SOFTWARE PROJECT MANAGMENT APPROACH FOR REDUCING RISK IN GLOBAL SOFTWARE DEVELOPMENT PROJECTS

By

SAKINA BIBI

NATIONAL UNIVERSITY OF MODERN LANGUAGES

ISLAMABAD

March, 2022

SOFTWARE PROJECT MANAGMENT APPROACH FOR REDUCING RISK IN GLOBAL SOFTWARE DEVELOPMENT PROJECTS

By

SAKINA BIBI

BSc. Software Engineering, Arid Agricultural University Rawalpindi, 2018

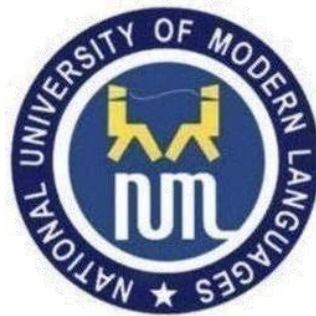A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR

THE DEGREE OF

MASTER OF SCIENCE

In **Software Engineering**

To

FACULTY OF ENGINEERING & COMPUTER SCIENCES

NATIONAL UNIVERSITY OF MODERN LANGUAGES ISLAMABAD

NATIONAL UNIUVERSITY OF MODERN LANGUAGES **FACULTY OF ENGINEERIING & COMPUTER SCIENCE**

THESIS AND DEFENSE APPROVAL FORM

The undersigned certify that they have read the following thesis, examined the defense, are satisfied with overall exam performance, and recommend the thesis to the Faculty of Engineering and Computer Sciences for acceptance.

Thesis Title: Software Project Management Approach for reducing risk in Global Software Development Projects

Submitted by: Sakina Bibi   **Registration #:** 17-MSSE/IBD/S19

Master of Science in Software Engineering

Degree name in full

Software Engineering

Name of Discipline

Dr. Huma Hayat khan   _____

Name of Research Supervisor   Signature of Research Supervisor

Dr. Basit Shahzad   _____

Name of Dean (FE&CS)   Signature of Dean (FE&CS)

Prof. Dr. Muhammad Safeer Awan   _____

Name of Pro-Rector Academics   Signature of Pro-Rector Academics

March 15th, 2022

Date

AUTHOR'S DECLARATION

I <u>Sakina Bibi</u>

Son of <u>M. Sulaiman</u>

Registration # <u>17-MSSE/IBD/S19</u>

Discipline <u>Software Engineering</u>

Candidate of **Master of Science in Software Engineering (MSSE)** at the National University of Modern Languages do hereby declare that the thesis **Software Project Management Approach for reducing risk in Global Software Development Projects** 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.

_____

Signature of Candidate

<u> Sakina Bibi   </u>

Name of Candidate

<u>   15th March, 2022   </u>

Date

ABSTRACT

Software Project Management Approach for reducing risk in Global Software Development Projects

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 effect 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 communication related issues in GSD.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVATION

GSD	-	Global Software Development
SPM	-	Software Project Management
IEEE	-	Institute of Electrical and Electronics Engineers
IT	-	Information Technology
LR	-	Literature Review

ACKNOWLEDGEMENT

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 project management (SPM) is the process for the planning and conducting software development life cycle for software projects in a methodical technique. Software project management is the systematic way of the planning, organizing, monitoring, regulating, and directing the SPM [1]. SPM for Global software development (GSD), then again, incorporates the coordination of various overall disseminated administrative and mechanical assets to create excellent programming at the most reduced conceivable expense and time. Particular SPM strategies (techniques, models, structures, and methods) have been found for managing Risks identified with correspondence, coordination, joint effort, and execution in GSD. The benefits of SPM are that it settles on work coordination and allotment choices simpler, gives straightforwardness of work progress to all partners, and gives a decent picture of how the venture is advancing in an agile and crystal are all terms that people use to describe how they work [1]. SPM additionally makes correspondence arranging and the board a breeze, particularly when stream planning is used to frame groups. SPM gives a way to refreshing the code just as some limit with regards to overseeing simultaneous changes in an orderly way in the change the board method. It likewise smoothest out in information the board framework that is based on the process of sharing, distributing, developing, recording, and interpreting the company's knowledge.

There is a connection between SPM and GSD is hazard. Successful project managers recognize that risk management is important, because achieving a project's goals depends on planning, preparation, results and evaluation that contribute to achieving strategic goals. Software projects including arranging, investigation, plan, execution, and upkeep, are full of hazard. Moreover, hazard is a troublesome term to depict and grasp, as it alludes to an assortment of articles and

people [2]. Risk has traditionally been term as likelihood which includes factors and outcomes will differ from those predicted, and it can be positive or negative [2]. Han and Huang [3] Each software risk has a different chance of happening, as well as a different impact on project cost, time, and quality. When software is produced in a co-located development environment, these risks are magnified. When it comes to GSD environments, it gets even more obvious. GSD (global software development) is the development of software by teams from several geographical locations, which may or may not be affiliated with the same company [4]. GSD teams have progressed from a single location to a multi-location setting. As a result, companies that create and/or maintain software products cannot ignore GSD's impact, as it is causing a significant shift in the way products are conceptualized, planned, built, tested, and delivered to customers [4].

As of the software projects experiences increased global business, interest in GSD is fast developing [5]. Stakeholders from various national and corporate cultures that's why many factor arises, as well as different other factors arises in GSD. GSD is often referred to as an outsourcing relationship. Outsourcing is defined as obtaining a source from any outsourced process, according to the Campbell Harvey Hypertextual Economics Glossary [6]. Many firms have long prioritized low-cost software development. If the organization's long-term benefits are increased even more [7]. The majority of businesses have adopted GSD for a variety of perceived benefits, including decreased development time, low-cost access to trained human resources, and improved product quality [7].

GSD is advantageable for the software developers who are looking to boost operational efficiency, gain additional expertise, speed, and time- to-market. Though GSD is emerging as an effective technique, but it suffers from many challenges like poor communication, lack of trust and coordination. The new tendency is shadowed by precise risk and need a deeper analysis for successful risk overcoming [1]. Software Project Management plays a key role in the success of GSD. Global Software Development is also have real Risks identified with project variety and intricacy. Certain SPM approaches (techniques, models, systems, and cycles) for GSD have been identified for managing Risks identified with correspondence, coordination, cooperation, and execution in GSD.

GSD alludes to programming advancement that is spread over something like two areas that are isolated by public or mainland borders [1]. In GSD, partners from various public and hierarchical

societies and time regions are engaged with programming improvement [1]. Nonetheless, GSD is mechanically and authoritatively intricate and presents an assortment of Risks to be overseen by the product advancement group. Especially, transient, topographical and socio-social distances force issues not experienced in conventional frameworks advancement. Utilizing SPM, to diminish the dangers related with GSD projects that emerge from temporal, geological, and socio-social distances. As SPM provides easier team collaboration, better communication with clients, better scheduling, budget management and provide platform to integrate with new team members etc, it helps to remove the risk factors that causes the harm in achieving the goals of global software development.

1.2   Literature Review

Global software development process of creating software projects by bringing together the teams from different locations of the world to work on it. These teams could be from the same company or from other organizations that collaborate. GSD teams have progressed from a single location to a multi- location setting. As a result, companies that create and/or maintain software products cannot ignore GSD's impact, as it is causing a significant shift in the way products are conceptualized, planned, built, tested, and delivered to customers [14]. Interest in GSD is quickly developing as the product business is encountering expanding globalization of business [4]. GSD alludes to programming improvement that is discrete over no less than two areas that are partitioned by public or mainland borders [1]. In GSD, partners from various public and hierarchical conditions and time regions are engaged with programming improvement. GSD is otherwise called a sort of reevaluating relations. Campbell R. Harvey's hypertext-based Finance Glossary characterizes reevaluating as buying a huge level of transitional parts from outside providers [5]. Minimal expense programming advancement has consistently been the need of numerous associations. In the event that this minimal expense improvement accompanies the additional benefit of an excellent item, then, at that point it further builds the drawn-out benefits appreciated by the association [6].

Most of organizations have embraced GSD to acquire a few saw benefits, for example, decreased advancement time, admittance to talented HR for somewhat minimal price and expanded item quality. As the software industry experiences increased globalization of business, interest in global

software development is fast developing [15]. Software development which is scattered at least two geographic separated by limitations is referred to as GSD [16]. Stakeholders from various national and corporate cultures, as well as different times due to different locations involved in the software development at GSD. GSD is often referred to as an outsourcing relationship. Outsourcing is defined as obtaining a considerable ratio of transitional mechanisms from outside providers, according to Campbell R. Harvey's Hyper Textual Finance Glossary [17]. Many firms have long prioritised low-cost software development. If this comparatively lower cost model of development come with the added benefit of a high-quality product, the organization's long-term benefits are increased even more [18]. The majority of businesses have adopted GSD for a variety of perceived benefits, including decreased development time, low-cost access to trained human resources, and improved product quality [19]. This research also discloses some of the remedies that have been implemented to address these risks. Based on qualitative interviews, the findings suggest that there are risks associated with temporal, geographical, and socio- cultural distance [20].

Most of organizations have embraced GSD to acquire a few saw benefits, for example, decreased advancement time, admittance to talented HR for somewhat minimal price and expanded item quality. As the software industry experiences increased globalization of business, interest in global software development is fast developing [15]. Software development which is scattered at least two geographic separated by limitations is referred to as global software development (GSD) [16]. Stakeholders from various national and corporate cultures, as well as different times due to different locations involved in the software development at GSD. GSD is often referred to as an outsourcing relationship. Outsourcing is defined as obtaining a considerable ratio of transitional mechanisms from outside providers, according to Campbell R. Harvey's Hyper Textual Finance Glossary [17]. Many firms have long prioritised low-cost software development. If this comparatively lower cost model of development come with the added benefit of a high-quality product, the organization's long-term benefits are increased even more [18]. The majority of businesses have adopted GSD for a variety of perceived benefits, including decreased development time, low-cost access to trained human resources, and improved product quality [19]. This research also discloses some of the remedies that have been implemented to address these risks. Based on qualitative interviews, the findings suggest that there are risks associated with temporal, geographical, and socio- cultural distance [20].

Risks associated to the human factors in global software development discussed in the Benjamin's

study [4]. The goal of this research was to first identify the risks associated with human variables in GSD, and then to offer a solution (or solutions) to help solve or reduce the overall impact of these risks. Propose a solution(s) that could assist in resolving or lowering the negative consequences of these Risks. Elzamly etl [2] discussed for successful software development, a framework software risk management technique was established. The purpose of this study is to present a new software risk management paradigm for successful software projects. The likelihood of a successful software project will be considerably increased if a successful software project risk management technique is used.

One strategy to overcome the inappropriate communication practices shared by the development team may be to train software engineers in cultural diversity by using onlogy as a communication facilitator. The study of people's characteristics and the characteristics of their surroundings can be useful in this regard. Emphasis on interpersonal communication will also be a part of any type of teaching training. The combination of clear communication measures, the use of synchronous technology and the freedom of work also solutions can solve communication issues. The response time to project emails with a time difference is usually large, so it is best to use voice communication using a video conference or speaking on Skype or any other live communication software.

However, the issue of differences in emphasis on different team members, along with poor command of a foreign language (e.g. English) for some team members, can lead to serious disturbances to viable correspondence. Be that as it may, the significance of up close and personal correspondence can't be overlooked, regardless of whether it appears as a video visit. Time region contrasts cause GSDs a greater number of issues than social contrasts and can create setbacks for the trading of thoughts.

Mix issues and necessities changes are extra factors in correspondence issues. There should be an equilibrium of involvement on each side of the correspondence, as the email framework helps somewhat in clarifying the prerequisites. In this manner, GSD video conferencing is a reasonable choice for working with up close and personal correspondence. In spry programming improvement, data isn't concealed among groups and colleagues, making it a more reasonable innovation for GSD.

Quick correspondence is probably going to decrease the time spent settling on key choices, and the blunder rate can be reduced by involving customers. However, the involvement of customers should be minimal in relation to a specific issue, so that they do not have the feeling that developers are shifting their responsibility to them.

In the context of GSD, face-to-face meetings should lead and follow the events outlined. The first task may include videoconferencing to keep partners away and get to know each other and the type of communication. The first step is to build the aircraft. Successful activities may include regular and frequent communication between participants to discuss software development issues as well as all management issues. In GSD, the type of work seems to be the most important factor in promoting cooperation among team members. Most communication activities influence behavior, resource sharing, and participation in feedback. Planning and search for input behavior are equal, while comment search, work organization and bunch abilities conduct have the most noteworthy extents in arranging and quest for input regions, and reflection, oversight and social communication have the most elevated extents. extents. Impermanent accepted practices and time designs of colleagues taking an interest in GSD projects are the primary reasons why discussions are insufficient, which can lead to project failure.

Problems related to social variety can be tended to by bringing the GSD group into the way of life and convictions of various networks. Furthermore, a few illustrations on morals and the significance of regarding different societies and religions can assist with forestalling racial variety issues. Intercultural obstructions can prompt miscommunication, misconception, disappointment and powerlessness to utilize innovation and along these lines represent a critical danger to the GSD cycle.

Therefore, there is a need to identify and address issues related to racial understanding. The difference between operating and cooperating with what does not exist and culture that does not show that both managers and producers need to build a foundation to build trust, such as their own race and language.An important feature in GSD is the promotion of software development in a variety of environments for reliability. Distributed monitoring leads to a better understanding of GDS team work through better communication and collaboration between teams. In short, different regions, different cultures, different customer perspectives and different authors of foundations can lead to failure. With this in mind, it is important to do a good job of correcting these issues.

1.3   Problem Background

GSD is a novel paradigm that delegated tasks to a large group of people via an open call style, allowing for the application of collective intelligence from many locations. GSD is quickly becoming the standard method in the software projects. Worldwide programming advancement enjoys many benefits in each progression of the product improvement life cycle. Because of its variety of groups, quicker critical thinking and tremendous expense investment funds and yet, there are many dangers implied which influences the achievement of the worldwide programming improvement in programming advancement life cycle. Due to lack of investigations about SPM for its contribution towards reducing risk in GSD, the software development teams are unaware about the ways of how SPM approaches can help them to treat risks they face while developing software in GSD paradigm. The aim of the study is to propose SPM approach for reducing risk in GSD environment.

