COMMUNICATION MEDIUM CHALLENGES AND SOLUTIONS TOWARDS AGILE IN GSD

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

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ABSTRACT

Communication Medium Challenges towards Agile in GSD

The process of developing software projects while having interactions of different organizations, people and technology across international boundaries, national cultures and languages is known as Global software development. GSD team members having various cultures and times zones are located at various positions. GSD is used at large scale in software industry as it provides many benefits but there are number of communication medium challenges that are being faced by global team members. There is need to identify those communication medium challenges with their solutions for effective communication across different sites This research work adopts Systematic Literature Review approach to report the communication medium challenges and Industrial survey approach to find out the solution of purposed challenges. The findings of this study reported 11 challenges. The purposed solutions of 11 mentioned challenges are also discussed in this research work. The results of this research work are expected to help researchers to understand communication medium challenges of agile in GSD and to understand the solutions for resolving these challenges.

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LIST OF ABBREVIATIONS

ASDF - Agile Global Software Development

GSD - Global Software Development

FDD - Feature Driven Development

RAD - Rapid Application Development

XP - Extreme Programming

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DEDICATION

This thesis work is dedicated to my parents and my teachers throughout my education career who have not only loved me unconditionally but whose good examples have taught me to work hard for the things that I aspire to achieve.

CHAPTER 1

INTRODUCTION

1.1. Introduction

This chapter documents the background of the research, problem statement, goal, research question and objectives along with the research scope, contributions and significance

1.2. Background of Research

The process of developing software projects while having interactions of different organizations, people and technology across international boundaries, national cultures and languages is known as Global software development(GSD)[1]. GSD team members having various cultures and times zones are located at various positions. GSD is used at large scale in software industry as it provides many benefits. Marcelo Dauane author in the year 2017 has come up with the study showing these benefits includes reduced cost to improve software quality and providing that advantage that organizations are trying to seek [2]. The author explained GSD as software development that is spread across various locations separated by various national boundaries. The study reports about teams working in GSD facing many communication challenges. The study further explains that these team members are from different cultures and works together in spite of the fact they are located at different positions worldwide and having difference of time as well. A team can be defined as a group of minimum two people who are involved in dynamic, interdependent and adoptive manner towards same goal where each

member of the team has a particular role. These teams are interacting each other in different situations where communication between them is sometimes electronic, asynchronous, where face to face interaction is sometimes informal and limited. The factors affecting GSD teams are geographical factors, temporal factors and distance of culture. For example, geographical distance affects the performance of a GSD team due to the coordination problems occurs between them[3]. Software development industry has been shifted from co-located to distributed environment. Organizations are distributing their products globally. Therefore, software development is fastly distributed among various places having various cultures[4].There are various software development methodologies such as waterfall, iterative waterfall model, spiral model, RAD model and agile methodologies.[4].Software companies are trying to produce high quality software and also they are competing in this regard. In the recent years, integration of Agile practices in GSD has been taking an increasing interest for producing high quality software which refers the term Agile Global Software Development (AGSD)[5]. The use of agile methods in GSD has introduced many challenges due to geographical distance, time differences, cultural differences and technological hurdles.

While using Agile methods in GSD, there comes a lot of challenges because agile methods broadly depend on formal communication. Kanban is one of the agile process methodologies. Kanban method in software development was originated in 2004. Kanban is a Japanese word meaning a signboard, and it is used in manufacturing a scheduling system[6]. The Kanban methodology was introduced by the manager at Toyota Motors. At each stage of production process, they limitize the inventory level as it was their ultimate purpose [3]. Kanban is described by Anderson as "Kanban is an evolutionary change method that utilizes a Kanban pull system visualization and other tools to catalyse the introduction of lean ideas…the process is evolutionary and incremental[7]. It is software development methodology that applies lean principles. Kanban implementation in field of software engineering brings a lot of challenges[6]. One of them includes communication challenge.

Traditional software development methodologies consists of specification and analysis of set of requirements taken through customer with the proceeding of further steps including design, coding, testing, deployment and maintenance[8].During the software development phase, planning is done before the development starts , in this case the traditional approach faces problems when requirements of customer is changing frequently[8]. To handle this issue agile software development methodologies was introduced in 2000s [8]. Agile methods overcome critical problems in software development including low quality product, late delivery and high

cost of development by lightweight and speedily development process[9]. Agile methods process the development of a software by iterative and incremental delivery system [8].The main characteristics of agile methods are requirement gathering continuously, face to face communication on regular basis , pair programming, continuous integration, customer feedback at early stage and minimum documentation [10]. Most commonly used agile software development approaches are extreme programming (XP), crystal , SCRUM, adaptive software development (ASD), feature driven development (FDD) and dynamic system development method (DSDM)[8].

Communication is the exchange of ideas with each other. Communication is the critical element for the successful completion of software projects. Furthermore, communication is the challenge that is faced by every software developer regardless of the fact where they are residing[3]. During communication in Global software development while implementing agile faces issues of communication in large scale software development organizations. Communication is the important and effective element that ensures the success of projects in distributed teams which in turn improves the profession. In process of development of software, one of the important factor is effective communication while using agile methods. That causes many communication problems. However, there are many factors that hinders communication in distributed teams. Nowadays, implementing software in a globally distributed environment is a famous approach and this creates extra challenges for communication [11]. Geographical and cultural distances are the basic hurdles in globally distributed environments [4]. Taking into consideration the reality that GSD teams are existing in different geographical areas physically, the challenges during implementation of Agile can't be ignored. Research shows that Agile implementation in GSD faces communication challenges such as cultural challenges, geographical challenges and temporal challenges [3].

Although the common communication challenges are reported by major state of knowledge [1] , [3]however none of them have investigated the communication medium challenges specifically for Agile implementation in GSD. In this research, communication medium challenges are going to be investigated in GSD platform for agile implementation.

1.3. Problem Statement

Agile methods depend strongly on synchronous communication and coordination between teams located at different sites[12]. The success rate of agile in many organizations motivates organizations having large size to adopt agile approaches in GSD environment. However, agile also have many challenges especially communication medium challenges[12]. There is need to focus on the study of communication medium challenges in agile GSD with the efforts of finding out purposed solutions against the explored challenges. Due to lack of investigation regarding communication medium challenges for implementation of agile in GSD, the software developer's team in GSD platform lack the understanding of communication practices to be adopted.

