and responsibilities of all members clearly	SCRUM meetings to verify that everyone on the team is on the same page	Provide personnel bonuses and incentives to boost team spirit.	To increase cooperation, break down large projects into smaller, manageable tasks	Arrange daily status meeting and send status updates electronically	Knowledge/data transfer sessions for new staff	The issues regarding team members should be brought in the notice of team leader for further…
Respondent Response Occurance	37	56	58	49	32	25	1
Percentage	14.30%	21.70%	22.50%	19.00%	12%	9.70%	0.40%

Figure 4.11: Mitigation Strategies of Team related issues

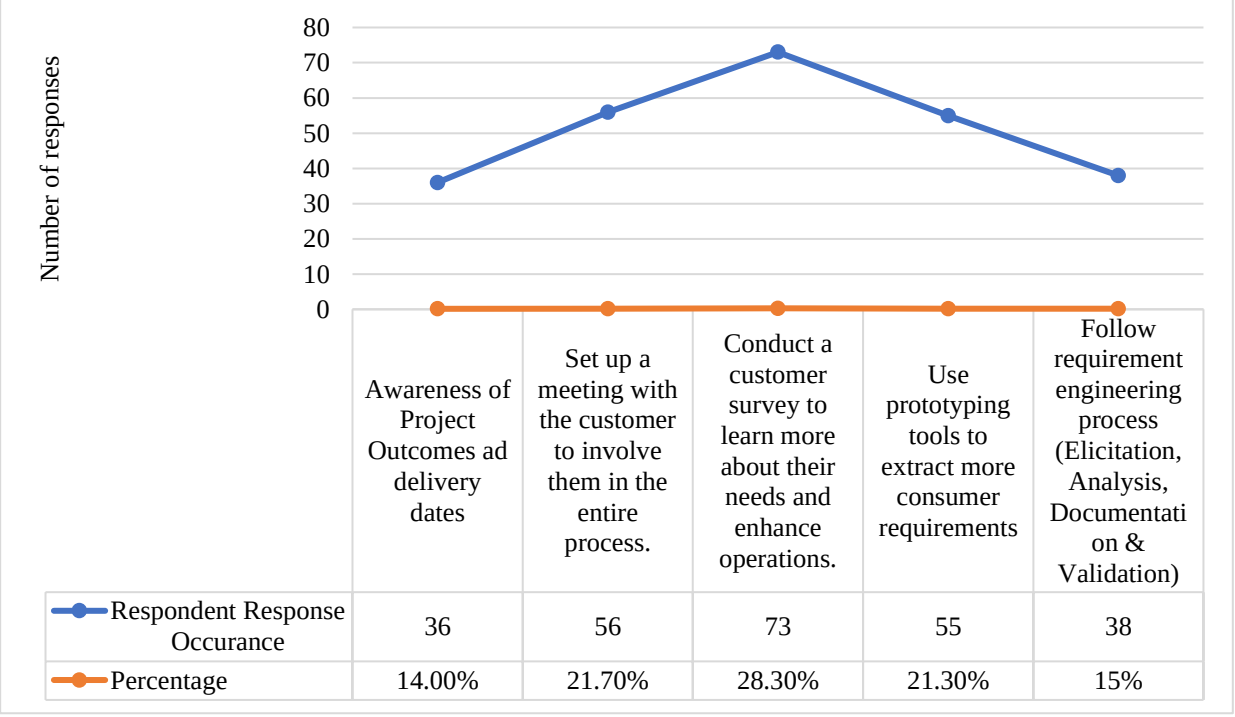
The appropriate mitigation strategies of Organization and Architectural related issues can be represented graphically in figure 4.12. In this graph we can represent Respondent Response on y-axis or vertical axis and appropriate mitigation plan represents on x-axis or horizontal axis.



	Creating a consistent development environment across all locations	All stakeholders are aware of process	Keep adequate records for any frequent changes.	Create an organizational hierarchy model that is understood by all employees.	Promote horizontal as well as vertical mobility across the organization domain	Follow standard document and follow single process will all teams
Respondent Response Occurance	39	55	59	46	36	23
Percentage	15.10%	21.30%	22.90%	17.80%	14%	8.90%

Figure 4.12: Mitigation Strategies of Organization & Architectural related issues

The appropriate mitigation strategies of Customer related issues can be represented graphically in figure 4.13. In this graph we can represent Respondent Response on y-axis or vertical axis and appropriate mitigation plan represents on x-axis or horizontal axis.