1.4   Problem Statement

There are many advantages of GSD in terms of every step of software development life cycle. Due to its diversity of crowd, it is faster problem solving, significant cost saving and a rich source of data method. But, at the same time, there are great risk involved in this process, which affects the success of GSD in software development life cycle. Risks like communication gap [8], collaboration and coordination [9], geographical and cultural effects [10], technical effects [11], cost estimation [12], knowledge management risks [13] etc. To overcome this problem, there is a need to build a mitigation plans to improve the success rate of GSD in software development life cycle.

1.5   Research Questions

The primary and first goal of this study is to investigate existing research in order to critically evaluate current software demand prioritization strategies. The aim of the study is to discover the present risks that are encountered when using the GSD. The following key issues covered in this research. The research questions that we have:

1.5.1   What are the risk factors affecting the global software development projects to achieve its goals?

1.5.2   How can we reduce those risk factors by using software project management approaches?

1.6   Aim of the Research

A research aim describes the research study's desire or ambition; it encapsulates with hope to achieve at the end of the project in a single phrase. Your objective should be exact and written in such a way that it can be established when it has been achieved. This research covers the gap of identification of Risks of global software development and its mitigation plan to help all the stakeholders in the industry to achieve maximum results in the GSD projects.

1.7   Research Objectives

The main focus of this research is to develop a mitigation plan to overcome all the Risks of GSD. So, the survey is based on conducted list of questions through questionnaire objectives of our research are.

1.7.1   To identify the risk factors affecting the global software development projects to achieve its goals.

1.7.2   To reduce those risk factors by using software project management approach?

1.8   Thesis Organization

The next chapters of this study are organized as follow:

Chapter 2 covers the literature review (LR) in which the entirety of the subtleties is clarified with subtleties and related investigations. Bibliometric investigation is given in reference section for this part in which every one of the subtleties of related examinations and writing are added. This helps

to assist with supporting the theory.

Chapter 3 Reports the methodologies of this study which are used in order to pursue the research. Systematic literature review shows the gap in the field of software project management specifically for identifying the GSD risks that could affect SPM process in GSD environment. In this study mixed method research is conducted. Through mixed methodology described qualitative and quantitative research. Survey design guidelines were followed to do quantitative analysis. The survey design guidelines and all survey steps are described.

Chapter 4 discusses the results of SLR that, we have from literature. Through literature, we get 8 risk factors that are explained along with their frequencies. And, it justifies the first research question of this study.

Chapter 5 discussed the results of survey. The list of risk factors was forwarded to industry validate the risks of global software development. And, also got some mitigation strategies from the industry against each risk.

Chapter 6 discusses about the contribution related to the problem statement and on research topic. It also contains limitations and future work of the research.

CHAPTER 2

LITERATURE REVIEW

2.1   Overview

Global software development is a process of creating software projects by bringing together the teams from different locations of the world to work on it. These teams could be from the same company or from other organizations that collaborate. GSD teams have progressed from a single location to a multi- location setting. As a result, companies that create and/or maintain software products cannot ignore GSD's impact, as it is causing a significant shift in the way products are conceptualized, planned, built, tested, and delivered to customers [14]. Interest in GSD is quickly developing as the product business is encountering expanding globalization of business [4]. GSD alludes to programming improvement that is discrete over no less than two areas that are partitioned by public or mainland borders [1]. In GSD, partners from various public and hierarchical conditions and time regions are engaged with programming improvement. GSD is otherwise called a sort of reevaluating relations. Campbell R. Harvey's hypertext based Finance Glossary characterizes reevaluating as buying a huge level of transitional parts from outside providers [5]. Minimal expense programming advancement has consistently been the need of numerous associations. In the event that this minimal expense improvement accompanies the additional benefit of an excellent item, then, at that point it further builds the drawn-out benefits appreciated by the association [6]. Most of organizations have embraced GSD to acquire a few saw benefits, for example, decreased advancement time, admittance to talented HR for somewhat minimal price and expanded item quality [6].

One strategy to overcome the inappropriate communication practices shared by the development team may be to train software engineers in cultural diversity by using onlogy as a communication facilitator. The study of people's characteristics and the characteristics of their surroundings can

be useful in this regard. Emphasis on interpersonal communication will also be a part of any type of teaching training. The combination of clear communication measures, the use of synchronous technology and the freedom of work also solutions can solve communication issues. The response time to project emails with a time difference is usually large, so it is best to use voice communication using a video conference or speaking on Skype or any other live communication software. Fast communication is likely to reduce the time spent making key decisions, and the error rate can be reduced by involving customers. However, the involvement of customers should be minimal in relation to a specific issue, so that they do not have the feeling that developers are shifting their responsibility to them. In the context of GSD, face-to-face meetings should lead and follow the events outlined. The first task may include videoconferencing to keep partners away and get to know each other and the type of communication. The first step is to build the aircraft. Successful activities may include regular and frequent communication between participants to discuss software development issues as well as all management issues. In GSD, the type of work seems to be the most important factor in promoting cooperation among team members. Most communication activities influence behavior, resource sharing, and participation in feedback.

Planning and search for input behavior are equal, while comment search, work organization and group skills behavior have the highest proportions in planning and search for input areas, and reflection, supervision and social interaction have the highest proportions. proportions. Temporary social norms and time structures of team members participating in GSD projects are the main reasons why discussions are insufficient, which can lead to project failure.

As the software industry experiences increased globalization of business, interest in global software development is fast developing [15]. Software development which is scattered at least two geographic separated by limitations is referred to as global software development (GSD) [16]. Stakeholders from various national and corporate cultures, as well as different times due to different locations involved in the software development at GSD. GSD is often referred to as an outsourcing relationship. Outsourcing is defined as obtaining a considerable ratio of transitional mechanisms from outside providers, according to Campbell R. Harvey's Hyper Textual Finance Glossary [17]. Many firms have long prioritised low-cost software development. If this comparatively lower cost model of development come with the added benefit of a high-quality product, the organization's long-term benefits are increased even more [18]. The majority of businesses have adopted GSD for a variety of perceived benefits, including decreased development time, low-cost access to trained

human resources, and improved product quality [19]. An important feature in GSD is the promotion of software development in a variety of environments for reliability. Distributed monitoring leads to a better understanding of GDS team work through better communication and collaboration between teams. In short, different regions, different cultures, different customer perspectives and different authors of foundations can lead to failure. With this in mind, it is important to do a good job of correcting these issues. This research also discloses some of the remedies that have been implemented to address these risks. Based on qualitative interviews, thefindings suggest that there are risks associated with temporal, geographical, and socio-cultural distance [20].

Risks associated to the human factors in global software development discussed in the Benjamin's study [4]. The goal of this research was to first identify the risks associated with human variables in GSD, and then to offer a solution (or solutions) to help solve or reduce the overall impact of these risks. Propose a solution(s) that could assist in resolving or lowering the negative consequences of these Risks. Elzamly etl [2] discussed for successful software development, a framework software risk management technique was established. The purpose of this study is to present a new software risk management paradigm for successful software projects. The likelihood of a successful software project will be considerably increased if a successful software project risk management technique is used.

Saad Yasser etl [20] discussed risk management frameworks in global software development projects are defined as follows: The goal of this study is to give an overview of the existing risk management frameworks available in the literature for global software development projects. The two frameworks that were chosen are evaluated and compared. A Framework for Integration. The goal was to find mitigation solutions in the literature to partially or completely mitigate the consequences of risk factors connected to GSD project management.

Integration issues and requirements changes are additional factors in communication issues. There must be a balance of experience on each side of the communication, as the email system helps a bit in explaining the requirements. Therefore, GSD video conferencing is a suitable option for facilitating face-to-face communication. In agile software development, information is not hidden between teams and team members, making it a more suitable technology for GSD.

As a result, companies that create and/or maintain software products cannot ignore GSD's impact, as it is causing a significant shift in the way products are conceptualized, planned, built, tested, and delivered to customers [14]. Interest in worldwide programming improvement (GSD) is quickly developing as the product business is encountering expanding globalization of business [4]. Worldwide Software Development (GSD) alludes to programming improvement that is discrete over no less than two areas that are partitioned by public or mainland borders [1].

Gabriela N. Arena, etl [11] discussed nadequate communication by the team was a serious problem in the engineering work. Multicultural issues such as mother tongue, self- motivation, religion, communication are important issues that lead to poor communication in communication and create misconceptions about team performance during project development. In most cases, GSD occurs between the customer and the supplier companies, although there are other commercial organizations, such as a company that operates in different geographic locations. Client firms benefit from cost savings, and firms benefit from favorable government policies and tax subsidies. In addition, these companies are increasingly able to use telecommunications infrastructure in their home environments [3] and outsource their technical work to suppliers with shared risks, while still focusing on core operations. For example, the bank may focus on its key roles in the financial institution, working beyond this requirement for more skilled employees [14].

Helena Holmstrom, etl [12] discussed GSD categorized the problems into three factors: time zone distance, response delay, loss of communication and coordination, loss of overall workflow tracking, geographic distance in building trust, team and client membership, communication based on project stage, social and cultural distance covered by national culture, and motivation Self, religion, politics, misunderstanding, and team size, the three factors affected team communication that disrupted the performance of GSD teams. Although all of these benefits of GSD apply to consumers and retailers, the majority of consumers and retailers have failed GSD due to irregularities, poor management procedures, and poor planning [11]. He found that a culture of trust, relationships, risk and management is important for both consumers and businesses. In one study, it was stated that consumers should choose the quality of retail based on some key criteria by analyzing the information and experience gained in the industry [14].

Barry Bohm presented one of his previous work on software risk management [2]. He stressed the importance of risk management in software development for the following reasons: avoiding disasters, avoiding redesign, avoiding overloading, and promoting cost-effective solutions. GSD has influenced the way software is developed. It requires different structures from group development, including the risk management process. Not only does the risk management process need to be adapted to the GSD setup, but it is more important in distributed software development projects than in joint ventures [18]. GSD risk management needs to be implemented at various levels, strategic, tactical and operational. At the strategic and tactical level, risk management is needed to help make decisions about whether or not to distribute a project. At the performance level, risk management is often associated with the software development process or project manager [17]. Prikladnicki and colleagues [16] conducted a systematic review (SLR) to evaluate the effectiveness of the GSD system model. The study identified five strategies to reduce risk: building trust, assessing the potential of foreign partners, demonstrating performance effectiveness, increasing efficiency, converting a foreign partner to dynamic development.

Niazi etl [7] discussed the dangers of project management in global software development were investigated using a client-vendor research. This paper proposes a paradigm for managing software risk in global software development projects that will aid practitioners in identifying risk factors and mitigating their effects through a list of recommended mitigation methods. Successful project management in global software development is defined by Nicholas paper [21]. From both the client and vendor viewpoints, the goal was to identify the risks that could compromise the successful management of global software development projects. A two-phase strategy was employed in the method: first, a systematic literature review was used to identify the hazards, and then the identified risks were validated using a questionnaire-based survey. Results both methods yielded 19 risks that are crucial to the success of GSD project management. According to research of the risks, there are more parallels than differences between the Risks identified in client and vendor industries.

They report a case study pointed toward understanding a work to empower measure knowing for further developing cycles in GSD. The discoveries give valuable bits of knowledge into the expected difficulties of absence of cycle knowing and how an association can empower measure knowing for accomplishing the ideal outcomes that additionally help in expanding social collaborations and positive conduct change, a few correspondence obstructions have been addressed that lead to project disappointment. The need to utilize quicker, less expensive and savvy

method for specialized instruments has applied a ton of tension on programming experts to take into account the interest of the worldwide world. The few existing examination articles are assessed that arrangement with the utilizations of delicate figuring in programming improvement regions and gives future exploration headings. A near report on GSD to feature its benefits and bad marks. Our discoveries uncover that a significant part of the examination in this space has been centered around resolving issues looked by customer associations, notwithstanding, merchant side in the GSD relationship is highly overlooked because of which this region is as yet youthful; and, henceforth, further exploration work is needed to be embraced to resolve the issues looked by the seller organizations.

The author [23] discussed global software development challenges which are a case study on temporal, geographical and socio-cultural distance and present discoveries from a contextual investigation in which we investigate the specific difficulties related with overseeing GSD. Their investigation likewise uncovers a portion of the arrangements that are utilized to manage these difficulties. We do as such by exact examination at three US based GSD organizations working in Ireland. In light of subjective meetings we present difficulties identified with worldly, topographical and socio-social distance. The point of this investigation is, first, to distinguish the difficulties identified with the human factors in GSD and, second, to propose the solution(s), which could help in tackling or lessening the general effect of these difficulties. Recognize the difficulties identified with the human factors in GSD. Propose the solution(s), which could help in tackling or decreasing the adverse consequence of these challenges.

Elzamly etl [24] characterized an improvement of structure programming hazard the board philosophy for fruitful programming advancement. The point of this paper is to propose the new structure about programming hazard the board system for effective programming project. There are five essential stages, for example, documentation hazard, hazard examination and assessment, hazard treatment, hazard controlling, hazard correspondence and documentation for programming improvement life cycle. Their structure resultant information from polls and past information from programming organizations. Effective programming project hazard the executives system will extraordinarily work on the possibility of programming project achievement.

Saad Yasir etl [20], in global software development, defines the identifying and reducing risks of the software project management.

This study is two parts:

(1) From the literature, identify features connected to successful project management in GSD and validate the identified elements in real-world experience.

(2) To Connect the discovered criteria to the PMBOK's 10 knowledge domains for project management.

To find mitigation measures that can be used to partially or completely mitigate the effects of risk factors connected to global software development project management that have been identified in the literature, as well as variables given in earlier study. They used six classification criteria to conduct a systematic mapping study. A total of 84 publications were chosen and examined. The findings show that since 2007, there has been an increase in interest in SPM for GSD. Coordination, planning, and monitoring methods, as well as estimation strategies that utilized, are the most often mentioned methods (40 percent). They attempted to uncover various communication challenges that frequently generate severe problems for GSD project developers, customers, and testers in this study [18].

A framework for the global project management and presentation was made which discussed the collaboration of different models [22]. The findings show a lack of study in important areas including technologies, culture, people, and information, all of which offer up new research possibilities while also revealing fresh potential in GSD governance. The study's goal is to develop a framework for global project management and performance. The study, which was based on a study of 19 dispersed projects in a Latvian software development firm, provides information on a variety of collaboration methods and project features, as well as areas of concern and distinct hazards.