This research investigates the common communication challenges and solution strategies for the communication medium challenges for agile global software development.

1.4. Research Questions of the Study

Following research questions are included in our research:

RQ1: What is the communication medium challenges confronted during the implementation of Agile in global software development

RQ2: What are the resolution strategies adopted to tackle these identifies challenges?

1.5. Research Objectives of the study

The study comprises of following objectives

1. To explore the communication medium challenges for implementation of agile in global software development.

2. To discover the resolution strategies that should be adopted in order to minimize communication medium challenges.

1.6. Aim of the Research

The aim of our study research is to identify the communication medium challenges that are faced during the implementation of Agile in Global software Development along with the proposed solutions to handle these identified challenges.

1.7. Scope of Research Work

SLR:

- SLR is conducted for the past 15 year's papers that is from 2005-2020.
- Google Scholar, ACM, IEEE Xplore, Science direct are used as database sources
- Published in English language

Survey:

The survey is conducted in the software industry specifically those who are implementing Agile in distributed teams.

- Participants having at least 5 years' experience of Agile implementation is selected for the survey approach
- Software developer's organizations are targets having projects on GSD with Agile

SLR and questionnaire survey methods both are selected. These methods were selected because they are appropriate match for this work nature and data type, also with the analysis that are required to perform on data.

1.8. Contribution and Significance:

i. The first contribution is the list of communication medium challenges during implementation of agile in GSD.
ii. The second contribution is the list of solutions proposed against the identified communication medium challenges.

The findings further the existing state of knowledge and practice. The existing knowledge in this domain will be extended and it will help the practitioners in the industry.

1.9. Thesis Organization

The rest of thesis is organized as follows:

Chapter 2, we will discuss about Systematic Literature Review approach and reports communication medium challenges in agile GSD. A number of latest studies will be reported that discusses the challenges of communication medium in agile during implementation in GSD. Chapter 3, We will choose systematic literature review as a research methodology that will help us to discover all the possible key challenges for implementation of Agile in global software development. For the purpose of performing SLR, we will select the best standard guideline by Kitchenham. The second selected methodology is an industrial survey. The main purpose of selecting this method is basically to propose the resolution strategies that will help to overcome the communication medium challenges while implementing Agile in global software development. A survey will be conducted by following the guidelines of Kasunic (2005) published by Software Engineering Institute (SEI).

We conduct and describe survey through quantitative research (survey). Survey design guidelines are followed to perform quantitative analysis. Chapter 4, We will analyze the survey results and describe about high significance values and low significance values. We will discuss the results of survey. We will evaluate the results one by one. Chapter 5, A comparative analysis of the results will be purposed. We will purpose the solutions after analysis of results. Chapter 6, This chapter will give summary of contribution and discussion of overall thesis including limitations and future work will be mentioned over there.

1.10. Summary:

This chapter described the introduction of the problem area by reporting the problem background and explaining the communication medium challenge is one of the most major issue in global software development. This chapter describes research questions, objectives, scope, contribution and significance of the study.

CHAPTER 2

LITERATURE REVIEW

1.11. Introduction

In our previous chapter, we reported the introduction of our study where the problem statement, background of the problem, research questions, scope, contribution and significance of the study is reported. This chapter further extends it by exploring the published work related to our research and problem area.

1.12. Global Software Development GSD Environment

Global software development (GSD) is the work done across national boundaries which involves communication, coordination, control and infrastructure.The development of software projects by the connections of organisations, people and technology between geographical boundaries, organisational and national cultures, languages and working styles is known as Global Software Development [3]. The importance of globalization started to appear during 1990s[13]. GSD is largely used in software industry because of its many benefits. These benefits may include reduced cost to improved software quality. GSD has evolutionary effect on software development process. The traditional software development approaches has been changed due to emergence of GSD[13].

Globalization not only affects the political, social or cultural and economic effects of present society but also the engineering and technical fields[13].GSD also allows organizations to have larger qualified resource pool with that of reduced development costs that lead to development of software in cost effective manner. According to Holmstrom, the team members from diverse geographical locations which are working under different time zones are included in software development activities throughout the project development life cycle.[8]

GSD is the type of business model that rises the company level up to the extent so that they can compete in global arena with significant cost savings[14]. GSD has many benefits including improved development process and cost savings[14].

GSD can also be described as the software work carried out at geographically distributed locations which are located between national boundaries in a synchronized manner besides with asynchronous interaction. It involves communication to perform information exchange, to have coordination among groups, coordination among activities and coordination among artefacts so they contribute to the overall objective. GSD is gradually becoming the standard practice in Global market due to the popularity of its benefits including reduction in cost and substantial development time , strategic flexibility and availability of support to perform 24/7 operations[15]. GSD teams faces the geographical, cultural and temporal challenges that acts as barriers between software development process which in result effects coordination, communication and collaboration elements [1]. As GSD teams are existing at different geographical areas physically, communication in GSD includes cultural, geographical and temporal factors faced by different teams between different national and international borders having varied time zones[3]. GSD teams are distributed across different cultures. Developers of GSD environment consist of multiple nationalities , cultural and different religious experiences[16]. Communication between them can be electronic, asynchronous or face to face contact with informal interactions. Communication is one of the important element in GSD, where it allows exchange of knowledge between team members and also allows understanding of requirements from customers as well as development activities that can perform effectively[5]. According to a survey conducted in 2012, 13 issues related to communication challenges are identified which are mentioned in Fig.1 [5].