	Awareness of Project Outcomes ad delivery dates	Set up a meeting with the customer to involve them in the entire process.	Conduct a customer survey to learn more about their needs and enhance operations.	Use prototyping tools to extract more consumer requirements	Follow requirement engineering process (Elicitation, Analysis, Documentation & Validation)
Respondent Response Occurance	36	56	73	55	38
Percentage	14.00%	21.70%	28.30%	21.30%	15%

Figure 4.13: Mitigation Strategies of Customer related issues

Table 4.13: Focus Group Results

No.	Mitigation Strategies against 8 major communication issues	R1	R2	R3	R4	R5	R6	R7
	Geographical Distance							
1	Adopt Latest Technologies such as videoconferencing, Data Conferencing and web-based technologies.	SA	SA	SA	SA	SA	SA	SA
2	Promote Synchronous (video) and Asynchronous (text) Communication.	A	A	SA	N	DA	A	SA
3	Central data Sharing Point (Central Version Control System).	A	A	A	A	N	SA	A
4	Onsite Management visits and Traveling Steering Groups.	SA	SA	A	A	A	SA	A
5	Interact with team regularly and establish a Strategies for Trust building.	SA	A	SA	A	SA	A	A
6	Increase frequency of communication among team members.	SA	N	A	SA	N	A	A
7	Early identification of Dependencies and their management and early estimation of cost and effort.	A	SA	A	A	A	A	A
8	The teams should focus strongly on formal as well as informal communication modes to share feedback/project progress.	N	DA	SDA	N	N	N	N
	Temporal Distance							
10	Presentation of Agile Customer.	A	SA	A	A	A	SA	A
11	Periodic meeting and use of instant messenger.	DA	N	A	N	SDA	SA	A
12	Allow Flexible hours and allocate tasks to respective team to increase productivity.	SA	SA	SA	A	SA	A	SA
13	Be online and stay connected with their office management.	A	SA	A	A	A	SA	SA
14	Adopt Agile Practices such as SCRUM (daily & schedule meeting).	SA	A	A	SA	A	N	N
15	Use RAD tools to ensure frequent deliveries.	A	A	A	N	A	N	A
16	Schedule training workshops on how to use synchronous and asynchronous communication tools effectively.	A	N	SA	SDA	N	DA	N
17	Use high bandwidth technology and voice communication.	SA	A	A	A	SA	N	SA

18	Teams should coordinate and setup meeting time that is convenient for all the teams involved from different geographical regions.	SA	SA	SA	SA	SA	SA	SA
Socio-cultural Distance								
19	Arrange trainings on cultural awareness.	A	A	A	A	A	A	A
20	Forigen Language course and Appoint language translation.	SA	SA	A	A	A	SA	SA
21	Friendly Interaction between team members and mutual respect for each other.	A	SA	SA	SA	SA	A	SA
22	Using Agile methods to reduced cultural distance and increase Project Manager domain knowledge.	DA	SDA	A	DA	N	N	DA
23	Present Cultural liaisons and Eliminate Ambiguity.	N	A	DA	A	SA	A	A
24	Common communication language should be adopted by all the team members that can be understood by all.	A	N	SDA	A	A	A	SA
Team Member's Attitude								
25	Use of Effective communication tools and techniques.	A	A	SA	SA	SA	A	A
26	Encourage training of remote team members in order to build effective communication and resolve behavioral issues between team members.	SA	A	SA	SA	N	DA	A
27	Ensure Project Manager can relate to the problem of lower-level employees.	SA	SA	A	SA	A	SDA	A
Technical issues								
28	ICT training sessions for new employees.	SA	SA	SA	A	A	SA	A
29	For IT service management, conform to ISO standards and the ITIL framework.	SA	A	N	A	A	DA	SDA
30	Upgrade IT infrastructure.	A	A	DA	A	SA	N	SDA
31	Use high quality of telecommunication bandwidth and teleconferencing.	A	SA	SDA	A	A	N	SA
32	Adopt Distributed Agile methods such as Distributed Pair Programming & Urgent Requests.	N	SA	SA	A	SA	A	DA
Team issues								
33	Define role and responsibilities of all members clearly.	SA	SA	SA	SA	SA	SA	SA
34	SCRUM meetings to verify that everyone on the team is on the same page.	A	N	A	A	SA	DA	A
35	Provide personnel bonuses and incentives to boost team spirit.	A	A	N	SA	SA	SDA	A

36	To increase cooperation, break down large projects into smaller, manageable tasks.	SA	A	A	DA	A	N	SA
37	Arrange daily status meeting and send status updates electronically.	SA	DA	A	N	A	SA	A
38	Knowledge/data transfer sessions for new staff.	A	SA	N	A	DA	A	A
39	The issues regarding team members should be brought in the notice of team leader for further resolution.	N	SA	DA	A	A	N	SA
Organization & Architectural issues								
40	Creating a consistent development environment across all locations.	SA	SA	A	A	A	A	SA
41	All stakeholders are aware of process.	A	A	A	A	SA	A	A
42	Keep adequate records for any frequent changes.	SA	SA	SA	SA	A	A	SA
43	Create an organizational hierarchy model that is understood by all employees.	A	N	DA	SA	A	SA	SA
44	Promote horizontal as well as vertical mobility across the organization domain.	DA	SA	N	A	N	A	A
45	Follow standard document and follow single process will all teams.	A	A	A	A	A	A	A
Customer issues								
46	Awareness of Project Outcomes ad delivery dates.	SA	SA	SA	A	SA	A	A
47	Set up a meeting with the customer to involve them in the entire process.	SA	SA	A	A	SA	SA	SA
48	Conduct a customer survey to learn more about their needs and enhance operations.	N	N	SA	A	N	A	A
49	Use prototyping tools to extract more consumer requirements.	A	A	A	N	SA	SA	N
50	Follow requirement engineering process (Elicitation, Analysis, Documentation & Validation).	A	A	SA	N	SA	SA	N