A framework was developed to identify the nature of global software development risks and to create a comprehensive risk assessment [23]. In this paper, they discuss research that aims to investigate the nature of global hazards and design a comprehensive and user-friendly risk management system. They emphasize the significance of being aware of global aspects and risks that define distributed initiatives and require careful attention throughout the project's duration. The studies also highlighted that the hazards of GSD are changing, as the key challenges were initially tied to various sorts of distances (geographical, temporal, sociocultural, language).

The authors [15] said that GSD (worldwide programming improvement) is normal and generally utilized in now a days due to Coronavirus period. At the point when organizations venture into new commercial centers across the globe, procuring organizations in different nations, and select qualified architects in new areas, projects should be overextended out. As tasks are turning out to be more spread and incorporate outer partners like re-appropriating organizations, ordinary top administration checking and control turns out to be more troublesome. How could organizations affirm that all gatherings in a product improvement project are acting in congruity with the venture's system vision and targets? The Worldwide Teaming Model is a most noteworthy and idea-based design for worldwide 20 programming advancement. As an outcome, it tends to be utilized to sort out GSD techniques for Software Development Governance. To find administration issues, a contextual analysis of a little gathering engaged with Global Software Development was led. The Global Teaming Model was then used to foster administration techniques to address the weaknesses. The suggestions in the Global Teaming Governance Model would work on an assortment of components of the group's relations with different groups inside the organization. The Worldwide Teaming Model is a product advancement control model that organizations might take on to deal with the globalization of existing development projects.

A Knowledge Base and a Risk Barometer have been created to assist practitioners who are new to global projects [7]. The characteristics of internationally distributed projects, as well as their impact on project performance, are codified in a reusable framework for dealing with uncertainty. The tools given provide input for risk identification and aid in risk evaluation based on previous project experience. This article outlines a method for recognizing project hazards early on. It collects data from past initiatives in a systematic way. As a result, the model can separately analyze risks for each project. It was made with the help of 19 practitioner interviews and qualitative content analysis. For this type of research, the article discusses how to depict a global software development project. The project is viewed as a complex socio-technical system with interlinked functional components and output-input interactions. The parts are not equivalent to the task's authoritative units, and their groups might be dispersed across the venture's topographical and hierarchical scene. In an IT association, the danger contemplations for worldwide professionals. This examination presents study research techniques to determine the on-going relationship of seaward and on location groups in GSD projects. Out of ten determinants, seaward and on location groups information sharing (KS) and information move (KT) mean qualities was previously. Their examination was seen from the

study results that seaward and on location groups' information sharing and information move has critical relationship with GSD project result.

A Socio Technical Systems (STS) obligation model is made for worldwide specialists to show the connection between worldwide experts inside an association structure and to portray the danger of worldwide professionals utilizing a bunch of graphical documentations [5]. This exploration likewise makes a Multiagent Simulation Model (MASM) to assess the danger of worldwide experts acquiring the trust of task partners. A Systematic Literature Review (SLR) was attempted to distinguish the entirety of the correspondence related issues in GSD. From that point onward, a reasonable structure was given for investigating the effect of different contemplations on correspondence hazard in GSD. The danger factors related with overall specialists in an IT firm are determined utilizing this technique, which is laid out in this examination. It incorporates a Multiagent Simulation Model (MASM) for assessing worldwide specialists' ability to acquire certainty from a wide scope of partners in worldwide programming improvement (GSD).This study emphasizes the sequential activities for monitoring risk and its associated worry using multi-agent. The purpose of this study is to see how much consensus there is among major stakeholder groups within a company about the value of software quality attributes developed as part of an outsourcing arrangement. Furthermore, the research aims to identify characteristics that influence. The different groupings were discovered to be aligned to variable degrees. Misalignment was recognised as a result of cultural characteristics, quality control in the development process, short-term versus long-term orientations, awareness of the cost-benefits of quality improvements, communication, and coordination. One of the leading human development methods can increase SQM (square metre) of projects developed under global software development [24]. The examination's discoveries show that mentorship respectably affects SQM. The program was enlivened by the developing pattern in the product business to foster programming in universally circulated conditions, for example, geologically conveyed groups or re-appropriating parts of programming advancement to different firms all throughout the planet. The studio's introductions and conversations focused on reasonable, down to earth thoughts and strategies for managing the geographic, fleeting, authoritative, and social obstructions that emerge in worldwide programming projects. In this paper, they present necessities following choices to further develop hazard the executives by explaining prerequisites, working together, and overseeing information. They propose ideas for better prerequisites following, like necessity avocation, related choices and their set of experiences, and partner incentives. They foster a money saving advantage model to assist with projecting supervisors decide if the following methodology is adequate for managing necessities hazard in a

venture. They give the consequences of an examination project designated at better understanding a work to empower measure information for upgrading GSD methodology. The discoveries give light on the expected risks of an absence of cycle information, just as how an association may utilize measure information to accomplish its objectives while additionally uplifting social communications and positive conduct changes. The point of this paper is to recognize if tutoring, one of the lead staff advancement apparatuses, can further develop SQM of undertakings created under GSD. The outcomes acquired in the examination uncover that the impact of tutoring on SQM is simply calm. The studio was propelled by the business pattern towards creating programming in internationally appropriated settings: topographically dispersed groups, or re-appropriating portions of the product advancement to different associations in different pieces of the world. Subjects introduced and talked about in the studio zeroed in on grounded, functional procedures and strategies that address the geographic, fleeting, authoritative, and social limits innate in worldwide programming projects. They address necessities following alternatives to work with hazard the executives with prerequisites explanation, coordinated effort, and information the board. They propose ideas for improved necessities following that incorporate the reasoning for prerequisites, related choices, their set of experiences; and partner offers. They sketch a money saving advantage model that helps the task chief to get what following methodology is advantageous to address prerequisites hazard in a venture. Mehmood has addressed several communication hurdles that lead to project failure in global software development [25]. The desire for communication tools that are faster, cheaper, and more cost-effective has put a lot of pressure on software developers to meet worldwide demand. Several existing research publications dealing with the applications of soft computing in communication barriers of software development sectors are examined in this study, as well as future research directions. The current study's goals are to identify the important barriers/risks that obstruct communication at any level of the software development process for various types and sizes of projects in the global software development ecosystem. "Lack of communication," "lack of sufficient documentation," "lack of compatibility," and "architecture mismatch" are among the top impediments. The consequences of our industry study are for the most part predictable with the discoveries of the SLR. The rankings of the different boundaries/Risks, notwithstanding, varied across the two informational collections (SLR and modern study). Programming merchants should effectively deal with the featured worries to lessen the intricacy of the mix interaction in GSD projects. In this work, they share relative examination on GSD to feature its advantages and restrictions. Their discoveries uncover that a significant part of the examination in this space has zeroed in on resolving issues looked by customer associations; nonetheless, the merchant side of the GSD relationship has been generally overlooked, bringing

about this space staying juvenile; and, subsequently, more exploration is expected to resolve the issues looked by seller organizations.

Childra [20] discussed the elements that influence task allocation were investigated in the context of worldwide software development project management. They started with a thorough Systematic Literature Review (SLR) to develop a set of characteristics that influence task assignment in GSD projects. Second, we developed a questionnaire survey based on the SLR and collected feedback from 62 industry professionals. Technical competence on site, time zone variations, resource prices, task dependency, task size, and vendor trustworthiness are the most critical criteria in deciding how work units are divided in a GSD project, according to the results of this combined SLR and questionnaire survey. However, data from industry research reveals that resource cost and task dependency are more important in a centralised GSD project structure, but task size is a critical aspect in a decentralised GSD project structure. Using Media Synchronicity Theory as a framework, they investigate the capabilities of various communication channels for facilitating software engineering across distances [21].

With global software development, the author highlighted the advancement of offshore and onsite teams [2]. The survey results revealed that knowledge exchange and information transfer between offshore and onshore teams had a substantial impact on the outcome of global software development projects. When a corporation embarks on its first GSD project, it assumes a lot of risks. The development team's lack of experience with GSD projects causes several of these problems. Following a systematic literature review (SLR), a repository was created that collects the dangers that RE confronts when produced in a distributed software development environment, as well as a set of safeguards that can help alleviate those risks. This article outlines a risk and compliance management framework for outsourced financial applications and ERP systems. A Systematic Literature Review (SLR) has been performed to perceive all the correspondence related issues in GSD. Starting there forward, a hypothetical design has been proposed for evaluating the impact of those issues on correspondence risk in GSD. A precise appraisal has been performed on data assembled from the item relationship of Pakistan working in GSD based environment. The finding of our investigation shows that topographical distance, socio-transient distance, socio-culture distance, colleague's demeanor, group issues, authoritative and compositional issue and client issue straightforwardly affect correspondence hazard in GSD. This work tries to comprehend the degrees of arrangement between key partner bunches inside an organization on the need given to parts of programming quality created as a feature of an offshoring relationship. Moreover, the

investigation means to recognize factors affecting the degrees of arrangement. Different degrees of arrangement were found between the different gatherings. The purposes behind misalignment were found to incorporate social variables, control of value in the advancement cycle, present moment versus long haul directions, comprehension of money saving advantages of value upgrades, correspondence and coordination. At the point when an association initially leaves upon a GSD project it opens itself to a lot of dangers. Large numbers of these dangers show up because of the absence of involvement of the advancement group on GSD projects. A Systematic Literature Review (SLR) has prompted the assemblage of an archive which accumulates the dangers that worry RE when created in a dispersed programming improvement climate, just as a bunch of shields, which help beating such dangers. The goal of this exploratory examination is to acquire an inside and out comprehension of hindrances that can sabotage SPI, with regards to Global Software Development, according to the point of view of programming advancement professionals; this will empower SPI directors to more readily oversee SPI drives. They expect to find if the obstructions to SPI drives in a created nation are distinctive to those in a non-industrial nation. They recognize (1) absence of venture the board, (2) absence of assets, (3) absence of sponsorship, (4) unpracticed staff/absence of information, and (5) absence of SPI mindfulness as 'high' esteem SPI obstructions in Vietnam. The outcomes additionally uncover similitudes and contrasts between the encounters of professionals with respect to the significance of the SPI boundaries distinguished.

Prikladniki Lee [23] identify threats in management included in the software development process. As a result of this process, risk assessment is performed on a case-by-case basis during site design and selection. Based on the selected website, a history is created of the beach threat that is used for active threat management. This approach shows how risk can be identified and managed for each project, depending on the choice of development sites. In particular, it carries out a general process, without instructions, to identify specific risks based on certain characteristics of a site. Therefore, this can be seen as a general process framework to be complemented by GSD-specific risk models.

Rollite et al. It presents a special GSD model that includes the specific risks posed by the decentralization of the GSD project [22]. This risk structure can be partitioned into two measurements: distance (topographical, fleeting, socio-social, institutional, innovative, intellectual) and action (correspondence, coordination, control, advancement, support).

For every mix of these two measurements, give a rundown of explicit issues that might emerge in the undertaking. The recognizable proof of these issues depends on a bibliographic audit. At times, hazard decrease arrangements are advertised. To apply the system for explicit ventures, project-

explicit dangers and arrangements should be chosen from the proposed list.

These are the issues and dangers that can emerge in GSD projects, are given below arranged into the four main thrusts of the world: effectiveness, presence, ability, and adaptability. The danger of every classification is investigated dependent on the creators' experience l writing survey. Albeit the quantity of distinguished dangers is somewhat little, this methodology focuses on risk reduction and offers suggestions on how to overcome the problems. As with the previous method, this is generally done: the method identifies some potential problems in the reduction project and then leaves it to the user to identify potential problems that arise in the particular activity.

Smite [24] discussed a specific method of risk assessment that is more suitable for determining the risks specific to each job. The approach outlined between threats may not be ideal in this situation and the results of the Outcome Projects. According to historical records, the threat was related to the incident and evidence of the incident. This makes it possible to identify a specific situation if there is a personal risk to the job. However, this approach relies on very detailed historical data and does not explain why a particular threat could cause problems or consequences.

Beckham Pretem [10] presents a framework for integrating the norms of several worldwide software development risks. They've handled this risk by extending the SABSA model to include these standards' integration. As a result, the framework explains customers' and outsourcing businesses' duties, allowing for more effective risk and compliance management. The objective of this exploratory investigation is to acquire a superior comprehension of the boundaries that can undermine sequential fringe interface drives with regards to worldwide programming improvement according to the viewpoint of programming advancement experts. This will help SPI chiefs oversee SPI drives all the more successfully. They need to check whether the boundaries to SPI drives vary in created nations as opposed to agricultural nations.

2.2   Summary

In this chapter, we covered our first question which is what the risks factors are which effects the success of global software development. First of all, we did literature review on the global software development to discover the dangers of the GSD. This Study discover seven significant dangers of

the GSD by evaluating the 35 papers from the writing survey which are vital dangers, correspondence and joint effort chances, social dangers, information the executives' hazards, specialized dangers, item and interaction the board dangers, instruments and topographical dangers. This study likewise checked on the product project the executives writing how can work on the dangers of GSD programming projects.

Chapter 3

METHODOLOGY

3.1   Overview

In Chapter 2, this study reported the literature that showed the gap in the field of software project management specifically for identifying the GSD risks that could affect SPM process in GSD environment. In this Chapter, the set of methodologies used in order to pursue the research are reported and discussed.

3.2   Research Design and Procedure

The Systematic Literature Review (SLR) and mixed methodology were used in this study. SLR was conducted to review the existing literature related to software project management. This SLR involved a comprehensive review and critical analysis of existing studies on and around the area of software project management and GSD. We performed SLR as it helps to conduct a thorough and fair literature review due to its predefined search strategy. The prime objective of this SLR was to come up with the list of risk factors that could affect SPM process in GSD environment. Mixed method research is conducted to described qualitative and quantitative research. Survey design guidelines were followed to do quantitative analysis.

3.2.1 Quantitative Research

The method involved with gathering and examining mathematical information is recognized as quantitative exploration. It very well might be used to look for models and midpoints, expect events, review fundamental linkages, and generalize results to greater social affairs of people [27].

3.2.2 Qualitative Research

The strategy of gathering and investigating mathematical information is known as quantitative exploration. It can likewise be utilized to search for patterns and midpoints, anticipat. Quantitative research approaches may be used in explanatory, co-relational, or empirical studies [28]. In contrast to quantitative research, qualitative approach doesn't really necessitate the collection and analysis of numerical data for statistical data. Qualitative research is used to learn more about people's perspectives. Theoretical framework, ethnographic, action research, phenomenological study, and research methodology is a systematic are all common approaches.