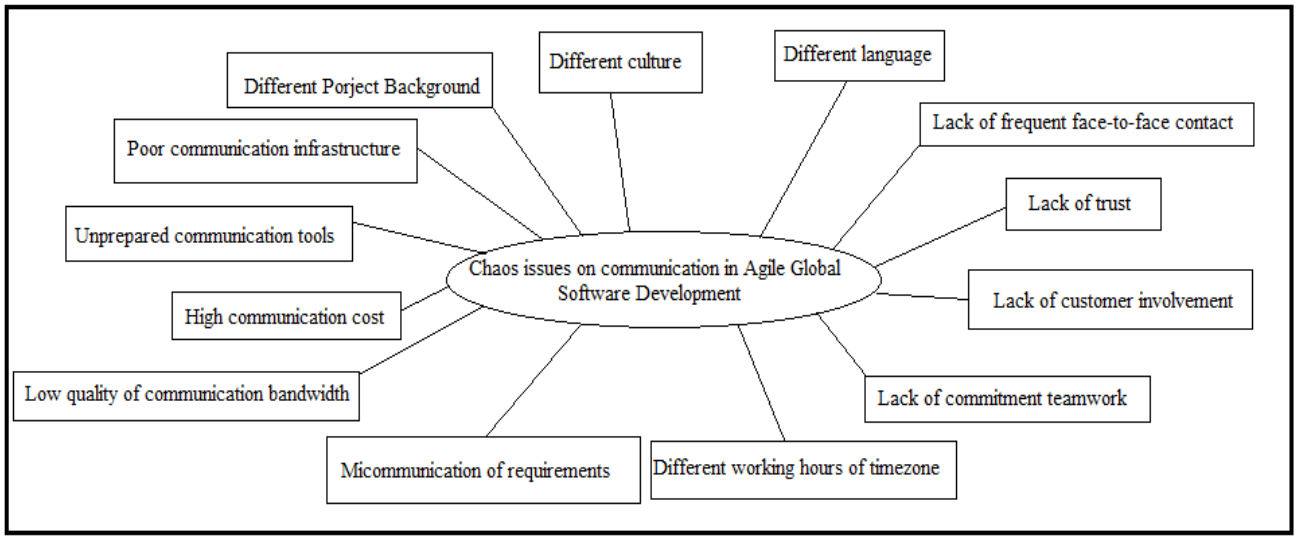

Figure 2.1: Communication Issues in GSD [5]

The above conceptual model highlighted the real problems that had really happened in global software development.

GSD is applied at various functional levels that include country, company and team levels. The challenges regarding GSD can also be categorized at country, company and team level.

According to research conducted in 2019, GSD challenges explored by Systematic Literature Review (SLR) regarding geographical distance are lack of informal communication, Lack of informal communication, less shared project awareness, problem in information exchange, knowledge management, process transparency, high communication cost and coordination issues[14]. Furthermore, the temporal challenges include Limited Synchronous communication and delay in feedbacks. The socio -cultural challenges are stated as Inconsistency in work practices, less informal communication. However the organizational challenges reported are Inconsistent development and build environment, differences in maturity and experience levels and mismatch process [14].

GSD teams distributed between national and international boundaries are basically the software development teams. GSD teams are affected by many issues. Communication is the critical factor for the successful completion of software development process. Furthermore, it is also a great challenge faced by all the team members involve in software development process regardless of the fact that team are co-located. Several studies have been reported that discusses the issues of implementing agile in GSD. Distribution of teams causes communication challenges across national boundaries. A number of studies has been conducted to report the communication challenges of implementing agile in GSD. But no one has highlighted the communication medium challenges as it the crucial issue that has been neglected. Therefore, this research work purpose is to fill the literature gap and uses SLR to investigate the communication medium challenges that is affecting communication among co-located team members. The solution strategies for the factors identified regarding communication medium challenges will be represented in next chapter.

1.13. Agile Software Development

Agile software development refers to the methodologies comprised on the idea of iterative development where requirements and the solutions are find out through collaboration between self-organizing cross functional teams [1]. Agile methods are used to focus on creating close collaboration between developers and customers and responsiveness to customer needs thus

improving the quality of software and productivity [9]. The important features of agile methods are continuous requirement gathering, frequent face to face communication, pair programming, early customer feedback and minimal documentation [10]. Agile methodologies has characteristics of quick and fast development pattern, short iterations and focusing on completion of working code[13]. Agile is the software management and development approach that helps to create software quickly while keeping in view the issue of requirement change. It is specific form of software development methodology focusing on providing flexibility in development processes while providing high level customer satisfaction the most commonly used agile development methodologies based on agile principles are extreme programming (XP) and Scrum. Other methods such as feature driven development and crystal clear methods have been also used[10]. Organizations are following Agile development in order to deliver a quality software effectively which fulfils the customer needs. Due to this increasing mode of implementing agile process, organizations are adopting agile manifesto in GSD[8].

Large number of researchers have been producing the process models and frameworks of agile model. To standardize such work, in February,2001, an agile manifesto consisting of twelve principles were categorized[13]. It states that agile this methodology fulfils customer requirements through early and continuous delivery. It also states that agile welcome the change in requirements even late in the project and it is highly accepting change methodology. Agile delivers working software over documentation and it releases the small chunks of software frequently by making every chunk of software operational. The interaction and collaboration between the team members is done on daily basis throughout the project. Agile promotes sustainable development. Agile focuses continuous attention to technical excellence and good design enhances agility. It also focuses on simplicity by decomposing the task. Agile is the methodology that enables team to come up with the architectures, design and best solutions. The team of agile must groom themselves at regular intervals to become more effective so that they can adjust in environment accordingly.

1.14. Agile Principles

All agile models qualify these twelve principles of agile manifesto. To compete the market requirements, the clients prefer to launch their products early in the market. Due to this requirement, the developers remain under the continuous pressure. Agile states that our highest priority is to satisfaction of the customer which can be possible by continuous and early delivery of software. Agile models provide this support to release early the code in appropriate required time. According

to agile principles, agile methodology believes in minimum or no documentation of software development project. Agile methodologies have also some limitations with respect to some project requirements and environment. Agile process provides limited support to the geographically distributed development environments, large team structures, large and complex software systems and reusable components development[13]. The success factor of agile software development is based on team interaction and collaboration. Agile strategies have empowered the project team members to tackle the issues of unstable business environment through enhanced flexibility and need of customer. Companies are adopting agile software development methodologies for their distributed environment to overcome most of the complications faced by the teams. Agile practices have been developed to help the co-located teams between national or international boundaries. Jalali and Wohlin shows that agile became famous in a distributed environment from 2004 and forward[17]. Agile is the evolutionary and iterative approach to software development which focuses on acceptance of frequent changing requirements.

Agile methodology has key features like pair programming, small releases, requirement gathering and customer feedback. Each of the feature provides benefits. Pair programming increases the quality of the project and develops software code. Defects can be resolved by small releases that will help to minimize roadblocks for the future developing software code. Customer decisions are under the influence of requirement gathering. Customer feedback at every release will minimize the fixes at the end. It is an approach which is used by organizations that combine requirements and solutions of software development to create products enabling cross-functional teams and customers.