0= Agree, 1=Disagree

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(2)	(1)	(0)	(-1)	(-2)

Table 4.14: Likert Scale Values for Focus Group Responses

No.	Mitigation Strategies against 8 major communication issues	R1	R2	R3	R4	R5	R6	R7	Agree*2	Disagree*-2	Result	Average Weightage
Geographical Distance												
1	Adopt Latest Technologies such as videoconferencing, Data Conferencing and web-based technologies.	2	2	2	2	2	2	2	7*2	0	14	2.0000
2	Promote Synchronous (video) and Asynchronous (text) Communication.	1	1	2	0	1	1	2	5	1	8	1.1428
3	Central data Sharing Point (Central Version Control System).	1	1	1	1	0	2	1	6	0	12	1.7142
4	Onsite Management visits and Traveling Steering Groups.	2	2	1	1	1	2	1	7	0	14	2.0000
5	Interact with team regularly and establish a Strategies for Trust building.	2	1	2	1	2	1	1	7	0	14	2.0000
6	Increase frequency of communication among team members.	2	0	1	2	0	1	1	5	0	10	1.4285
7	Early identification of Dependencies and their management and early estimation of cost and effort.	1	2	1	1	1	1	1	7	0	14	2.0000
8	The teams should focus strongly on formal as well as informal communication modes to share feedback/project progress.	0	-1	-2	0	0	0	0	0	2	-4	-0.5714
Temporal Distance												
10	Presentation of Agile Customer.	1	2	1	1	1	2	1	7	0	14	2.0000
11	Periodic meeting and use of instant messenger.	-1	0	1	0	-2	2	1	3	2	2	0.2857
12	Allow Flexible hours and allocate tasks to respective team to increase productivity.	2	2	2	1	2	1	2	7	0	14	2.0000
13	Be online and stay connected with their office management.	1	2	1	1	1	2	2	7	0	14	2.0000
14	Adopt Agile Practices such as SCRUM (daily & schedule meeting).	2	1	1	2	1	0	0	5	0	10	1.4285
15	Use RAD tools to ensure frequent deliveries.	1	1	1	0	1	0	1	5	0	10	1.4285
16	Schedule training workshops on how to use synchronous and asynchronous communication tools effectively.	1	0	2	-2	0	-1	0	2	2	0	0.0000

17	Use high bandwidth technology and voice communication.	2	1	1	1	2	0	2	6	0	12	1.7142
18	Teams should coordinate and setup meeting time that is convenient for all the teams involved from different geographical regions.	2	2	2	2	2	2	2	7	0	14	2.0000
Socio-cultural Distance												
19	Arrange trainings on cultural awareness.	1	1	1	1	1	1	1	7	0	14	2.0000
20	Forigen Language course and Appoint language translation.	2	2	1	1	1	2	2	7	0	14	2.0000
21	Friendly Interaction between team members and mutual respect for each other.	1	2	2	2	2	1	2	7	0	14	2.0000
22	Using Agile methods to reduced cultural distance and increase Project Manager domain knowledge.	-1	-2	1	-1	0	0	-1	1	4	-6	-0.8571
23	Present Cultural liaisons and Eliminate Ambiguity.	0	1	-1	1	2	1	1	5	1	8	1.1428
24	Common communication language should be adopted by all the team members that can be understood by all.	1	0	-2	2	1	2	2	5	1	8	1.1428
Team Member/s Attitude												
25	Use of Effective communication tools and techniques.	1	1	2	2	2	2	1	7	0	14	2.0000
26	Encourage training of remote team members in order to build effective communication and resolve behavioral issues between team members.	2	1	2	2	0	-1	1	5	1	8	1.1428
27	Ensure Project Manager can relate to the problem of lower-level employees.	2	2	1	2	1	-2	1	6	1	10	1.4285
Technical issues												
28	ICT training sessions for new employees.	2	2	2	1	1	2	1	7	0	14	2.0000
29	IT service management, conform to ISO standards and the ITIL framework.	2	1	0	1	1	-1	-2	4	2	4	0.5714
30	Upgrade IT infrastructure.	1	1	-1	1	2	0	-2	4	2	4	0.5714
31	Use high quality of telecommunication bandwidth and teleconferencing.	1	2	-2	1	1	0	2	5	1	8	1.1428
32	Adopt Distributed Agile methods such as Distributed Pair Programming & Urgent Requests.	0	2	2	1	2	1	-1	5	1	8	1.1428