They have certain similarities, but their goals and perspectives are indeed very different.

- Observations**:** To make thorough the field notes about anything you've witnessed, heard, or come across.

- Interview**:** You can have one-to-one talks with them and ask them a question.

- Focus groups: Questions are framed to a group of people, and have a discussion ensues.

- Questionnaires with open-ended questions: distribute surveys with open inquiries.

- Secondary study: gathering information already available in text form, photos, auditory, filmed recordings, and so on.

- Quantitative research approaches may be used in explanatory, co - relational, or empirical studies

3.2.3 Benefits of qualitative approach

Respondents' voices and viewpoints are frequently protected in subjective examination, and it tends to be modified when new exploration points create. Subjective examination is helpful for the accompanying purposes:

- Flexibility: As new thoughts or patterns emerge, the assortment and investigation of information technique can be changed. They aren't actually foreordained ahead of time.

- Natural setting: Data is gathered in genuine settings or even precipitously.

- Meaningful insights: As fresh ideas or trends arise, the collection and analysis of data method can be adjusted. They aren't really predetermined in advance.

- Generation of ideas: Researchers can identify startling issues or openings that they might not have considered in any case on account of open-finished reactions.

3.2.4 Drawback of qualitative approach:

When assessing and deciphering information, scientist should distinguish both functional and hypothetical imperatives. Subjective exploration has the accompanying downsides:

- Unreliability: Due to wild angles that affected information with in genuine world, clear investigation is habitually problematic.

- Subjectivity: Descriptive strategy can't be recreated in light of the fact that the examination's essential obligation is to decipher the information.

- Limited generalizability: Small examples were habitually used to get exact data on specific circumstances. Notwithstanding modern examination measures, generalizable discoveries are hard to draw since the information might be one-sided and non - delegate of the bigger populace.

- Labor Intensive: While programming could be utilized to deal with and record gigantic amounts of data, information investigation is normally done the hard way.

3.2.5 Mixed Method Research

Mixed methods research, that is an academic and practical integration of qualitative research, is the set of methods or research paradigms. It acknowledges the value of traditional quantity and quality study, but it also provides a powerful triple paradigm choice that frequently produces the most perceptive, comprehensive, balanced, and helpful study outcomes [4].

Mixed methods, as according Creswell and Clark, is better suited to issues for which one source of data is unsatisfactory, ii) findings have to be clarified, iii) explorative findings have to be generalize the results, iv) a second procedure is necessary to complement the main means, v) a conceptual stance is required, and vi) an as whole objective of the research can be better handled with different techniques [5] [6].

Figure 3. 1: Process Diagram of Mixed Method Research

The mixed-methods family for empirical software development techniques is described in this specialized briefing, which describes how quantitatively empirical research methodologies can be combined [7].

In mixed methodology, we will use questionnaire from quantitative research in survey form.

3.3   Research Context and Justification

Using only a questionnaire which will be circulated to industrial and professional responders, we will determine the issues of global software development through a systematic literature review and then identify all of those hazards, as well as mitigating methods to meet those issues.

3.4   Systematic Literature Review

We performed the systematic literature review (SLR) in order to identify the risk factors which could influence SPM process in GSD environment. In our attempt to review, we followed the work of Kitchenham (2007; B. Kitchenham, et al., 2009) as it is the most comprehensive guideline for conducting SLR in field of software engineering. Our SLR comprised of three parts: Review planning, Review conduction and Results reporting. Figure 3.2 shows the overview of the SLR steps.

Result Reporting

Review Conduction

> 6. Identification of research
> 7. Selection of studies
> 8. Study quality assessment
> 9. Data extraction and monitoring progress
> 10. Data synthesis

Review Planning

> 1. Research goal and research questions identification
> 2. Identifying the keywords
> 3. Identifying the sources
> **4.** Identifying the inclusion/exclusion criteria
> 5. Identifying the data extraction strategy

Figure 3.2: Overview of SLR steps (B. Kitchenham, 2007)

Research Goal and Research Question: The goal of this SLR was to come up with a unique list of risk factors which can influence SPM process in GSD environment. The unique list of risk factors with their associated categories answered our research question 1 (RQ1).

Keywords/ Major Terms: We identified the key terms of Software Project Management, risks and Global Software Development. We identified the alternate spellings and synonyms for Major Terms as shown in Table 3.1

Table 3.1: Synonyms of the key terms

Key Terms	Synonyms
Software Project Management	Project Management, Software development lifecycle, SPM approaches, SPM tool, people management, software industry, Knowledge areas.
Risks	Risk identification, Software risk management, Software risk factors, Risk management techniques
Global Software Development	Worldwide software development, Distributed software development, large scale software development, geographically distant team software development, Virtual teams' software development

The search string was formulated based on the main terms and its synonyms, shown below.

(Software Project management OR All synonyms of Software Project management) AND (Risks OR All synonyms of risks) AND (Global software development OR All synonyms of Global software development).

The search string was tailored based on the interface of database. The search strings used for SLR conduction is shown in Appendix A.

3.4.1 Search Process

It was an atomized search of specific databases. Seven databases were selected named as; ACM, IEEE Xplore digital library, Google search, Wiley inter science, and ISI web. The reason of selection of above-mentioned databases was that they were acknowledged to include software engineering literature. Each database was reviewed for journals articles, workshop papers, conference papers, books chapters and published thesis. The data sources (papers) that addressed risk factors influencing SPM directly or indirectly were recognized as potentially relevant. For searching the specific database, we applied the comprehensive and thorough inclusion/exclusion criteria to the relevant data sources (papers).

Table 3.2: Name of Databases

No #	Name of Databases
1	ACM
2	IEEE Xplore Digital library
3	Google Search
4	Wiley Inter Science
5	Science Direct
6	Web of Science
7	Scopus

3.4.2   Study Inclusion and Exclusion Criteria

The hazards connected with GSD are the primary priority. Research studies are separated dependent on their help for logical proof in the particular field. Coming up next are the necessities for completing examination study.

3.4.3 Inclusion Criteria:

Our inclusion/exclusion was based on following criterion:

- We included all the articles from the databases that were either discussing SPM in general, SPM for GSD in specific, Risks related to SPM in GSD and risks in GSD in general.

3.4.4 Exclusion Criteria:

The studies which were excluded from our dataset were either;

- The unpublished research papers in English

- Papers which were repeated in our data sources were excluded in the later stages.

- Table of contents, or giving information related to proceedings of conference and workshops, or on basis of their Title.

- Papers which were not having any of the keywords Software Project Management, Risks, and Global Software Development.

3.4.5 Quality Assessment Criteria

To evaluate the quality of primary research programs, the qualitative evaluation criteria (QAC) were developed. The QAC is a set of research inquiries which are used to assess the quality of the study. We assessed the quality of the selected studies by adopting a check list from the work of (B. Kitchenham, 2007). Table 3.2 shows the checklist we used for assessing the studies quality.

Table 3.3: Quality assessment checklist

No #	Question	Answer
1	Are the aims clearly stated?	Yes/ No/Partially
2	Are the findings credible and important?	Yes/ No/Partially
3	Are the prediction techniques used clearly described and their selection are justified?	Yes/ No/Partially
4	Is the knowledge or understanding been extended by the research?	Yes/ No/Partially
5	Is the diversity of perspective and context been explored?	Yes/ No/Partially
6	Are the links between data, interpretation and conclusions are clear?	Yes/ No/Partially
7	Does the detail/ depth/ complexity of the data is conveyed?	Yes/ No/Partially

The questions were scored as follows:

_ QA1: Y (yes), the aim of the study is clearly defined; P (Partly), the aims are implicit; N (no), the aims are not defined.

_ QA2: Y, the findings of the study is convincing and reliable as it is based on comprehensive set of peer reviewed published work; P, the findings of the study is based on few papers which are even not published in peer reviewed journals and conferences; N, the findings are not credible and important as it is based on assumptions only.

_ QA3: Y, the identification techniques and methodologies are clearly described and justified by the study; P, the identification techniques are mentioned but not defined clearly and comprehensively; N, the identification techniques are neither defined nor justified.

_ QA4: Y, the knowledge of the previous cited studies is broaden by the study by giving progressive contribution to the area of research; P, the knowledge of the cited studies are discussed but no important contribution is performed; N, the study is not extending the knowledge and understanding of the previous studies.

_ QA5: Y, the area of research is explored by the researchers diversely by looking into various perspectives; in short multiplicity of the idea is explored; P, the study is exploring the idea but some parts are diversely explored and some are ignored; N, the study is not discussing the context of research diversely.

_ QA6: Y, the study is organizing the study data in an understandable and traceable manner where every interpretation and conclusions are clear and easily be linked; P, the study is using the data extracted from the other studies but it is not easy to trace that data due to its inappropriate organization; N, the study lacks the links between the data, its interpretation and conclusions.

_ QA7: Y, the study is discussing the concept in detail and its complexity is conveyed to the reader; P, the study is discussing the concept and its complexity in general; N, the study is not discussing the data in detail.

The Quality evaluation procedure of this study was a coordinated process, where the studies were randomly allocated to researchers who were post graduate students. We organized the researchers in four main groups. Each group was comprised of 7 members. In total 196 papers (after applying inclusion and exclusion criteria) were randomly distributed among four groups. Each group was

provided with 49 papers. In specific every member of the group was given 7 papers to assess its quality, based on the above-mentioned checklist, as shown in Table 3.3. The scoring procedure was $Y = 1$, $P = 0.5$, $N = 0$. The feedback against each question of the checklist was recorded and given the values accordingly. The scores for each paper were accumulated. We selected those papers whose accumulated summed values were either 5 or above 5. We found that among 196 papers 32 papers were having accumulated summed value below 5. So, remaining 164 papers that were having accumulated summed values above or equal to 5 were selected and reviewed for identification of situational factors that could affect SPM process in GSD environment. The tables showing the quality scores of the selected studies are shown in Appendix B.

Data Extraction: The data extracted from each of the paper was: Paper source(data base; conference, journal, book) with its full reference, Paper Title, Authors, Year of publication, and risk factors. Table 3.4 shows the example of a study information form for one of the data source. We tabularized all the selected data sources in similar information forms. The example of study information shown in Table 3.3 shows the data source id (which is unique for each of the data source), title, authors, publication year, publication type (journal, conference, standard etc), and the identified data units from the data source.

Table 3.4: Study information form

Data Source	Data Unit information
Id	SFP27
Title	ISO 9001 for Software Organizations
Author	Weissfelner
Year of Publication	1999-2000
Publication Type	Standard
What are the data units which may lead to varying situations?	Organization Size
	Organization Work environment........

3.4.6 Qualitative Analysis

We performed qualitative analysis on the data units gathered from SLR in order to generate a unique list of risk factors. We used techniques from Grounded Theory. This is a commonly used mature theory that "emphasizes the systematic approach to data collection, handling and analysis" (Douglas, 2003). Our research also inquired about to implement a corresponding systematic approach for handling and analyzing the data. Therefore we borrowed three main techniques for data management and analysis from Grounded Theory (Barney Glaser & Anselm Strauss, 1992; D. Rennie, 2006; D. L. Rennie, Phillips, & Quartaro, 1988). The techniques used were (1) Data coding, (2) Data constant comparison, and (3) Memoing. Figure 3.3 defines the techniques of data coding, constant comparison and memoing.
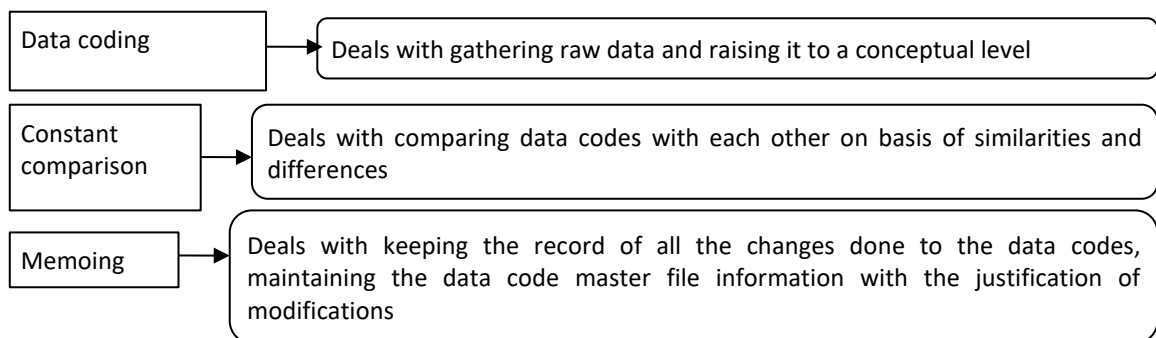
Figure 3.3: Techniques, adopted from Grounded Theory (Barney Glaser & Anselm Strauss, 1992)

Data analysis in Grounded theory involves coding i:e, "taking raw data and raising it to a conceptual level" (J. M. Corbin & A. L. Strauss, 2008). Data coding involves relating or interacting data by making comparisons among them, and in doing so, obtaining concepts for that data, then rising those concepts in terms of their properties (J. M. Corbin & A. L. Strauss, 2008). Therefore, basically coding is "the process of defining what the data is about" (A. Bryant & Charmaz, 2010), and "deriving and developing concepts from data" (J. M. Corbin & A. L. Strauss, 2008), where "codes capture patterns and themes and cluster them under an evocative title" (Antony Bryant & Charmaz, 2007).

Coding comprised of three main phases; Open coding, focused coding and axial coding. Open coding is a process in which data is reduced into small set of themes that helps in describing the phenomenon under investigation (Charmaz, 2007). Open coding remained open to explore

whatever theoretical possibilities we can determine in the data and moves us to take decisions about core concepts and categories. At this stage of coding data with data comparison takes place to come up with unique identification of data units. For our research, open coding was the initial step towards defining our core situational factors and their related categories based on the generated data units. In our research we named these data units as sub-factors.

Focused coding is the second phase of coding. It is a process where establishment of the strong analytic directions among the data units are generated. It is the decision about which data unit generated from the open coding makes the most analytic sense with each other (Charmaz, 2007). In our research, focused coding directed us to develop an analytic sense among the sub-factors genereted from open coding and enabled us to cluster them in situational factors.

Axial coding is the third phase of coding where data is brought back to a whole based upon their properties and dimensions. It is process where categories are created and are linked with sub-categories and the data is reassembled (Charmaz, 2007). In our research, axial coding directed us to identify the common properties and dimensions among the sitational factors and enabled us to brought them back into a whole called category.