1.14.1. Agile Team

Self-organization is the basic requirement for the agile team members. Self-organization means that a team can decide itself how to achieve the goals given to them in the most appropriate manner. This means that every team will choose different ways of organizing itself, because the way that works best for the team is depending on multiple factors like the ability and experience of single team members, team size and the project goal. Furthermore, letting a team decide the internal structure instead of one manager giving the orders. One of the main aspects to enable self-organization within a team is frequent communication. Many agile frameworks strongly demand

co-location of teams and while not being inevitable requirement most authors strongly recommend to co-locate the development team.

To convey the information efficiently and effectively within a development team, the most effective method is face to face conversation [18].

1.14.2. Scrum

The basic focus of scrum is on project management instead of software development[9]. Scrum process includes sprints, daily stands ups, sprint planning, retrospectives and sprint reviews. At the end of an iteration in Agile software development, a meeting is held known as Retrospective. Sprints are the way to analyse the time which is required to implement the required aim. A sprint is the short iteration which remains continuous for few weeks. In a sprint, requirements are gathered in user stories. Product backlog collects the user stories where they are arranged by the product owner on behalf of customer. Team members in scrum are self-organizing, multidisciplinary. Small increments of working software are developed[9].

1.14.3. Scrum Roles

The three jobs characterized in Scrum are the ScrumMaster, the Product Owner, and the development Team (which comprises of Team individuals). Individuals who are able to satisfy these jobs, cooperate closely, consistently, to guarantee the smooth progression of data and the successful achievement of goal.

1.14.4. Scrum Master

The Scrum Master is the keeper of the process. The ScrumMaster is responsible for making the process run smoothly, for removing hurdles that are affecting productivity, and for organizing and facilitating the critical meetings.

The ScrumMaster needs to understand Scrum well enough to train and mentor the other roles, and educate and assist other stakeholders who are involved in the process. The ScrumMaster should be awareness of the status of the project by analysing that it is up to date and relative to the expected progress. The ScrumMaster does not assign tasks to Team members, as task assignment is

responsibility of Teams. The ScrumMaster's approach encourage the team by facilitating their decision-making and problem-solving capabilities, so that they can work with increasing efficiency and decreasing need for supervision. In this way they creates a empowered team that is able to make important decisions.[19].

1.14.5. Product owner

Product owner keeps all the customer requirements. The Product Owner provides the "single source of truth" for the Team regarding requirements and their planned order of implementation. In practice, the Product Owner is the interface between the business, the customers, and their product related needs on one side, and the Team on the other. The Product Owner buffers the Team from feature and bug-fix requests that come from many sources, and is the single point of contact for all questions about product requirements.

1.14.6. Development Team

The development team consist of five to nine cross functional people who are responsible for designing the product and also building and testing it. The development team is self-organizing and it possesses all the needed skills for completing the required goal. It is recommended to split the larger team up to multiple smaller scrum teams[19].

1.14.7. Artifacts

Scrum uses the following Artifacts in its process:

1.14.8. Product backlog

It is the list of work items that are prioritized for the whole project. The product Backlog consist of everything that anyone is interested in the product or process has thought is needed or would be a good idea in the product. Product backlog includes anything that represent the work to be done on the product.

Product backlog is also called user stories. User stories are designed to understandable for all stakeholders, software developers as well as business people. They have simple structure. They follow the template like "As a *<user role> I want to <goal> so that <benefit>".* The product backlog

is continuously changing artifact. Work items can be removed, added, altered as condition of project change. Each item has to be estimated in its size and cost. After this, it is being prioritized depending upon multiple factors. The person in charge of product backlog is the product owner. It is his duty to continuously maintain and refine the items and keep the priority of single items correct [19].

1.14.9. Sprint Backlog

At the start of every development iteration, the items with highest priority are moved from product backlog to the sprint backlog. The items that are still not completed at the end of the iteration are moved back to the product backlog. When a user story from the Product backlog is selected for a Sprint, it is pulled to the sprint backlog and discussed with the Product Owner to ensure clarity on what it means and what are the acceptance criteria for it. User stories are frequently divided into multiple smaller tasks which are estimated and prioritized as well [19].

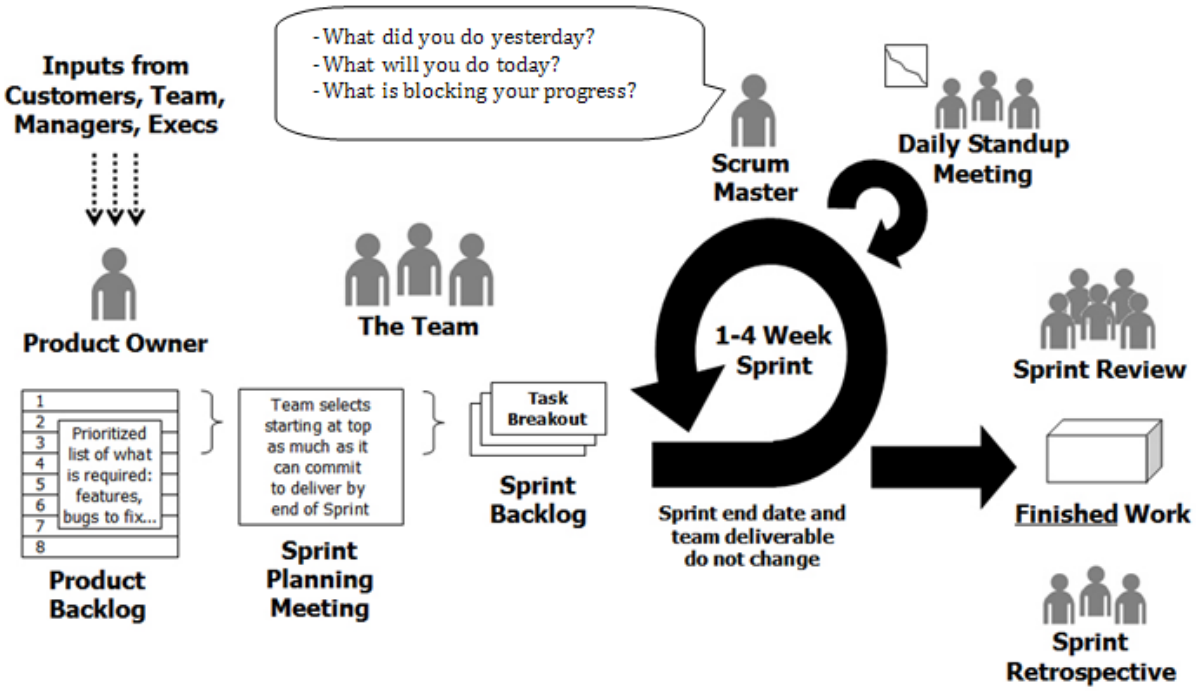

Figure 2.2: Scrum Process [1]