Team issues												
33	Define role and responsibilities of all members clearly.	2	2	2	2	2	2	2	7	0	14	2.0000
34	SCRUM meetings to verify that everyone on the team is on the same page.	1	0	1	1	2	-1	2	5	1	8	1.1428
35	Provide personnel bonuses and incentives to boost team spirit.	1	1	0	2	2	-2	1	5	1	8	1.1428
36	To increase cooperation, break down large projects into smaller, manageable tasks.	2	1	1	-1	0	1	2	5	1	8	1.1428
37	Arrange daily status meeting and send status updates electronically.	2	-1	1	0	1	2	1	5	1	8	1.1428
38	Knowledge/data transfer sessions for new staff.	1	2	0	1	-1	1	1	5	1	8	1.1428
39	The issues regarding team members should be brought in the notice of team leader for further resolution.	0	2	-1	1	1	0	2	4	1	6	0.8571
Organizational & Architectural issues												
40	Creating a consistent development environment across all locations.	2	2	1	1	1	1	2	7	0	14	2.0000
41	All stakeholders are aware of process.	1	1	1	1	2	1	1	7	0	14	2.0000
42	Keep adequate records for any frequent changes.	2	2	2	2	1	1	2	7	0	14	2.0000
43	An organizational hierarchy model that is understood by all employees.	1	0	-1	2	1	2	2	5	1	8	1.1428
44	Promote horizontal as well as vertical mobility across the organization domain.	-1	2	0	1	0	1	1	4	1	6	0.8571
45	Follow standard document and follow single process will all teams.	1	1	1	1	1	1	1	7	0	14	2.0000
Customer issues												
46	Awareness of Project Outcomes ad delivery dates.	2	2	2	1	2	1	1	7	0	14	2.0000
47	Set up a meeting with the customer to involve them in the entire process.	2	2	1	1	2	2	2	7	0	14	2.0000
48	Conduct a customer survey to learn their needs and enhance operations.	0	0	2	1	0	1	1	4	0	8	1.1428
49	Use prototyping tools to extract more consumer requirements.	1	1	1	0	2	2	0	5	0	10	1.4285
50	Follow requirement engineering process (Elicitation, Analysis, Documentation & Validation).	1	1	2	0	2	2	0	5	0	10	1.4285

CHAPTER 5

RESULTS

5.1 Overview

Discuss the final results that were evaluated in the previous chapter; we can only write the final results from the survey and the final results from the focus group in this chapter. After that, we'll talk about triangulation before writing a chapter summary.

5.2 Results From Survey

Now we can write all the results in a sequence. After that we can see that some issues and their arising factors are accepted and some are rejected.

The accepted factors are the high significance factors and the rejected factors are low significance factors. The rejected one can be highlighted in given below table 5.1 that can be seen easily.

Table 5.1: Final result from survey

No	Factors	Weightage Values	Avg. Weightage Responses	Results
1	Geographical Distance	285	1.1046511628	Accepted
2	Temporal Distance	283	1.0968992248	Accepted
3	Socio-cultural Distance	255	0.988372093	Accepted
4	Team Member's Attitude	266	1.0310077519	Accepted
5	Technical issues	275	1.0658914729	Accepted
6	Team issues	277	1.0736434109	Accepted
7	Organizational & Architectural issues	286	1.1085271318	Accepted
8	Customer issues	284	1.1007751938	Accepted
Geographical Distance				
1	Lack of Face-to-Face Meetings.	302	1.1705426357	Accepted
2	Lack of Trust.	259	1.003875969	Accepted
3	Lack of Informal Communication.	266	1.0310077519	Accepted
4	Loss of Data during transfer.	295	1.1434108527	Accepted
5	Increased cost and logistics of holding face-to-face meetings.	232	0.8992248062	Rejected
6	Lack of interpersonal relationships.	262	1.015503876	Accepted
7	Increase effort to initiate contact.	228	0.8837209302	Rejected
Temporal Distance				
1	Time zone differences.	261	1.011627907	Accepted
2	Reduced opportunities for synchronous communication.	241	0.9341085271	Rejected
3	Delayed in response / feedback.	284	1.1007751938	Accepted
4	Improper selection of Technology.	262	1.015503876	Accepted
5	Less time overlapping.	261	1.011627907	Accepted
6	Reduced communication frequency.	258	1	Accepted
7	Inadequate communication.	219	0.8488372093	Rejected
Socio-cultural Distance				
1	Cultural differences.	265	1.0271317829	Accepted
2	Language difference/ Poor business language skills.	257	0.996124031	Accepted
3	Lack of mutual understanding.	275	1.0658914729	Accepted
4	Different project background.	301	1.1666666667	Accepted
Team Member's Attitude				
1	Inability to see the Problems.	165	0.6395348837	Rejected