Throughout these data coding phase's constant comparison and memoing was performed. Constant comparison technique of Grounded theory relates with the analytical process in which data is compared with other data on basis of similarities and differences (J. M. Corbin & A. L. Strauss, 2008). In this technique, inductive process of comparing "data with data, data with category, category with category and category with concepts" generates abstract concepts and theories (A. Bryant & Charmaz, 2010) that help to differentiate one category to another and to identify properties specific to that category (J. M. Corbin & A. L. Strauss, 2008). In our research we also had to compare various situational factors, sub-factors and categories iteratively, for their similarities and differences until we got the core and unique situational factors, sub-factors and their categories. We performed data filtration process on basis of similarities and differences among the data. Data coding with constant comparison is a complex process as more than one category and properties can relate to various level of conceptualization (Glaser, 1998). Therefore the complexity can be kept tracked by using memoing technique (A. Bryant & Charmaz, 2010; Glaser, 1998) that is basically a "written record of analysis" (J. M. Corbin & A. L. Strauss, 2008). We used memoing for tracking and recording the changes and modification [7]. The implementation and

examples of data coding and constant comparison and memoing techniques are discussed and shown in Chapter 4; Section 4.1.1.

3.4.7 Data Synthesis

The conclusions are summarized, which is based on information acquired through primary studies. For collecting data, both descriptive and inferential statistical approaches are used. SLR evaluates data from multiple worldwide software development approaches based on empirical evidence, documented needs prioritization aspects, and scalability and complexity challenges. We synthesize data in tabular form and in the form of points. The results of SLR are mentioned in the form of points and the results from survey are shown in the tabular form. And, the proposed strategies are also synthesized in tables form.

The results from Systematic Literature Review are shown in chapter 4.

3.5 Survey

A survey was conducted by following the guideline of Kasunic (2005) published by Software Engineering Institute (SEI). We followed his work as it is most commonly and widely used handbook for conducting effective survey in field of software engineering. Figure 3.4 shows the steps for survey conduction.

Research objectives of Survey Conduction: The objectives for survey conduction were:

Objective 1: To identify the Risks of the of global software development to achieve the success of software projects.
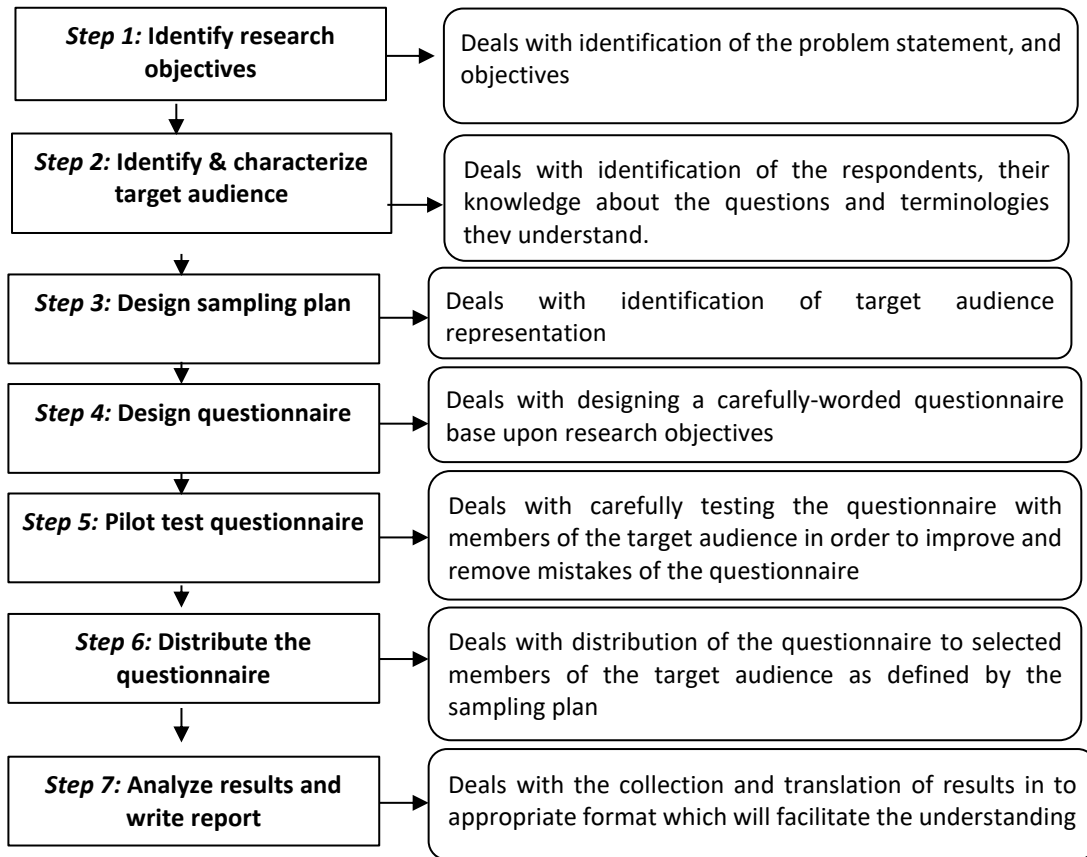Objective 2: To propose a mitigation plan to overcome those Risks in GSD.

Step 1: Identify research objectives	Deals with identification of the problem statement, and objectives
Step 2: Identify & characterize target audience	Deals with identification of the respondents, their knowledge about the questions and terminologies they understand.
Step 3: Design sampling plan	Deals with identification of target audience representation
Step 4: Design questionnaire	Deals with designing a carefully-worded questionnaire base upon research objectives
Step 5: Pilot test questionnaire	Deals with carefully testing the questionnaire with members of the target audience in order to improve and remove mistakes of the questionnaire
Step 6: Distribute the questionnaire	Deals with distribution of the questionnaire to selected members of the target audience as defined by the sampling plan
Step 7: Analyze results and write report	Deals with the collection and translation of results in to appropriate format which will facilitate the understanding

Figure 3.4: Steps for survey conduction, adopted from work of Kasunic (2005)

3.5.1 Sample Size

A sample is the subset of the total population, having characteristics of the population. In this study, the questionnaire was sent to the person who are working in industry. A contact person from the industry was selected so that the questionnaire could be forwarded to the relevant person and accurate feedback could be gathered. Sample size of this research consisting of 100 respondents that's are chosen from the industry which have answer to all questions.

3.5.2 Respondent's profile for survey

Kasunic [31] discussed in Software Engineering survey, gives a set of basic parameters for obtaining the major qualities on defining the intended audience. This study likewise suggest grouping them

as reliant (" D," typically alluding to respondents' experience) or autonomous (" I," for the most part alluding to because of segment attributes) from the examination setting, and pick the objective that dependent on the accompanying variables.

- Size
- Role and Responsibilities
- Level of Education
- Relevant Experience (D)
- Knowledge of Domain

3.5.3 Response format

The respondents' responses gathered using the following methods:
- Google forms
- Excel sheet

3.5.4 Justification for Survey

First, the survey recognizes the GSD Risks utilizing a precise writing study, and possibly list those Risks, just as the mitigation technique for conquering those Risks, utilizing a survey that is disseminated to industry proficient respondents.

Subsequently, the review helps with the approval of the discoveries from the writing research by affirming them with practitioners and industry experts.

3.6 Verification and Validation of Framework

The Risks of global software development which is acknowledged from the writing audit are checked from directing the overview from the professionals and from industry. This study verifies data from experts through survey. And, its validation is through secondary study.

Then, its time to approve those Risks. Through triangulation, the moderation plan is approved by directing a center gathering.

3.7   Objectives and Activities

The objective of this study is to identify GSD risks and afterwards propose a relief methodology to build the accomplishment of publicly supported programming projects.

To do such undertakings, we do a writing search to distinguish GSD dangers, and afterward direct a study to affirm those dangers. Then we conduct a focus group to confirm the mitigation plan's validity in terms of improving GSD's success.

3.8   Data Collection

In this segment, data is collected through survey and focus group. We have directed a study on every one of the significant risks of the GSD from the deliberate writing survey from the business through google structure. It was just online-based review on account of COVID precautionary measures. Then, assess the review information through dominate sheet by discovering the Cronbach alpha worth and afterward perceive the number of qualities that are acknowledged and dismissed in the study. Afterwards, those risks are approved from the center gathering too. Then, direct the center gathering and see the acknowledgment and SLR the outcomes from Survey are discussed in chapter 5.

3.9   Summary

This chapter described the research design used for data collection and data analysis with the set of methodologies and techniques to achieve our research objectives. This chapter has reported the steps to conduct systematic literature review (SLR) with the detail description of the data coding

techniques. The criteria to select the experts and the steps to conduct expert review are also reported in this chapter. the survey methodology is also described with the set of activities that were performed to gather the industry responses. The implementation of the SLR methodology and its output is detailed in Chapter 4, the implementation of the survey methodology and its results are reported in Chapter 5.

Chapter 4

SLR Results

4.1   Overview

In this chapter, the list of risk factors, sub-factors and their associated categories are described which were identified from the literature. This study covered the first question of this study through SLR, which is what are the risks factors that effects the success of global software development. Basically, this chapter illustrates the results of the SLR results.

4.2   SLR Findings

Methodology of SLR is reported in chapter 3 section 3.2.

In this study Systematic Literature Review was done by focusing 35 papers and find total of 8 risks which are strategic risks, collaboration risks, communication and cultural risks, knowledge management risks, product, technical risks and process management risks, tools and geographical risks that were affecting the success of global software development.

The details of the papers is attached in appendix A.

Table 4.1 shows the identified risks and its frequency or the references. Table comprises of two columns namely risks and references. In total we have identified 8 risks that is shown in the table 4.1

Table 4.1: Frequency of Risk

Risks	References
Geographical Risks	P1, P4, P13
Technical Issues	P3, P10, P12, P19, P26
Communication	P19, P28
Coordination	P7, P15, P24, P32
Knowledge Management	P17, P18, 3P0
Socio-Cultural	P21, P25, P28, P33, P35
Time Management	P11, P15, P22, P26
Cost	P1, P12, P17, P19

- Geographical issues effect Global software development with loss of data in transferring between teams, different perspective, lack of face to face and personal relationships and reduced communication within the team.

- Technical issues effect Global software development with limited infrastructure, tools, and Techniques. Low quality of telecommunication bandwidth and technical incompatibilities with connectivity issues also hinder communication. There can be the lack of ICT /technological cohesion within the team.

- Lack of synchronous communication, delayed feedback, personal communication, interactive medium, and teleconference management within the team all have an impact on global software development.

- Coordination challenges have an impact. With limited or no overlapping work hours, collaboration capabilities, coordination methods, and process alignment within the team, global software development is possible.

- Knowledge management challenges impact global software development by affecting knowledge creation, capture, and integration within the team.

- The impact of socio-cultural issues Language differences, varied terminology usage between sites, and cultural diversity all contribute to global software development. Within the team, there is a lack of mutual or shared understanding.

- Time Management issues effect Global software development by not prioritizing task, failing to Manage Distractions and Procrastination within the team.

- Cost issues effect Global software development with hidden and additional cost.

4.3   Summary

This chapter described the list of risks identified from literature and, then we separated risks along with their frequencies in the form of table. These are the risks that occur in GSD platform while doing software projects. The description of each risk is also mentioned in this chapter.

Chapter 5

Survey Results

5.1   Overview

Chapter 4 has described the list of risk factors, and their associated categories which were identified from the literature. This list of risk factors was forwarded to industry for investigating the industry respondent's perceptions on risk factors practicality and investigating for any new industry-based mitigation plans. This chapter illustrates the results of the survey.

5.2   Survey Conduction

In this section, the results are gathered from survey. The survey is conducted from the industry to validate the risks of global software development. The focused population was mostly the people who have experienced working with the global software development projects. 90 people have responded to our online survey form. From our 13 questions based on the risks of global software development, 9 were accepted and 4 were rejected by the experienced people in the industry. The results and details of the survey are following.

5.2.1 Organization size

So, out of all the people 42% people had less than 2 years of experience, 32% people have had less than 4 years of experience, 16% people have had less than 6 years of experience, 10% people have had less than 8 years of experience. Fig 5.1 shows the ratio on the basis of organization size.
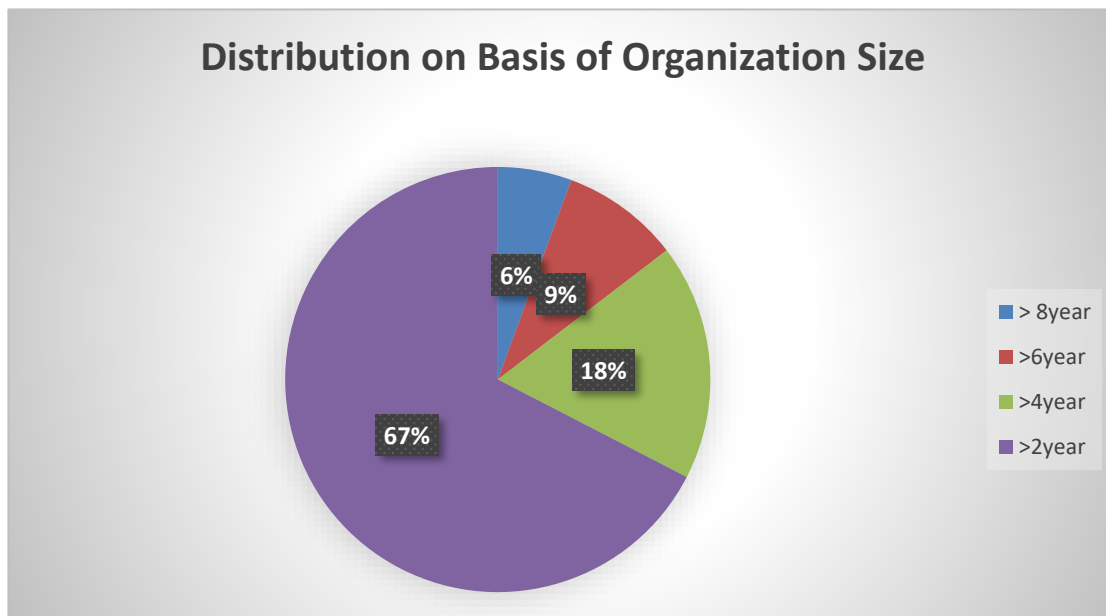