1.15. Extreme programming (XP)

Extreme Programming consist of four values regarding software development "communication, simplicity, feedback and courage"[9]. These values are implanted in twelve development practices : planning game, small releases, metaphor, simple design, test driven development, refactoring , pair programming, collective code ownership, continuous integration, 40-hours week, on site customer and coding standards[9].

1.16. Kanban

Kanban is one of the agile process methodologies. Kanban method in software development was originated in 2004. Kanban is a Japanese word meaning a signboard. A scheduling system is manufactured with the help of it[6]. The Kanban methodology was introduced by the manager at Toyota Motors .Their aim was to limit the inventory level at every stage of the production process with the help of cards[3]. It is software development methodology that applies lean principles. Kanban has five principles proposed by Anderson as visualise workflow, Work in progress (WIP), Measure and manage flow, make process policies explicit, use models to recognize improvement opportunities[7]. Kanban is a workflow method that is used for managing continuous software engineering work. Practitioners face serious issues while implementing Kanban[3].

Kanban is also famous for the best method for execution of lean thinking in practice. Kanban board is a tool which is used to visualize the workflow of Kanban methodology. It consist of columns that represents the workflow stages of development processes and the number of user stories in every column is limited in order to manage the workflow[20].

1.17. Feature Driven Development

Feature driven development (FDD) is one of the agile models that organizes the development of software around making progress on the features of the software associated. It consists of five step development process built largely around discrete feature projects. The five steps are as follows; develop an overall model, build a feature list, plan by feature, design by feature, build by feature. These five steps allow the development to be done more rapidly. It allows larger teams to handover

the products forward with assurity of continuous success[21]. In the first step of developing the overall model, FDD team determines the project scope. Multiple models are proposed and combined together to create an overall model. In the next step of building the features list, the team members will focus the customer focused features to be developed. The customer focused features are the small functions that are completed in short period of time. In the 3rd step of planning by feature, individuals' features are listed and arranged in the proper order. In the 4th step of design by the feature, team chief programmer selects the features to be completed in period of two week. A designed package is created for each feature. In the last step of build by feature, developers work to build the code for aforementioned features. This code will be then test before the release of final version[22]. The FDD team structure consist of six chief roles including project manager, chief architect, development manager, chief programmer, class owner, domain expert[22]. FDD was first applied in 1997 working on the product for Singapore bank. Fifteen months were spent to complete the product with team member of 50 people[23]. The successful completion of this project spreads widely the use of FDD worldwide. It is best suited for large scale long term projects as it is able to manage the changing of requirements on ongoing basis[22].

1.18. Agile Global Software Development (AGSD)

There is greater competition between various software development companies due to increased globalization. To cope with different challenges of GSD including communication, coordination and control, it has now become recent trend to apply agile methods in Global Software Engineering. Projects having high level of uncertainty can be handled efficiently by these methods. Software companies are using agile software development at global level to develop the product that ensures quality and to have combine benefits of agile methods and Global software development. The combined effect of Agile development methods and GSD is known as Distributed Agile Software Development. This combination ensures the success factors of software industry such as quality, time and cost. The benefits of combining agile and GSD includes increased collaboration and communication, access to talented work forces, transfer of knowledge and resource, reduce time to market pressure. It also increases productivity with quick innovations with higher quality software[24].

Co-located distributed teams face most of the challenges globally, to overcome these challenges companies are applying agile methods. Agile methods have been developed to help teams located

across national or international boundaries. Many studies have shown that agile methods can be suitable for mitigation of GSD issues. For this perspective, agile is the best methodology as it is increasingly used in development of software globally[17].

1.19. Related work on Agile Global Software Development

Numerous studies are conducted on Agile GSD. Table 2.1 shows some of the existing studies on communication challenges towards agile in GSD. Table 2.1 comprises of five columns namely 'Author/year', 'Domain', 'Methodology', 'Contribution' and 'Limitation'. Column Author/year shows the name of the paper with the year of publication. Column domain shows the area regarding the paper title. The methodology column shows the methodology or the technique used in the research work. The contribution column shows the work done in the paper according to the mentioned title. The limitation column is the gap identified in the paper which should be filled later in the future.

Table 2.1: Existing studies on Communication challenges towards agile in GSD

	Author/year	Domain	Methodology	Contribution	Limitation
1.	Richa Sinha, Mohammad Shameem, Chiranjeev kumar /2020 [8]	Strength, weakness, Opportunities and Threats for scaling agile methods in GSD	Systematic Literature Review	Identified 13 factors positively and 11 factors negatively impacting agile methods in GSD	A large number of studies relevant to research question have been missed due to limited number of search string and digital databases.
2.	Mohammad Shameem,Bibhas Chandra,Rakesh Ranjan	Human related challenges in GSD towards a hypothetical	Systematic Literature Review	11 challenges have been identified out of which 6	One of the limitations is related to its

	Kumar,Chiranjeev Kumar / 2018 [26]	model for scaling agile methodologies		challenges are the critical challenges in scaling agile methods	content validity. In our study, The scope of SLR is limited to the five digital libraries and used limited search strings.
3.	Asif Qumer Gill, Ahmed Al-ani,Yehia Ibrahim/ 2016 [18]	Empirical study of geographically distributed agile development communication challenges	Systematic Literature Review	6 categories of Communication challenges with the solution strategies to overcome those challenges has been identified	Study is limited to number of selected databases and limited number of search strings.
4.	Nazish Saleem, Dr,Sanjay Marthani, Dr. Nazim Taskin / 2019 [14]	Understanding different level of challenges in GSD	Systematic Literature Review	Investigated challenges at country, company and team level	Solution strategies has not been identified.
5.	Hasssan Khalid, Farhat ul ain , Kokab Khushboo /2017 [16]	Basic factors for failure of communication in GSD	Systematic Literature Review	Communication challenges which affects Requirement Change Management process has been identified	Framework for solution set of issues needed to be addressed
6.	Muneera Bano, Didar Zowghi ,Natalie Sarkissian/2016	Explores communication structure and	Case Study	Identified barriers for effective	Case study is non