2	Inability to Effective Communication.	259	1.003875969	Accepted
Technical issues				
1	Connectivity issues that hinder communication.	260	1.007751938	Accepted
2	Limited infrastructure, tools, and Techniques.	258	1	Accepted
3	Low quality of telecommunication bandwidth.	264	1.023255814	Accepted
4	Lack of ICT /technological cohesion.	256	0.992248062	Accepted
5	Technical incompatibilities.	203	0.7868217054	Rejected
Team issues				
1	Lack of Coordination among team members.	268	1.0387596899	Accepted
2	Difficulty in distribution of team or task.	253	0.980620155	Accepted
3	Insufficient knowledge transfer.	205	0.7945736434	Rejected
4	Large Team size.	269	1.0426356589	Accepted
5	Loss of team spirit.	278	1.0775193798	Accepted
Organizational & Architectural issues				
1	Lack of uniform processes.	264	1.023255814	Accepted
2	Lack of management commitments.	267	1.0348837209	Accepted
3	Lack of appropriate architecture.	164	0.6356589147	Rejected
Customer issues				
1	Lack of customer involvement.	271	1.0503875969	Accepted
2	Miscommunication of customer requirements.	281	1.0891472868	Accepted

The total 8 arising factors are rejected and 8 major issues and recent arising factors are accepted means that in general out of 35 arising factors that can arise 8 major issues have 27 accepted and 8 are rejected that can be seen with calculation in table 4.14.

5.3 Results from Focus Group

After converting values in Likert scale and find avg weighted value than we can calculate an average value by dividing the total avg value by total no of avg weight value of question 1 and find the average value that is 0.9583. On the basis of this value acceptance and rejected can be done in table 5.2.

Table 5.2: Final Results from Focus Group

Appropriate Mitigation Strategies	Average Weighted	Results
Geographical Distance Related Issues		
Adopt Latest Technologies such as videoconferencing, Data Conferencing and web-based technologies.	2.0000	Accepted
Promote Synchronous (video) and Asynchronous (text) Communication.	1.1428	Accepted
Central data Sharing Point (Central Version Control System).	1.7142	Accepted
Onsite Management visits and Traveling Steering Groups.	2.0000	Accepted
Interact with team regularly and establish a Strategies for Trust building.	2.0000	Accepted
Increase frequency of communication among team members.	1.4285	Accepted
Early identification of Dependencies and their management and early estimation of cost and effort.	2.0000	Accepted
The teams should focus strongly on formal as well as informal communication modes to share feedback/project progress.	-0.5714	Rejected
Temporal Distance Related Issues		
Presentation of Agile Customer.	2.0000	Accepted
Periodic meeting and use of instant messenger.	0.2857	Rejected
Allow Flexible hours and allocate tasks to respective team to increase productivity.	2.0000	Accepted
Be online and stay connected with their office management.	2.0000	Accepted
Adopt Agile Practices such as SCRUM (daily & schedule meeting).	1.4285	Accepted
Use RAD tools to ensure frequent deliveries.	1.4285	Accepted
Schedule training workshops on how to use synchronous and asynchronous communication tools effectively.	0.0000	Rejected
Use high bandwidth technology and voice communication.	1.7142	Accepted
Teams should coordinate and setup meeting time that is convenient for all the teams involved from different geographical regions.	2.0000	Accepted
Socio-Cultural Distance Issues		
Arrange trainings on cultural awareness.	2.0000	Accepted
Forigen Language course and Appoint language translation.	2.0000	Accepted
Friendly Interaction between team members and mutual respect for each other.	2.0000	Accepted
Using Agile methods to reduced cultural distance and increase Project Manager domain knowledge.	-0.8571	Rejected
Present Cultural liaisons and Eliminate Ambiguity.	1.1428	Accepted
Common communication language should be adopted by all the team members that can be understood by all.	1.1428	Accepted
Team Member's Attitude Issues		
Use of Effective communication tools and techniques.	2.0000	Accepted