Fig 5.1: Distribution on Basis of Organization Size

5.2.2 Gender

So, the out of all the people who participated in the survey 61% people were the male and 39% population were the female. Fig 5.2 shows the ratio on the basis of gender.
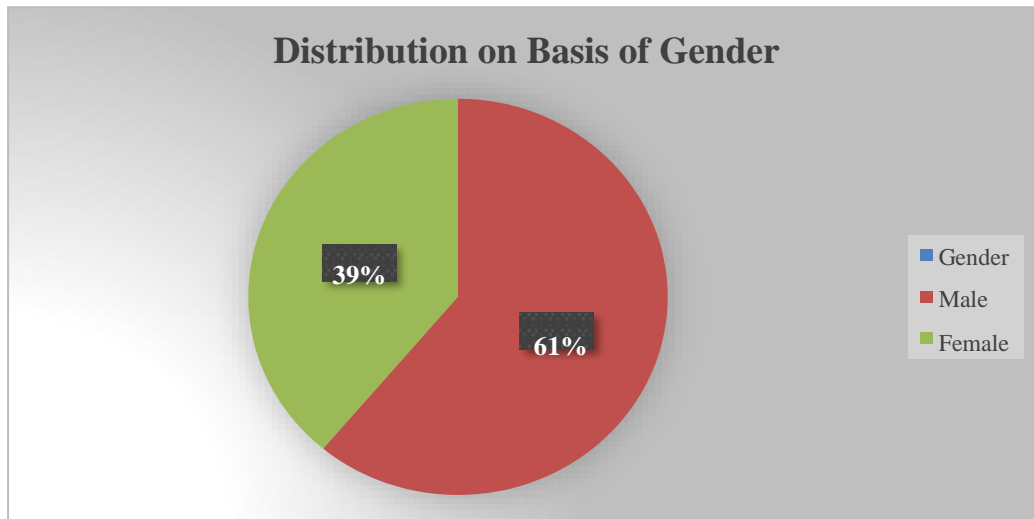
Fig 5.2: Distribution on Basis of Gender

5.3 Survey Result

Table 5.1: Survey Result

No	Factors	Weightage Values	Avg. Weightage Responses
1	Global Software Development working environment follows the software development life cycle.	91	1.022
2	Global Software Development (GSD) has radically altered traditional software development techniques.	86	0.964
3	GSD is carried out by groups of knowledge workers from all over the world who develop software for a corporation.	84	0.969
4	GSD is centralised software development that is decentralised to dispersed teams or/and external entities in remote places.	84	0.964
5	The only difference between distributed software development and global software development is that GSD teams are always worldwide.	92	1.057
6	Strategic Issues exist between the team working from different places in GSD.	93	1.048
7	The communication gap affects the effectiveness of global software development projects.	92	1.092
8	Coordination and collaboration effects the global software development projects.	91	1.035

9	Have you used any tools in global software development projects?	92	1.057
10	Different culture also effects the working environment global software development projects	83	0.933
11	Different geographical of the team members effects the working environment of global software development projects	82	0.916
12	Cost estimation changes in global software development projects	82	0.920
13	There are different tools used to manage time and tasks in global software development projects.	85	0.947

Therefore, out of the 13 possibilities available, 9 are accepted and 4 are rejected. To start, we divide the absolute number of inquiries by the amount of all of the normal weighting factor reactions to get the normal number of our replies as a whole.

Normal of Response Value = 12.7/13

= 0.976

Along these lines, the normal reaction esteem is 0.97 so we considered every one of the qualities above 0.97 as acknowledged and every one of the qualities beneath 0.97 as dismissed in above Table 5.1.

As a result of our poll, 64 percent of our total values are approved, whereas 36 percent of our total values are refused.

5.3.2 Cronbach Alpha:

The degree of insider, or how precisely a group of items is related to one another, is measured by Cronbach alpha. As a scale dependability indication, it is noted. The average inter-item correlations rises in lockstep with Cronbach's alpha (holding the number of items constant) [32]. Table 5.2 show Cronbach's alpha value.

Table 5.2: Cronbach's alpha value

Cronbach's alpha	Internal consistency
a ≥ 0.9	Excellent
0.9 > a ≥ 0.8	Good
0.8 > a ≥ 0.7	Acceptable
0.7 > a ≥ 0.6	Questionable
0.6 > a ≥ 0.5	Poor
0.5 > a	Unacceptable

Cronbach's alpha coefficient is the most often used internal reliability metric ("reliability"). It is most typically it's when a questionnaire contains many Likert items that create a scale and you need to check whether without a doubt the scale is reliable.

- Total Number of Questions: 13

- Variance of Total Score: 172

- Sum of things difference: 21.7

- Cronbach's alpha: 0.9401

5.3.2 Low importance factors

The respondents have dismissed four low significance measures, which are recorded underneath:

1: Have you utilized any apparatuses in GSD projects?

Reason: Respondents either have very little involvement with GSD or unfit to comprehend this inquiry.

2: Different topographical of the colleagues impacts the workplace of worldwide programming improvement projects.

Reason: Respondents either have relatively little insight or incapable to comprehend this

inquiry that distinctive topographical of the colleagues impacts the work space of worldwide programming improvement projects.

3: GSD alludes to display that is expected to manage complex work of different degrees of development and decomposability that possibly incorporate the trained professionals.

Reason: Respondents either have relatively little insight or incapable to comprehend this inquiry that GSD alludes to demonstrate is planned to manage complex work of different degrees of development and decomposability that possibly incorporate the subject matter experts. That conceivably include the specialists.

4: The critical assurance of a GSD is to help as an efficient method of settling the complicated activities regularly quickly developing gathering of members.

Reason: Respondents either do not have a lot of experience or unable to understand this question that the main purpose of a GSD is to serve as a systematic way of solving the complex projects often rapidly evolving group of participants.

5.3.3 High Significance factors

We find 9 significant high elements that the respondents agree with, and they are as follows:

1: The workplace environment is organized according to the software development process.

Reason: Defendants either have a lot of experience or understand this question that the working environment follows software development life cycle.

2: GSD is a paradigm for obtaining commodities or services, especially ideas, by individuals or organizations.

Reason: Respondents either have a lot of experience or understand this question that GSD is a model for obtaining commodities or services, including ideas, by individuals or organizations.

3: Requirement documentation is not documented properly in GSD projects.

Reason: Respondents either have a lot of experience or understand this question that requirement documentation is not documented properly in GSD projects.

4: Communication gap effects the effectiveness in GSD projects.

Reason: Respondents either have a great deal of involvement or comprehend this inquiry that correspondence hole impacts the viability in GSD projects.

5: Coordination and joint effort impacts the GSD projects.

Reason: Respondents either have a great deal of involvement or comprehend this inquiry that coordination and cooperation impacts the GSD projects.

6: Different social impacts the GSD projects.

Reason: Respondents either have a great deal of involvement or comprehend this inquiry that diverse social impacts the GSD projects

7: Time period is characterized for every one of the undertakings in GSD projects.

Reason: Respondents either have a ton of involvement or comprehend this inquiry that time span is characterized for every one of the errands in GSD projects.

8: Software devices can be utilized to oversee time with the assignments in GSD projects.

Reason: Respondents either have a great deal of involvement or comprehend this inquiry that product instruments can be utilized to oversee time with the assignments in GSD projects.

9: Coordination and joint effort impacts the GSD projects.

Reason: Respondents either have a great deal of involvement or comprehend this inquiry that coordination and cooperation impacts the GSD projects.

10: Cost assessment changes in the GSD projects.

Reason: Respondents either have a ton of involvement or comprehend this inquiry that cost assessment changes in the GSD projects.

5.3.4 Proposed Strategies from Survey

Here the summary of most common mitigation strategies that we got from the industry for each risk of the global software development. And, we have try to map all of those strategies here. Table 5.3 shows the proposed strategies from survey respondents.

Table 5.3: Proposed Strategies from Survey Respondents

Risks	S1	S2	S3	S4	S5	S6	S7	S8
Geographical Distance	Adopt techno logies such as teleconferenc e.	By increase- g communicati on	Promoting the written communication	Onsite Manageme- nt visits	Using some project managem ent tools	Scrum meeting s	(Central Version Control System)	Written Commu nicat- ion
Knowledge management	Presentation of Agile Customer	Encouraging the new technologies	Paid certificati -ons	Bonus on higher education	Collabora tions	SPM awarene ss	Coordin --ion	High bandwidt h technolog y.
Cultural effects	Common language communicate- on	Written communicat- ion	Agile methods	Using collaborati on tools	Proper interactio n between the teams	Eliminat e Ambigui ty	Appoint languag e translati on	Cultural lessons
Communicati on and collaboration	Effective communicat ion tools and techniques	Formal methods of collaboratio ns via some tools	Training of team members	Usage of some PM tools like Jira, Asana.	Common Language courses.	Proper coordin a---tion	Integrat ed approac hes	Transpare n t communic a tion
Technical Risks	Analyze security threats	Analyze software and hardware threats.	Identify controlle technolo gy	Upgrade d Infrastruct --ure	Analyze measurin g impact	Use high quality bandwi dth browsin g	Flexibili ty for uncertai nty	Key measure probabilit y
Tools related Risks	Use the most updated tools	Training of latest tools.	Promote Certifications	Monitor the progress and plan.	Risk likelihoo d	Scrum meeting s	Latest agile technolo g- -ies	Adoption of new technique s.

Product and Process management	Usage of SWOT analysis	Documentation reviews	Root cause Analysis	Risks register	Updated risk categorie s	Quality assessm ent	Simulati on Techniq ues	Trainings

5.4 Proposed Strategies

All in all, to our subsequent point, how may these GSD hazards be alleviated? Programming project the board (SPM) is an orderly way to deal with arranging and coordinating programming advancement drives. Software Project Management (SPM) is a "process of preparation, putting together, checking, controlling, and driving a product project"[1].To answer our second question, we have use the software project management techniques and the mitigation strategies that we obtained through conducting our survey.

Here are the proposed strategies from the literature that we can use to mitigate the risks of GSD from literature. Table 5.3 shows the risks and their proposed mitigation strategies

Table 5.4: Risks and their Proposed Mitigation

Geographical Distance	1. Take advantage of cutting-edge technologies such as teleconference, - 1ta Conference, and internet solutions. 2. Engage with the team members and develop a partnership strategy. 3. Increase the intensity with which members of the team communicate. 4. Support the Central -1ta exchange Point for Synchronous (video) and Delayed (text) Communications (Central Version Control System) 5. On-site leadership visits and travelling, directing groups are both possible options. 6. Early detection and administration of interconnections, as well as early cost and effort estimate
Knowledge management	1. Flexibility in work hours and assign assignments to the relevant team to boost production. 2. Remain in contact with their office management by going online. 3. Agile Customer Presentation 4. Utilize agile methods like SCRUM (-1ily & schedule meeting) 5. To pattern enables deployments, use RAD technologies. 6. Use voice chat and advanced tech. 7. Organizations should plan and schedule meetings at a time convenient for all of the clubs playing, who are from various geographical areas.
Cultural and Geographical	1. Interaction between members of the team that is friendly and mutually respectful 2. Utilizing Agile approaches to bridge the culture gap and improve 3. Utilizing Agile approaches to bridge the culture gap and improve 4. Appoint linguistic translating and Forigen language training 5. Reduce ambiguity by presenting intercultural liaisons. 6. Interaction between members of the team that is friendly and mutually respectful 7. Utilizing Agile approaches to bridge the culture gap and improve 8. Utilizing Agile approaches to bridge the culture gap and improve Appoint linguistic translating and Forigen language training. 9. Appoint linguistic translating and Forigen language training 10. Reduce ambiguity by presenting intercultural liaisons. All members of the team should use a common communication precise language by all.

Communication and Collaboration	1. Ascertain that the Program Manager understands the issues faced by lower-level employees.
	2. Encouraging distant team members to receive training so order to improve communication and handle behavioural issues.
	3. Communications methods and techniques that work
Technical Issues	1. Improve your IT infrastructure.
	2. For new workers, use slightly elevated communications bandwidth and videoconferencing ICT training sessions.
Tools Issues	1. Employee incentives for obtaining new certification on new stack might help motivate your team.
	2. To guarantee that the entire team is now on the road, SCRUM sessions are held.
	3. To increase collaboration, break down major undertakings into smaller, manageable tasks.
	4. Using project management techniques, explicitly define each participant's position and duties.
	5. Set up a daily review meeting and send out status updates via email.
	6. For new employees, knowledge/-1ta transference seminars are held.
Product and Process management	1. Ensure excellent documenting for any changes that occur frequently.
	2. The process is understood by all stakeholders.
	3. Create an organisational hierarchical organizational structure that all employees are aware of.
	4. All sites and tools have the same development platform.
	5. All groups will follow the stan-1st document, stack, and execute a single procedure.

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1   Overview

In this chapter, conclude the research findings and summarizes the contribution to both of the research questions. This study was set out to explore the concept of reducing risks in GSD environment.

6.2   Summary of contribution

RQ1: To identify the risk factors affecting the global software development projects to achieve its goals.

The principal question was, what are the Risks of GSD? Along these lines, to respond to this inquiry, we directed a deliberate audit to decide the impacts of GSD. We explored the 35 papers identified with the GSD and from these papers. This study discovered the eight Risks of GSD which are prerequisites documentation, cooperation, correspondence, coordination, specialized hole, social hole, the board hole and cost assessment. Then, at that point, utilizing a survey and focus group, these risks are validated. To validate the risks identified in the systematic literature analysis, after that the survey was conducted for this study.

RQ2: **To reduce those risk factors by using software project management approaches?**

The study's second goal is to come up with a plan to mitigate eight main risks that could have an impact on worldwide software development. From the literature, we were able to identify 36 mitigation solutions against eight primary concerns, which we confirmed with our response.

There are eight mitigating measures for geographical distance, including Adopt cutting-edge techniques such as teleconference, one-to-one conferencing, and internet solutions. Interact with your employees on a regular basis and develop a partnership strategy. Increase the frequency with which members of the team communicate. Encourage simultaneous (video) and asynchronously (text) communications, a centralized IT share point (single version control system), on-site administration visits, and travelling directing groups. Early detection and administration of interconnections, as well as early cost and labor estimation. To exchange feedback and project status, the groups should place a heavy emphasis on both formally and informally communication mechanisms.