	[27]	corresponding challenges faced by distributed software organizations globally		communication in distributed teams	generalisability limitation.
7.	Samireh Jalali, Claes Wohlin /2010 [10]	Use of agile practices and lean software development in GSD	Systematic Literature Review	Practices of agile were modified with respect to the context and situational requirements	Few papers have been missed due to constraint on limited number of strings. Results are limited to peer reviewed conference that is published between 1999 and 2009
8.	David Marcell, Szabo , Jan philipp/2019 [9]	Exploring the interconnection among agile and three distances including temporal, geographical and sociocultural	Case Study	Identified bidirectional connection between agile practices and distance	Benefits and cost of distance-agile relationship is not identified.
9.	Nina Kamrina Kamaruddin, Noor Habibah Arshad /2012	Issues on communication in agile GSD	Literature survey	Identified 13 issues regarding communication	Empirical investigation needed to be

	[5]			in agile software development projects GSD	done in order to find out more issues related to communication in Agile Global Software Development projects
10.	Yasir Hassan Shah, Mushtaq Raza, Sami ul haq /2012 [15]	Communication Issues in GSD	SLR	Explored key factors that creates problem in communication with possible solutions	Modularization of work approach needed to be used to formulate viable solutions for communication in GSD environment
11.	Juan Garbajosa, Agustin Yague,Eloy Gonzalez/2014 [28]	Exploratory study on impact of infrastructure on communication during agile in GSD	Experimental Research	By using tools like VSee, Smart Boards, communication can be improved	Issues regarding Dependency on bandwidth is not addressed in this paper
12.	Yehia Ibrahim Alzoubi /2014 [12]	Agile Global software development communication challenges	Systematic Literature Review	7 Major categories of communication challenges were identified	Limited number of studies has been reviewed from limited databases.

13.	Peniile Paolo Tell, Christian Bo Michelsen/2018 [29]	Challenges of distributed development in agile teams with the solution strategies to tackle those challenges	Case study	Reported 5 elements Including agile servant leader, agile team, trust, virtual work environment, inspect and adapt, reduce waste.	Scope is limited to only one organization.
14.	Muhammad Ilyas | Siffat Ullah Khan/2017 [30]	Identified barriers during integration in GSD environment	Systematic Literature Review, Questionnaire survey	16 Challenges has been identified	It was performed on single system developed by one organization.
15.	Biyagamage Agra, Tracy Hall, Anthony Fitzpatrick/2011 [31]	Media selection affect during communication in agile GSD	Case Study	Media Synchronicity theory has been applied to the selection of communication media	Theory doesn't cover all the important factors like media availability, media familiarity and infrastructure capabilities.
16.	Joshua Connor /**2020**	Team collaboration in software development	Exploratory research	Framework purposed for improving feedback and quality of	The purposed feedback framework is not verified on Kanban implementation

				education quantitively	
17.	Raoul Vallon, Stefan Strobl, Martin Ras/**2019** [1]	Kanban in distributed teams with limited geographical distance /Conference paper	Case study (interviews)	Showing that Kanban and specifically the selected aspects of pull principle, WIP limits and Kaizen culture are being successfully applied in a distributed environment	Study was limited to only three aspects of Kanban Pull System, Work In Progress Limit and the concept of Kaizen culture (continuous improvement)
18.	V. N. Vithana,D. Asirvatham/**2018**[3]	Using Agile Methods in GSD	Survey-based research.	Identified the Impact of challenges on software success by using hypothetical model of success.	study was based on only Sri Lankan product engineering industry
19.	MuhammadOvais/ **2018** [4]	Kanban in software engineering /Journal	SLR (Kitchenham)	High lightening the benefits and challenges in primary studies and experienced reports	They studied vast knowledge of software engineering literature but non peer reviewed scientific studies, books, book chapters,

					short papers, experience papers, and assimilation studies were excluded.
20.	Maureen Tanner/**2017** [2]	Use of Kanban in GSD facing communication and collaboration issues	Case study	Communication and collaboration challenges were identified that can be alleviated using Kanban elements	There is lack of awareness on Kanban elements so an extended study following a similar approach with the bigger sample using Kanban elements need to be addressed
21.	Maha Khaled Yacoub/**2016** [6]	Kanban methods for distributed teams /Journal	Case study	List of possible challenges with proposed solutions.	Kanban was not implemented on large scale within global software development companies.
22.	Mikko Korkala/**2014** [7]	Waste identification for improving communication in Global	Case Study	Identification of communication waste and solutions	Study was limited to only North American software intensive

		software development			company that was implementing a product across three sites in a globally distributed fashion.
23.	Muhammad Ovais Ahmad, Jouni Markkula /**2013** [11]	Kanban in software development / Conference Paper	SLR (Kitchenham)	Challenges and benefits are reported from 492 papers out of which 19 were identified as primary studies.	There were no proposed solutions for the reported challenges.
24.	Rafael Camara, Iury Monte/**2020** [17]	Agile Global Software Development: A Systematic Literature Review/ Conference Paper	SLR	Detailed systematic review of 48 agile practices has been carried out. These practices have been adopted mitigating agile challenges.	Only five databases were selected, some valid studies were excluded.

It is found that three studies talked about the communication challenges with the purposed solution strategies[12][27][5]. Two studies among them identified major categories of communication challenges for GSD environment during implementation of agile[12].Two studies based upon Kanban ,one of the agile methodologies shows the communication and collaboration challenges that can be reduced with the help of Kanban elements[20][11]. There

is the case study in the above mentioned literature shows list of possible challenges with the purposed solutions[6]

By above mentioned literature it was found that Empirical study of geographically distributed agile development identified 6 categories of communication challenges with their purposed solution strategies but the study was limited to few databases[18].Another study reported 11 communication challenges out of which 6 challenges are the critical most in scaling agile methods but the study was limited to only five digital libraries and they have used limited search strings[26]. One of the study reported communication challenges at country, company and team level but the solution strategies of those challenges were not identified [14]. Another study reported basic reasons for failure of communication in GSD.They have identified those challenges which affects requirement change management process but they didn't mention any framework for the issues they have identified[16]. A study based upon communication structure was conducted to identify barriers for effective communication in distributed teams but there was none generalisability issue[27]. Another study conducted identified 13 issues regarding communication in agile software development projects in GSD[5].