Encourage training of remote team members in order to build effective communication and resolve behavioral issues between team members.	1.1428	Accepted
Ensure Project Manager can relate to the problem of lower-level employees.	1.4285	Accepted
Technical Related Issues		
ICT training sessions for new employees.	2.0000	Accepted
For IT service management, conform to ISO standards and the ITIL framework.	0.5714	Rejected
Upgrade IT infrastructure.	0.5714	Rejected
Use high quality of telecommunication bandwidth and teleconferencing.	1.1428	Accepted
Adopt Distributed Agile methods such as Distributed Pair Programming & Urgent Requests.	1.1428	Accepted
Team Related Issues		
Define role and responsibilities of all members clearly.	2.0000	Accepted
SCRUM meetings to verify that everyone on the team is on the same page.	1.1428	Accepted
Provide personnel bonuses and incentives to boost team spirit.	1.1428	Accepted
To increase cooperation, break down large projects into smaller, manageable tasks.	1.1428	Accepted
Arrange daily status meeting and send status updates electronically.	1.1428	Accepted
Knowledge/data transfer sessions for new staff.	1.1428	Accepted
The issues regarding team members should be brought in the notice of team leader for further resolution.	0.8571	Rejected
Organizational & Architectural Related Issues		
Keep adequate records for any frequent changes.	2.0000	Accepted
All stakeholders are aware of process.	2.0000	Accepted
Create an organizational hierarchy model that is understood by all employees.	2.0000	Accepted
Creating a consistent development environment across all locations.	1.1428	Accepted
Promote horizontal as well as vertical mobility across the organization domain.	0.8571	Rejected
Follow standard document and follow single process will all teams.	2.0000	Accepted
Customer Related Issues		
Awareness of Project Outcomes ad delivery dates.	1.1428	Accepted
Set up a meeting with the customer to involve them in the entire process.	1.7142	Accepted
Conduct a customer survey to learn more about their needs and enhance operations.	2.0000	Accepted
Use prototyping tools to extract more consumer requirements.	2.0000	Accepted
Follow requirement engineering process (Elicitation, Analysis, Documentation & Validation).	1.4285	Accepted

So out of total 50 values, 42 values are accepted and 8 values are rejected. First of all, we find the sum of total values and then we find average weightage value of respondent

responses and then we considered all the values above from 0.9583 as expected and the values below from 0.9583 are considered as rejected.

5.4 Result explanation

So, our focus group shows that the value our total 84% of our total values are accepted and 16% of our total values are rejected.

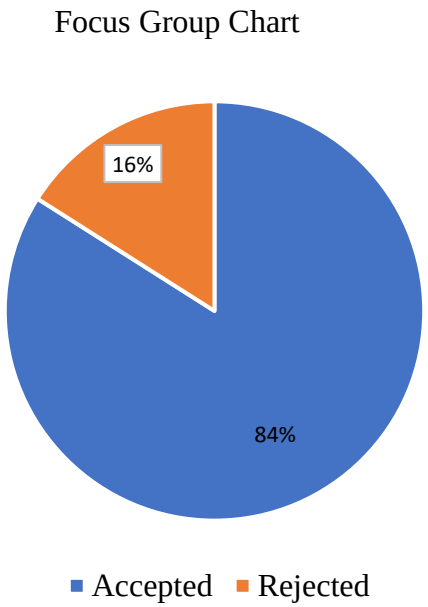


Figure 5.1: Focus Group Chart

5.4.1 Low significance factors

We find 8 low significance factors which are rejected by the respondents, here are the followings in table 5.3:

Table 5.3: Low Significance factors From Focus Group

Geographical Distance	1. The teams should focus strongly on formal as well as informal communication modes to share feedback/project progress.
Temporal distance	1. Periodic meeting and use of instant messenger. 2. Schedule training workshops on how to use synchronous and asynchronous communication tools effectively.
Socio-cultural distance	1. Arrange trainings on cultural awareness.
Technical issues	1. For IT service management, conform to ISO standards and the ITIL framework. 2. Adopt Distributed Agile methods such as Distributed Pair Programming & Urgent Requests.
Team issues	1. The issues regarding team members should be brought in the notice of team leader for further resolution.
Organizational & architectural issues	1. Promote horizontal as well as vertical mobility across the organization domain.

5.4.2 High Significance factors

We find 41 high significance factors which are accepted by the respondents.

Table 5.4: High Significance Factors from Focus Group

Geographical Distance	1. Adopt Latest Technologies such as videoconferencing, Data Conferencing and web-based technologies. 2. Promote Synchronous (video) and Asynchronous (text) Communication. 3. Central data Sharing Point (Central Version Control System). 4. Onsite Management visits and Traveling Steering Groups. 5. Interact with team regularly and establish a Strategies for Trust building. 6. Increase frequency of communication among team members. 7. Early identification of Dependencies and their management and early estimation of cost and effort.
Temporal distance	1. Presentation of Agile Customer. 2. Allow Flexible hours and allocate tasks to respective team to increase productivity. 3. Be online and stay connected with their office management. 4. Adopt Agile Practices such as SCRUM (daily & schedule meeting). 5. Use RAD tools to ensure frequent deliveries.