There are nine temporal distance mitigating options available. To boost productivity, allow more flexibility hours and assign responsibilities to each team. Meetings on a regular basis, as well as the usage of instant messaging Stay in touch with their workplace management by using the internet. The Agile Customer's Presentations SCRUM is a good example of agile practices (-1ily & schedule meeting), Make regular delivery with RAD tools. Set up instructional courses on the best way to utilize coordinated and offbeat strategies for correspondence viably. Use transmission of voice and specialized advancement. Groups should plan and timetable gatherings all at once helpful for the entirety of the groups in question, who are from various topographical regions.

Friendly Communication between members of the team and mutually respectful for one another, using Nimble methods of reducing culture differences and boost Project Leader domain expertise, second language curriculum and translation, arrange cultural sensitivity trainings, and so on are six mitigation strategies for socio- cultural distance. Society's cultural liaisons and minimize ambiguity. Everybody team members should use a common communication precise language by all.

There are three mitigation strategies for member of the team attitude. Verify that the program manager is aware of the challenges that lower-level employees confront. Encouraging remote team

participants to join training to improve communications and resolve behavioral issues, as well as to learn how to use strong communication tools and techniques.

Five ways to reduce the risk of among the technical concerns are: IT infrastructure should be upgraded, ISO standards should be implemented, and the ITIL framework should be followed for IT customer service. Adopt dispersed agile methodologies like Collaborative Extreme Programming and Immediate emergency Requests, as well as high-quality telecommunications bandwidth, videoconferencing, and ICT trainings for new hires.

Seven ways to reduce the risk of Concerns about the team include: SCRUM gatherings to check the whole group is on the 2me way, and worker rewards and grants to improve group inspiration to expand cooperation, separate significant endeavors into more modest, sensible undertakings. Plainly characterize every part's work and obligations. Set up an everyday status meeting and convey notices through email. Fresh recruit ought to go to information/ - 1ta exchange meetings. Colleague concerns ought to be brought to the consideration of the gathering chief for additional arrangement.

The following are six mitigation measures for organizational and architectural issues: Maintain good documentation for any changes that occur frequently. The process is understood by all stakeholders. Create an organizational hierarchy model that is understood by all employees. Creating a consistent development platform across all sites, encourage both horizontal and vertical mobility across the group's domain. All teams would follow the stan-1st document and a document simultaneously.

6.3   Future Work

Since we have proposed the strategies for the risks of global software development, so in future we can implement these strategies on some real time project. Also, we can broad the study out of software engineering projects by focusing other areas.

References

[1] L. Fern, J. Manuel, C. De Gea, M. El Bajta, and A. Idri, "Software Project Management Approaches for Global Software Development : A Systematic Mapping Study," vol. 23, no. 6, pp. 690–714, 2018.

[2] A. Elzamly and B. Hussin, "An enhancement of framework software risk management methodology for successful software development," J. Theor. Appl. Inf. Technol., vol. 62, no. 2, pp. 410–423, 2014.

[3] W. Han and S. Huang, "An empirical analysis of risk components and performance on software projects," vol. 80, pp. 42–50, 2007, doi: 10.1016/j.jss.2006.04.030.

[4] S. Misra, R. Colomo-Palacios, T. Pusatli, and P. Soto-Acosta, "A discussion on the role of people in global software development," Teh. Vjesn., vol. 20, no. 3, pp. 525–531, 2013.

[5] H. Holmstrom, E. Ó. Conchúir, P. J. Ågerfalk, and B. Fitzgerald, "Global software development challenges: A case study on temporal, geographical and socio-cultural distance," Proc. - 2006 IEEE Int. Conf. Glob. Softw. Eng. ICGSE 2006, pp. 3–11, 2006, doi: 10.1109/ICGSE.2006.261210.

[6] D. Šmite, "A case study: Coordination practices in global software development," Lect. Notes Comput. Sci., vol. 3547, no. June 2005, pp. 234–244, 2005, doi: 10.1007/11497455_20.

[7] M. Niazi, S. Mahmood, M. Alshayeb, A. M. Qureshi, K. Faisal, and N. Cerpa, "Toward successful project management in global software development," Int. J. Proj. Manag., vol. 34, no. 8, pp. 1553–1567, 2016, doi: 10.1016/j.ijproman.2016.08.008.

[8] Q. Min, Z. Liu, and S. Ji, "Communication effectiveness in global virtual teams: A case study of software outsourcing industry in China," Proc. Annu. Hawaii Int. Conf. Syst. Sci., pp. 1–8, 2010, doi: 10.1109/HICSS.2010.111.

[9] D. Šmite, "A case study: Coordination practices in global software development," Lect. Notes Comput. Sci., vol. 3547, no. September, pp. 234– 244, 2005, doi: 10.1007/11497455_20.

[10] E. Ó. Conchuir, P. J. Ågerfalk, H. H. Olsson, and B. Fitzgerald, "Global software development: Where are the benefits?," Commun. ACM, vol. 52, no. 8, pp. 127–131, 2009, doi: 10.1145/1536616.1536648.

[11] J. Noll, S. Beecham, and I. Richardson, "Global Collaboration: Software Development

Solutions," ACM Inroads, vol. 1, no. 3, pp. 66–78, 2010.

[12]   P. Keil, D. J. Paulish, and R. S. Sangwan, "Cost estimation for global software development," p. 7, 2006, doi: 10.1145/1139113.1139117.

[13]   M. Heindl and S. Biffl, "Risk management with enhanced tracing of requirements rationale in highly distributed projects," p. 20, 2006, doi: 10.1145/1138506.1138512.

[14]   P. Mohagheghi, "Global software development: Issues, solutions, challenges," Retrieved April, no. September, pp. 1–26, 2004, [Online]. Available: http://www.idi.ntnu.no/grupper/su/publ/parastoo/gsd-presentation-slides.pdf.

[15]   J. Noll, S. Beecham, I. Richardson, and C. N. Canna, "A global teaming model for global software development governance: A case study," Proc. - 11th IEEE Int. Conf. Glob. Softw. Eng. ICGSE 2016, pp. 179–188, 2016, doi: 10.1109/ICGSE.2016.33.

[16]   M. Nordio, H. C. Estler, B. Meyer, J. Tschannen, C. Ghezzi, and E. Di Nitto, "How do distribution and time zones affect software development? A case study on communication," Proc. - 2011 6th IEEE Int. Conf. Glob. Softw. Eng. ICGSE 2011, pp. 176–184, 2011, doi: 10.1109/ICGSE.2011.22.

[17]   P. Kruchten, Y. Hsieh, E. MacGregor, D. Moitra, W. Strigel, and C. Ebert, "Global software development for the practitioner," Proc. - Int. Conf. Softw. Eng., vol. 2006, pp. 1032–1033, 2006, doi: 10.1145/1134285.1134489.

[18]   J. M. Verner, O. P. Brereton, B. A. Kitchenham, M. Turner, and M. Niazi, "Risks and risk mitigation in global software development: A tertiary study," Inf. Softw. Technol., vol. 56, no. 1, pp. 54–78, 2014, doi: https://doi.org/10.1016/j.infsof.2013.06.005.

[19]   J. Hanisch and B. J. Corbitt, "Requirements Engineering During Global Software Development: Some Impediments to the Requirements Engineering Process - A Case Study," ECIS 2004 Proc., p. Paper 68, 2004.

[20]   S. Y. Chadli and A. Idri, "Identifying and mitigating risks of software project management in global software development," ACM Int. Conf. Proceeding Ser., vol. Part F1319, pp. 12–22, 2017, doi: 10.1145/3143434.3143453.

[21]   S. Y. Chadli, A. Idri, J. L. Fernández-Alemán, and J. N. Ros, "Frameworks for risk management in GSD projects: A survey," 2015 10th Int. Conf. Intell. Syst. Theor. Appl. SITA 2015, 2015, doi: 10.1109/SITA.2015.7358381.

[22]   M. Cataldo and J. D. Herbsleb, "Communication patterns in geographically distributed software development and engineers' contributions to the development effort," Proc. - Int. Conf. Softw. Eng., pp. 25–28, 2008, doi: 10.1145/1370114.1370121.

[23]   S. Deshpande, I. Richardson, V. Casey, and S. Beecham, "Culture in global software

development - A weakness or strength?," Proc. - 5th Int. Conf. Glob. Softw. Eng. ICGSE 2010, pp. 67–76, 2010, doi: 10.1109/ICGSE.2010.16.

[24] K. Moumane and A. Idri, "Software quality in mobile environments: A comparative study," 2017 4th Int. Conf. Control. Decis. Inf. Technol. CoDIT 2017, vol. 2017-Janua, pp. 1123–1128, 2017, doi: 10.1109/CoDIT.2017.8102750.

[25] M. Grechanik, J. A. Jones, A. Orso, and A. Van Der Hoek, "Bridging gaps between developers and testers in globally-distributed software development," Proc. FSE/SDP Work. Futur. Softw. Eng. Res. FoSER 2010, pp. 149–153, 2010, doi: 10.1145/1882362.1882394.

[26] B. Kitchenham and S. Charters, "Guidelines for performing Systematic Literature Reviews in SE," pp. 1–44, 2007, doi: 10.1145/1134285.1134500.

[27] R. Durbarry, Quantitative research. 2019.

[28] E. Fossey, C. Harvey, F. Mcdermott, and L. Davidson, "research *," 2002.

[29] K. Yilmaz, "Comparison of quantitative and qualitative research traditions: Epistemological, theoretical, and methodological differences," Eur. J. Educ., vol. 48, no. 2, pp. 311–325, 2013, doi: 10.1111/ejed.12014.

[30] "Designing an Effective Survey," 2005.

[31] M. Kasunic, "Designing An Effective Survey.," Softw. Eng. Inst., no. September, p. 140, 2005, [Online]. Available: https://resources.sei.cmu.edu/asset_files/Handbook/2005_002_001_14435.pdf.

[32] M. Tavakol and R. Dennick, "Making sense of Cronbach's alpha," Int. J. Med. Educ., vol. 2, pp. 53–55, 2011, doi: 10.5116/ijme.4dfb.8dfd.

[33] M. Niazi et al., "Challenges of project management in global software development: A client-vendor analysis," Inf. Softw. Technol., vol. 80, pp. 1–19, 2016, doi: 10.1016/j.infsof.2016.08.002.

[34] Y. H. Shah, M. Raza, and S. Ulhaq, "Communication Issues in GSD," Int. J. Adv. Sci. Technol., vol. 40, pp. 69–76, 2012.

[35] A. Manjavacas, A. Vizcaíno, F. Ruiz, and M. Piattini, "Global software development governance: Challenges and solutions," J. Softw. Evol. Process, vol. 32, no. 10, pp. 1–26, 2020, doi: 10.1002/smr.2266.

[36] D. Šmite, "Global software development projects in one of the biggest companies in Latvia: Is geographical distribution a problem?," Softw. Process Improv. Pract., vol. 11, no. 1, pp. 61–76, 2006, doi: 10.1002/spip.252.

[37] D. Šmite and J. Borzovs, "A framework for overcoming supplier related threats in global projects," Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes

Bioinformatics), vol. 4257 LNCS, pp. 50–61, 2006, doi: 10.1007/11908562_6.

[38] A. Vizcaíno, F. García, J. C. Villar, M. Piattini, and J. Portillo, "Applying Q- methodology to analyse the success factors in GSD," Inf. Softw. Technol., vol. 55, no. 7, pp. 1200–1211, 2013, doi: 10.1016/j.infsof.2013.01.003.

[39] A. Jansone and J. Borzovs, An approach to geographical data quality evaluation, no. January. 2006.

[40] A. Lamersdorf, J. Münch, A. F. D. V. Torre, C. R. Sánchez, M. Heinz, and D. Rombach, "A rule-based model for customized risk identification in distributed software development projects," Proc. - 5th Int. Conf. Glob. Softw. Eng. ICGSE 2010, no. Icgse, pp. 209–218, 2010, doi: 10.1109/ICGSE.2010.32.

[41] I. Bider, H. Otto, and S. Willysson, "Using a Socio-Technical Model of a Global Software Development Project for Facilitating Risk Management and Improving the Project Structure," Complex Syst. Informatics Model. Q., no. 15, pp. 1–23, 2018, doi: 10.7250/csimq.2018-15.01.

[42] C. Arumugam and B. Kaliamourthy, "Global software development: An approach to design and evaluate the risk factors for global practitioners," Proc. Int. Conf. Softw. Eng. Knowl. Eng. SEKE, vol. 2016-Janua, pp. 565–568, 2016, doi: 10.18293/SEKE2016-077.

[43] G. Ammad, U. Iqbal Janjua, T. M. Madni, M. F. Cheema, and A. R. Shahid, "An Empirical Study to Investigate the Impact of Communication Issues in GSD in Pakistan's IT Industry," IEEE Access, vol. 7, pp. 171648–171672, 2019,

doi: 10.1109/ACCESS.2019.2953008.

[44] C. Arumugam and B. Kaliamourthy, "Global Software Development: A design to measure risk of global practitioners," Int. Conf. Comput. Anal. Secur. Trends, CAST 2016, pp. 590–593, 2017, doi: 10.1109/CAST.2016.7915036.

[45] S. Barney, V. Mohankumar, P. Chatzipetrou, A. Aurum, C. Wohlin, and L. Angelis, "Software quality across borders: Three case studies on company internal alignment," Inf. Softw. Technol., vol. 56, no. 1, pp. 20–38, 2014, doi: 10.1016/j.infsof.2013.06.004.

[46] R. Colomo-Palacios, P. Soto-Acosta, A. Mishra, and Á. García-Crespo, "Software quality management improvement through mentoring: An exploratory study from GSD projects," Lect. Notes Comput. Sci. (including Subser. Lect. Notes Artif. Intell. Lect. Notes Bioinformatics), vol. 7046 LNCS, pp. 190–199, 2011, doi: 10.1007/978-3-642-25126-9_29.

[47] M. Zahedi and M. A. Babar, "Towards an understanding of enabling process knowing in global software development: A case study," ACM Int. Conf. Proceeding Ser., no. May, pp. 30–39, 2014, doi: 10.1145/2600821.2600836.

[48] A. Iftikhar, M. Alam, S. Musa, and M. M. Su'Ud, "Trust Development in virtual teams to implement global software development (GSD): A structured approach to overcome communication barriers," 2017 IEEE 3rd Int. Conf. Eng. Technol. Soc. Sci. ICETSS 2017, vol. 2018-Janua, pp. 1–5, 2018, doi: 10.1109/ICETSS.2017.8324169.