There is a study based upon impact of infrastructure regarding communication. They used tools like Vsee and Smart Boards for improvement of communication problems but they have not addressed the issue of bandwidth facing during implementation of those tools[28].One of the study has mentioned 16 communication challenges but the their scope was limited to only single system of single organization[30]. There is a primary research that used media synchronicity theory that has been applied to selection of communication media but the theory doesn't cover all the important factors of the media availability[31].

It was found that four studies conducted case study for identification of communication challenges [1][4][11] . More specifically the study [3] reported Agile related communication and collaboration challenges but there is lack of awareness of medium challenges and the implementation of agile was not confined up to global area. Also, there are studies that proposed no solutions for the reported challenges of communication medium in implementation of Agile. One of the study among them was conducted in 2020[1] proposed the framework for improving feedback and quality of communication medium, collaboration, trust and team cohesion, but they lack the implementation of Kanban during purposed feedback framework. Another study

in year 2018 [7], highlighted the benefits and challenges regarding agile methodology implementation. The study is having limitation of lack of coverage to the scientific studies, books, short papers and assimilation studies. Besides the study also ignored the GSD aspect of software development. Although the above-mentioned studies significantly discussed the importance of communication for implementation of agile methodology in GSD but none of them identified the agile related communication medium challenges for GSD platform in detail. In this study communication medium challenges are going to be investigated for the agile implementation at GSD level besides with its solution strategies.

Although the existing studies have comprehensively discussed the concept of agile in GSD, however they lack to link the studies with communication medium challenges in agile GSD. Based on existing state of knowledge on agile implementation in GSD, it is observed that there is a need to further investigate the challenges associated with communication medium element while implementing the agile approach in GSD.

This study is based on communication medium challenges towards agile in GSD. The methodology to achieve the research objective is reported in chapter 3.

1.20. Summary

In this chapter, literature review is conducted to find out the gap in the existing studies. 24 related studies are discussed in this chapter. After thorough investigation of the mentioned related studies, gap has been identified. The research problem identified from the existing gap is reported in chapter 1. The methodology used to achieve the research objective is reported in chapter 3.

CHAPTER 3

METHODOLOGY

1.21. Introduction

In Chapter 2, we reported the literature and identified the gap in the field of agile communication in global software development. In this chapter, the set of methodologies used in order to pursue our research are reported and discussed.

1.22. Overview

Research methodology is the set of specific procedures or techniques which is used to identify and analyze information about a topic. In a research paper, the methodology section allows the reader to judgmentally estimate a study's overall validity and reliability. This section discusses the set of methodologies adopted in order to pursue our research. The first adopted research methodology that is SLR (Systematic Literature Review) was conducted to review the existing literature related to communication medium challenges. It was chosen due to the reason that it provides a broad review and critical analysis of all related existing researches on and around the area of software requirement engineering. It helps in conducting an organized and reasonable literature review having a predefined search strategy. The prime objective of selecting SLR was to explore the challenges that are faced during the implementation of Agile in global software development. Along with this research methodology, an industrial survey is selected as a second research methodology in order to propose the solutions against the highlighted challenges.

1.23. SYSTEMATIC LITERATURE REVIEW (SLR)

Systematic Literature Review as a research methodology is adopted. This methodology helped us to identify all the possible important key factors for implementation of Agile in global software development. For the purpose of performing SLR, best standard guideline by Kitchenham[32] is selected , as it is the most comprehensive guideline for conducting SLR in field of software engineering. SLR standard guideline which is selected for research methodology, consist of three parts: Review planning, Review conduction and Results reporting[32].The systematic literature review conducted to review the existing literature related to communication medium challenges towards agile in GSD. The SLR involved a comprehensive review and critical analysis of existing studies on and around the area of communication medium issues in agile. SLR is performed as it helps to conduct a thorough and fair literature review due to its predefined search strategy. The goal of this SLR is to find the communication medium challenges while implementing Agile in global software development process. It also comes up with a unique list of communication medium challenges which can influence agile implementation in GSD platform.

1.24. Systematic Literature Review Protocol

Systematic Literature Review is a process of identifying, assessing and interpreting all the facts and figures that are available in relation to a specific research question. The various steps in conducting SLR are planning the review, conducting the review by considering all the related information into account and reporting the findings of the review. Every research starts with some type of literature review. Unless literature review is also fair but it is of little scientific value. The systematic review manages the manage the existing work in a fair manner. SLR is a type of secondary study and is different from ordinary literature review. It is more rigorous, thorough and comprehensive the main reason for performing the SLR is to identify any gaps in the research in order to suggest areas for more research. If there are quantitative studies, it is possible to combine data using meta analytic techniques. This increases the likelihood of detecting real effects that individual smaller studies are unable to detect. SLR can provide information about the effects of some phenomenon across a broad range of settings and empirical methods. Systematic reviews depend on a defined search strategy that purpose is to explore the maximum relevant literature as possible. Systematic reviews require explicit inclusion and exclusion criteria to assess each potential primary

study. SLR identifies the information to be obtained from each primary study including quality criteria by which primary study evaluation can be done. Although SLR has many advantages over traditional literature reviews but the main disadvantage is it requires more effort than the previous method of conducting literature review. The selected SLR standard guideline comprised of following three parts: Review planning, Review conduction and Results reporting. Figure 3.1 shows the overview of the SLR steps.