	6. Use high bandwidth technology and voice communication. 7. Teams should coordinate and setup meeting time that is convenient for all the teams involved from different geographical regions.
Socio-cultural distance	1. Arrange trainings on cultural awareness. 2. Forigen Language course and Appoint language translation. 3. Friendly Interaction between team members and mutual respect for each other. 4. Present Cultural liaisons and Eliminate Ambiguity. 5. Common communication language should be adopted by all the team members that can be understood by all.
Team members attitude	1. Ensure Project Manager can relate to the problem of lower-level employees. 2. Encourage training of remote team members in order to build effective communication and resolve behavioral issues between team members. 3. Use of Effective communication tools and techniques.
Technical issues	1. Upgrade IT infrastructure. 2. Use high quality of telecommunication bandwidth and teleconferencing. 3. ICT training sessions for new employees.
Team issues	1. Define role and responsibilities of all members clearly. 2. SCRUM meetings to verify that everyone on the team is on the same page. 3. Provide personnel bonuses and incentives to boost team spirit. 4. To increase cooperation, break down large projects into smaller, manageable tasks. 5. Arrange daily status meeting and send status updates electronically. 6. Knowledge/data transfer sessions for new staff.
Organizational & Architectural issues	1. Keep adequate records for any frequent changes. 2. All stakeholders are aware of process. 3. Create an organizational hierarchy model that is understood by all employees. 4. Creating a consistent development environment across all locations. 5. Follow standard document and follow single process will all teams.
Customer issues	1. Awareness of Project Outcomes ad delivery dates. 2. Set up a meeting with the customer to involve them in the entire process. 3. Conduct a customer survey to learn more about their needs and enhance operations. 4. Use prototyping tools to extract more consumer requirements. 5. Follow requirement engineering process (Elicitation, Analysis, Documentation & Validation).

5.5 Triangulation

After finding all the results by using quantitative and qualitative research methods we can perform a validation on it. First, we can find all the major's issues and factors that arise these major issues in GSD by conducting a Systematic Literature Review on it. We can find 8 Major issues and 35 factors that can arises these major communication issues through SLR

After that we conduct a questionnaire-based survey to validate that our findings from literature is valid or not. We can perform quantitative research method i.e., survey. Then after validate the SLR by conducting a survey our first research question can be resolved.

After that we can again identified a mitigation strategies of major communication issues by conducting a SLR. Now we can validate the mitigation strategies we can perform a qualitative research method i.e., focus group.

Now we can perform both research methods and we can analyze that all the results that can be find by conducting SLR are approximately equal or same to all the results that can be find or validate by conducting Survey and Focus Group.

5.6 Summary

Through triangulation we can conclude our findings of the study and briefly explain all the results and analysis by adding their references. We conclude that our findings are approximately to all findings that can be find firstly through literature review.

CHAPTER 6

CONCULSION AND FUTURE WORK

6.1 Conclusion

The major goal of this study is to identify communication issues in GSD and to suggest a mitigation strategy for addressing the identified communication issues. From the respondent's perspective, this study was conducted to investigate the communication difficulties that might cause problems, as well as the end conclusions and all those outcomes or results in global software development. Because they do not assist them create a high-quality product, respondents may "value" technologies that help them discover the best mitigation measures for significant difficulties and their respective originating reasons.

Making decisions in global software development, as well as programmers, project managers, and all other participants in judgement and outcome procedures with uncertain future repercussions and intended results Every one of these results occur in a variety of personality and varied circumstances, and they often have global software development implications.

The study also looked at communication issues in GSD and how to address them. To do so, we highlighted communication problems in GSD and then proposed mitigation strategies to address these issues in GSD.

The research is divided into two primary questions. And the goal of this study was to find answers to these research issues. The main goal was to find out the answers to those two queries which are What are the communication issues that can affect on Global Software

development? And What are the mitigation strategy for identified communication issues in Global Software Development?

RQ-1 What are the communication issues that can affect on Global Software development?

The first question in the study is to identify the communication issues that can affect on global software development. For this purpose, we can a conduct a systematic literature review and identified 8 major issues and 35 factors that arises these 8 major issues.

The 8 major issues include Geographical Distance, Temporal Distance, Socio-cultural Distance, Team Member's Attitude, Technical related issues, Team related issues, Organizational & Architectural issues and Customer Related issues.

The 7 factors that arise the Geographical Distance include Lack of Face-to-Face Meetings, Lack of Trust, Lack of Informal Communication, Loss of Data during transfer, Increased cost and logistics of holding face-to-face meetings, Lack of interpersonal relationships and Increase effort to initiate contact.

The 7 factors that arise the Temporal Distance include Time zone differences, Reduced opportunities for synchronous communication, Delayed in response / feedback, Improper selection of Technology, Less time overlapping, Reduced communication frequency and Inadequate communication.

The 4 factors that arise the Socio-cultural Distance include Cultural differences, Language difference/ Poor business language skills, Lack of mutual understanding and Different project background. The 2 factors that arise the Team Members Attitude include Inability to see the Problems and Inability to Effective Communication.

The 5 factors that arise the Technical related issues include Connectivity issues that hinder communication, Limited infrastructure, tools, and Techniques, Low quality of telecommunication bandwidth, Lack of ICT /technological cohesion and Technical incompatibilities.