[49] A. Iftikhar, S. Musa, M. Alam, M. M. Su'Ud, and S. M. Ali, "A survey of soft computing applications in global software development," 2018 IEEE Int. Conf. Innov. Res. Dev. ICIRD 2018, no. November, pp. 1–4, 2018, doi: 10.1109/ICIRD.2018.8376330.

[50] M. Ilyas and S. U. Khan, "Software integration in global software development: Challenges for GSD vendors," J. Softw. Evol. Process, vol. 29, no. 8, pp. 1–17, 2017, doi: 10.1002/smr.1875.

[51] S. ul Haq, M. Raza, A. Zia, and M. N. A. Khan, "Issues in Global Software Development: A Critical Review," J. Softw. Eng. Appl., vol. 04, no. 10, pp. 590– 595, 2011, doi: 10.4236/jsea.2011.410069.

[52] S. Mahmood, S. Anwer, M. Niazi, M. Alshayeb, and I. Richardson, "Key factors that influence task allocation in global software development," Inf. Softw. Technol., vol. 91, pp. 102–122, 2017, doi: 10.1016/j.infsof.2017.06.009.

[53] T. Jaanu, M. Paasivaara, and C. Lassenius, "Effects of four distances on communication processes in global software projects," Int. Symp. Empir. Softw. Eng. Meas., pp. 231–234, 2012, doi: 10.1145/2372251.2372293.

[54] A. K. Sangaiah and A. K. Thangavelu, "Factors affecting the outcome of Global Software Development projects: An empirical study," 2013 Int. Conf. Comput. Commun. Informatics, ICCCI 2013, 2013, doi: 10.1109/ICCCI.2013.6466113.

[55] A. López, J. Nicolás, and A. Toval, "Risks and safeguards for the requirements engineering process in global software development," Proc. - 2009 4th IEEE Int. Conf. Glob. Softw. Eng. ICGSE 2009, no. 1, pp. 394–399, 2009, doi: 10.1109/ICGSE.2009.62.

[56] C. Magnusson and S. C. Chou, "Risk and compliance management framework for outsourced global software development," Proc. - 5th Int. Conf. Glob. Softw. Eng. ICGSE 2010, pp. 228–233, 2010, doi: 10.1109/ICGSE.2010.34.

[57] M. Niazi, M. A. Babar, and J. M. Verner, "Software Process Improvement barriers: A cross-cultural comparison," Inf. Softw. Technol., vol. 52, no. 11, pp. 1204–1216, 2010, doi: 10.1016/j.infsof.2010.06.005.

[58] B. Bell, D. Best, C. Hope, T. Ward, and D. O'Sheedy, "A study of agile project management methods used for IT implementation projects in small and medium-sized enterprises," Notes, vol. 6, no. 1, pp. 1–57, 2012, doi: http://dx.doi.org/10.1016/j.ausmj.2009.05.014.

[59] R. C. Nienaber and E. Smith, "Incorporating PMBOK2004 guidelines into the software project management supported by software agents model," Int. J. Knowl. Learn., vol. 5, no. 5–6, pp. 443–456, 2009, doi: 10.1504/IJKL.2009.031508.

[60] S. Prajapat and L. Kavanagh, "Investigation of SPM Approaches for Academic IT – Projects Related papers," 2017.

[61] P. P. Control, P. M. Performance, and D. Contexts, "Project Portfolio Control and Portfolio," Proj. Manag. J., vol. 39, no. 5, pp. 28–42, 2008, doi: s10.1002/pmj.

[62] F. Ahlemann, "Towards a conceptual reference model for project management information systems," Int. J. Proj. Manag., vol. 27, no. 1, pp. 19–30, 2009, doi: 10.1016/j.ijproman.2008.01.008.

Appendix A

Literature Review of GSD

No	Author & Year	Title	Issues /Findings of the paper	Methodology
1	Holmstrom, Helena Conchúir [5], 2006	Global software development Risks: A case study on temporal, geographical and socio- cultural distance	They report findings from a case study in which we investigate the specific risks associated with controlling GSD in this publication. This research presents risks connected to temporal, geographical, and socio-cultural distance based on qualitative interviews.	Case study and Empirical Investigation
2	Sanjay Misra [4] (2012)	A Discussion on The Role of People in GSD	The goal of this study is to first identify the risks associated with human factors in GSD, and then to provide a solution (or solutions) to help solve or reduce the overall impact of these risks.	This study is mainly based on Literature Review
3	Elzamly, Abdelrafe Hussin, Burairah [2] (2014)	An enhancement of framework software risk management methodology for successful software Development.	This study presents a new software risk management strategy for the global software development projects.	Qualitative Methodology

4	Chadli, Saad Yasser Idri, Ali Fernández-Alemán, [20] 2015	Frameworks for risk management in GSD projects: A survey	The purpose of this study is to provide a review of the current frameworks for risk management in global software development projects that are currently accessible in the literature. The two frameworks that were chosen are evaluated and compared.	Literature Review
5	Chadli, Saad Yasser Idri, Ali Fern, Luis [20] 2016	Identifying Risks of Software Project Management in Global Software Development: An Integrative Framework	The goal of this work is to find mitigation measures that may be used to partially or completely mitigate the effects of risk factors connected to GSD project management.	Systematic Literature Review
6	Niazi, Mahmood, Mahmood, Sajjad, Alshayeb, Mohammad, Riaz, [33] 2016	Risks of project management in global software development: A client-vendor analysis	The goal of this study is to identify the risks that can jeopardise the successful management of GSD projects from both the client and vendor perspectives. The method used a two-phase approach: first, a Systematic Literature Review (SLR) was used to identify the risks, and then the identified risks were validated using a questionnaire-based survey.	Systematic Literature Review
7	Niazi, Mahmood Mahmood, Sajjad [7]	Toward successful project management in global software development	This article has two goals: (1) to find characteristics linked to successful project management in GSD from the literature and to validate the discovered factors in real-world practise; and (2) to map the identified factors to the PMBOK's 10 project management knowledge areas.	Systemic Literature Review
8	Chadli, Saad Yasser Idri, Ali Fern, Luis [20]	Identifying and mitigating risks of software project management in global software	The goal of this work is to find mitigation measures that may be used to partially or completely mitigate the effects of risk factors connected to GSD project management that have been identified in the literature, as well as to update the list of risk variables given in earlier research.	Systematic Literature Review

		opment		
9	Fern, Luis Manuel, Juan Gea, Carrillo De Bajta, Manal El Idri, Ali [1]	vare Project Management Approaches for Global Software Development: A Systematic Mapping Study	The goal of this work is to find and classify research on SPM techniques for GSD that is currently available in the literature, as well as to highlight their current flaws and strengths and to analyse their applicability in industry. The findings show that since 2006, interest in SPM for GSD has grown. Coordination, planning, and monitoring methods, as well as estimation strategies that can be utilised to better match a distributed project, are the often mentioned methods (40 percent).	Systematic Literature Review
10	Yasir Hassan Shah, Mushtaq Raza [34]	munication Issues in GSD	They attempted to identify many communication challenges that frequently generate severe problems for GSD project developers, customers, and testers in this article. also recommend some strategies for overcoming these dangers.	Literature Review
11	Antonio Manjavacas, Aurora Vizcaíno, [35]	Global software development governance: Risks and solutions	study presents a analysis on identifying the primary challenges of the global software development to do a better governess of the GSD projects.	Qualitative Research
12	Darja Smite [36]	Global Software Development Projects in One of the Biggest Companies in Latvia: Is Geographical Distribution a	The goal of this study is to build a framework for worldwide project management and performance. case study provides an overview of distant initiatives, highlighting specific concerns such as organizational and cultural disparities, language and time zone variances, loss of personal interaction, and difficult communication over long distances.	Case Study

		Problem?		
13	Darja Šmite and Juris Borzovs [37]	A Framework for Overcoming Supplier Related Threats in Global Projects	They discuss a study that attempts to analyse the nature of global hazards and develop a complete and user-friendly risk management system in this paper. They stress the importance of being aware of global elements and hazards that define distributed initiatives and necessitate proper attention throughout the duration of the project.	Qualitative Research
	Aurora Vizcaíno, Félix García, [38]	Applying Q-methodology to analyses the success factors in GSD	Since the critical difficulties were initially related to the various types of distances, the results of this study have indicated that the risks of GSD are changing (geographical, temporal, sociocultural, language).	Literature Review
15	Darja Šmite, Juris Borzovs [39]	Managing Uncertainty in Globally Distributed Software Development Projects	This paper outlines a Knowledge Base and a Risk Barometer that were created to help practitioners who have never worked on a worldwide project before. The characteristics of internationally distributed projects, as well as their impact on project performance, are codified in a reusable framework for dealing with uncertainty.	Mixed Methodology (Qualitative & Quantitative)
16	Ansgar Lamersdorf, [40]	A Rule-based Model for Customized Risk Identification in Distributed Software Development Projects.	This article outlines a method for recognising project hazards early on. This model is based on a collection of logical rules that describe how project parameters influence typical hazards in dispersed development. It systematically captures experiences from previous projects.	Mixed Methodology (Qualitative & Quantitative)

17	Ilia Bider, Henning Otto, [41]	Using a Socio-Technical Model of a Global Software Development Project for Facilitating Risk Management and Improving the Project Structure.	The article explains how to represent a global software development project for this type of research. The components do not correspond to the project's organizational units, and their teams can be dispersed.	Systematic Literature Review
18	Chamundeswari Arumugam [42]	Global Software development: An Approach to Design and Evaluate the Risk factors for Global Practitioner	A Socio Technical Systems concern model is made for global experts to display the interaction between global practitioners within an organization structure and also to express the risk of global practitioners using graphical notations.	Qualitative Research
19	Ghana Ammad, Uzair Iqbal Janjua1, [43]	An Empirical Study to Investigate the Impact of Communication Issues in GSD in Pakistan's IT Industry	A Systematic Literature Review (SLR) was conducted to identify all of the communication-related problems in GSD.	Systematic Literature Review
20	Chamundeswari Arumugam, [44]	Global Software Development: A Design to Measure Risk of Global itioners	This study presents a Multi Agent Simulation Model to measure the global software development practitioner's ability.	Qualitative Research

21	Sebastian Barney, Varun Mohankumar [45]	Software quality across borders: Three case Studies on company internal alignment	The goal of this study is to determine the degree of agreement among major stakeholder groups within a firm regarding the importance attributed to characteristics of software quality produced as part of an outsourcing arrangement. In addition, the study tries to uncover factors that influence alignment levels.	Systematic Literature Review
22	Ricardo Colomo-Palacios, Pedro Soto-Acosta, [46]	Software Quality Management Improvement Through Mentoring: An Exploratory Study from GSD Projects	The goal of this paper is to see if mentorship, one of the most important personnel development methods, can improve SQM in GSD projects. The study's findings show that mentorship has a moderate impact on SQM.	Literature Review
23	Philippe Kruchten, Yvonne Hsieh [17]	Global Software Development for the Practitioner	The programme was inspired by the growing trend in the software industry to develop software in internationally distributed environments, such as geographically distributed teams or outsourcing aspects of software development to other firms around the world.	Survey
24	Matthias Heindl, Stefan Biffl, [13]	Risk Management with Enhanced Tracing of Requirements Rationale in Highly Distributed Projects	study discusses cost and benefits model which helps the projects to plan and organize the global software development strategies.	Mixed Methodology (Qualitative & Quantitative)
25	Mansooreh Zahedi, Muhammad Ali Babar, [47]	Towards an Understanding of Enabling Process Knowing in Global Software Development:	The findings offer important insights into the possible risks of a lack of process knowledge, as well as how an organization may enable process knowledge to achieve the intended objectives while simultaneously promoting social interactions and beneficial behavioral changes.	Case Study

		A Case Study		
26	Asim Iftikhar, Muhammad Alam [48]	Trust Development in Virtual teams to Implement Global Software Development (GSD)	Several communication hurdles that lead to project failure have been addressed in this study. The desire for communication tools that are faster, cheaper, and more cost-effective has put a developer to meet worldwide.	Literature Review
27	Asim Iftikhar, Sharulniza Musa [49]	A Survey of Soft Computing Applications in Global Software Development	Several existing research publications dealing with the uses of soft computing in software development fields are examined in this study, as well as future research directions.	Literature Review
28	Muhammad Ilyas | Siffat Ullah Khan, [50]	Software integration in global software development	The current study's goal is to identify the significant barriers/risks that obstruct the integration process for various types and sizes of projects.	Systematic Literature Review
29	Sami ul Haq, Mushtaq Raza [51]	Issues in Global Software Development: A Critical Review	This study presents the research of comparative with the global software development to draw its benefits and drawbacks.	Survey
30	Sajjad Mahmood, Sajid Anwer, [52]	Key factors, that can influence task allocation in global software development	This study presents the elements which can affects the task and their assignment in terms of global software development projects.	Systematic Literature Review

31	Tuomas Jaanu, Maria Paasivaara. [53]	Effects of Four Distances on Communication Processes in Global Software Projects	They investigate the effects of these four distances on communication in software engineering projects in this research. present their findings from three distributed software projects on the interaction between communication channels and distance.	Survey
32	S. Arun Kumar, Arun Kumar Thangavelu. [54]	Factors Affecting the Outcome of Global Software Development Projects: An Empirical study	The purpose of this study is to give survey research methods for determining the ongoing relationship between offshore and onshore teams in GSD projects. The survey results revealed that knowledge exchange and information transfer between offshore and onshore personnel has a substantial relationship with GSD project outcomes.	Survey
33	Alejandro Lopez, Joaqu Nicolas, [55]	Risks and Safeguards for the Requirements Engineering Process in Global Software Development	When a company embarks on a GSD project for the first time, it takes a number of risks. Many of these dangers arise as a result of the development team's lack of experience with GSD projects. A systematic literature review (SLR) has resulted in the creation of a repository that compiles the dangers that are associated with RE when produced in a distributed software development environment, as well as a set of safeguards to.	Systematic Literature Review
34	Christer Magnusson, Sung-Chun Chou [56]	Risk and Compliance Management Framework for Outsourced Global Software Development	This article presents a methodology for risk and compliance systems that are outsourced. As a result, the framework help mitigate those risks. explains customers' and outsourcing businesses' duties, allowing for more effective risk and compliance management.	Experiment

| 35 | Mahmood H Niazi, Muhammad Ali Ahmed Babar [57] | Software Process Improvement Barriers: A Cross-cultural Comparison | The goal of this experimental study is to learn more about the obstacles to SPI in the component of international software development. | Systematic Literature Review & Survey |