The 5 factors that arise the Team related issues include Lack of Coordination among team members, Difficulty in distribution of team or task, Insufficient knowledge transfer, Large Team size and Loss of team spirit.

The 3 factors that arise the Organizational & Architectural issues include Lack of uniform processes, Lack of management commitments and Lack of appropriate architecture. The 2 factors that arise the Customer related issues include Lack of customer involvement and Miscommunication of customer requirements.

RQ-2 What are the mitigation strategies for identified communication issues in Global Software Development?

The second question in the study is to provide a mitigation Strategies of 8 major coomunication related issues that can effect on global software development. For this we can identified 50 mitigation strategies against 8 major issues from literature and verified through our respondent.

The 8 mitigation strategies about Geographical Distance include Adopt Latest Technologies such as videoconferencing, Data Conferencing and web-based technologies, Promote Synchronous (video) and Asynchronous (text) Communication, Central data Sharing Point (Central Version Control System). Onsite Management visits and Traveling Steering Groups., Interact with team regularly and establish a Strategies for Trust building, Increase frequency of communication among team members, Early identification of Dependencies and their management and early estimation of cost and effort and The teams should focus strongly on formal as well as informal communication modes to share feedback/project progress.

The 9 mitigation strategies about Temporal Distance include Presentation of Agile Customer, Periodic meeting and use of instant messenger, Allow Flexible hours and allocate tasks to respective team to increase productivity, Be online and stay connected with their office management, Adopt Agile Practices such as SCRUM (daily & schedule meeting), Use RAD tools to ensure frequent deliveries, Schedule training workshops on how to use synchronous and asynchronous communication tools effectively, Use high bandwidth technology and voice

communication and Teams should coordinate and setup meeting time that is convenient for all the teams involved from different geographical regions.

The 6 mitigation strategies about Socio-cultural Distance include Arrange trainings on cultural awareness, Forigen Language course and Appoint language translation, Friendly Interaction between team members and mutual respect for each other, Using Agile methods to reduced cultural distance and increase Project Manager domain knowledge, Present Cultural liaisons and Eliminate Ambiguity and Common communication language should be adopted by all the team members that can be understood by all.

The 3 mitigation strategies about Team Member Attitude include Use of Effective communication tools and techniques, Encourage training of remote team members in order to build effective communication and resolve behavioral issues between team members and Ensure Project Manager can relate to the problem of lower-level employees

The 5 mitigation strategies about Technical related issues include ICT training sessions for new employees, For IT service management, conform to ISO standards and the ITIL framework, Upgrade IT infrastructure, Use high quality of telecommunication bandwidth and teleconferencing and Adopt Distributed Agile methods such as Distributed Pair Programming & Urgent Requests.

The 7 mitigation strategies about Team related issues include Define role and responsibilities of all members clearly, SCRUM meetings to verify that everyone on the team is on the same page, Provide personnel bonuses and incentives to boost team spirit., To increase cooperation, break down large projects into smaller, manageable tasks, Arrange daily status meeting and send status updates electronically, Knowledge/data transfer sessions for new staff and The issues regarding team members should be brought in the notice of team leader for further resolution.

The 6 mitigation strategies about Organizational & Architectural issues include Creating a consistent development environment across all locations, All stakeholders are aware of process, Keep adequate records for any frequent changes, Create an organizational hierarchy model that is understood by all employees, Promote horizontal as well as vertical mobility

across the organization domain and Follow standard document and follow single process will all teams.

The 5 mitigation strategies about Customer related issues include Awareness of Project Outcomes ad delivery dates, Set up a meeting with the customer to involve them in the entire process, Conduct a customer survey to learn more about their needs and enhance operations, Use prototyping tools to extract more consumer requirements and Follow requirement engineering process (Elicitation, Analysis, Documentation & Validation).

6.2 Research Contribution

The researchers will easily find the factors that arise the communication issues in global software development and their mitigation strategies.

Our study provides approx. all the mitigation strategies of communication issues that affect on global software development, so in future it will be very helpful to review these mitigation strategies before starting a new project in global software development.

Our mitigation technique will be very useful in resolving GSD communication issues and their emerging reasons, as well as achieving the best possible results for GSD Projects.

6.3 Limitations

The limitation of this research can be written below:

1. The research finding of our research is based on local respondent.
2. Through, it is using a guideline but we can’t generalize the research problem among all area of the world.
3. The GSD has its own dynamics so we will focus on local market (local respondent) in our research topic.

4. Our research will have one-year span to complete research topic and conclude it so it is not possible to cover all possible areas.

6.4 Future Work

We can identify the mitigation strategies of 8 major issues that can effect on global software development. We might advise that in future projects, we identify all of the mitigation measures for the 35 elements that cause communication problems in GSD.

When all 35 elements that can cause communication issues in GSD projects are recognized and mitigation techniques are developed, the failure rate of GSD projects is reduced to a very low level.

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