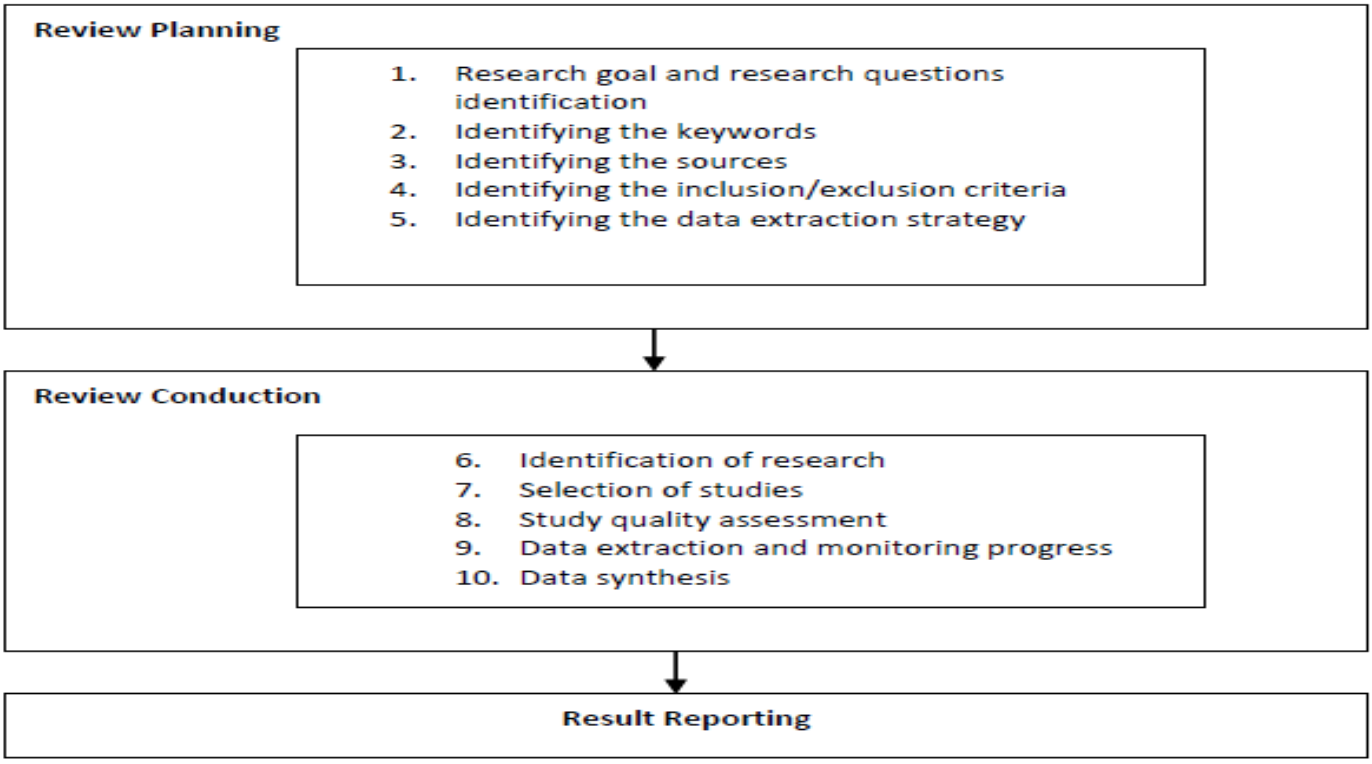

Figure 3.1: Overview of SLR stage[Kitchenham][32]

The aim of this SLR is to explore the communication medium challenges while implementing Agile in global software development process (RQ1). The appropriate keywords are finalized. Latterly, the keywords are used to generate the search query that is executed in various databases. Based upon the inclusion/ exclusion criteria, the data sources are filtered then. Lastly, the data is organized in data extraction forms and the result are reported.

1.25. Research Goal

The goal of this SLR is to come up with a unique list of communication medium challenges which can influence agile implementation in GSD platform. The unique list of communication medium challenges is the answer of our research question RQ1.

1.26. Keywords/ Major terms

We identified the key terms of agile implementation, communication medium challenges and Global software development. We also identify the alternate spellings and synonyms for major terms as shown in table 3.1

Table 3.1 comprised of two columns namely Key terms and synonyms. The key terms are the terms used in the research work most commonly. Synonyms are the alternative words according to the terms respectively.

Table 3.1: Synonyms of keywords.

KEY TERMS	SYNONYMS
Challenges	Issues, problems, difficulties, hardships, obstacles, barriers
Global software development	Worldwide software development, Distributed software development, Large scale software development, geographically distributed team software development, Virtual team software development
Communication Medium	Transmission method, information exchange way

This research work has designed review protocol for conducting our SLR. Review protocol contains 7 research phases.

1.27. Research questions

RQ1: What are the communication medium challenges confronted during the implementation of Agile in global software development?

RQ2: What are the resolution strategies adopted to treat these identifies challenges?

1.28. Search String search

The research process is conducted by evaluating all the primary studies. For evaluation of primary studies search strings are developed by extracting the keywords from title. These keywords are then concatenated to develop new search string using Boolean OR and Boolean AND operators.

Table 3.2 shows the key terms and the strings using Boolean OR and Boolean AND operators.

Table 3.2: Strings for searching the primary studies

Global Software development = "GSD" OR "Offshore development" OR "Distributed development" OR "Software Outsourcing"
Challenges= "Issues" OR "Problems" OR "Weaknesses" OR "Threats"
Agile = "Agile development" OR "Kanban" OR "Scrum" OR "Lean" OR "Agile software development"
Communication medium= "Communication method "OR "Communication Process"

1.29. Search process

Following 7 digital libraries are used for searching primary studies by applying search strings.

- IEEE explorer
- Springer
- Wiley
- ACM
- Science direct
- Google scholar
- Elsevier

1.30. Study selection

The selection of primary studies includes following inclusion and exclusion criteria:

1.30.1. Inclusion Criteria

Our inclusion is based on following criteria.

- Our research includes all the articles from the databases that is discussing Agile implementation in GSD environment and the communication medium challenges that are being faced by the global teams during implementation of Agile**.**
- The selected papers are written in English language and the full text must be available
- The selected papers are published in some conference or Journal
- Articles are answering their intended research questions

3.10.2. Exclusion Criteria

These studies excluded from our database are based on following criteria:

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

- Papers which are not having any of the keyword like GSD, Agile and communication challenge.
- Papers which are repeated in above mentioned data sources.

1.31. Quality assessment criteria

The quality of the selected studies are accessed by adopting a check list from the work of Kitchenham[32]. Table 3.3 shows the checklist we used for assessing the studies quality. It consists of three columns namely number, questions list and the associated answers expectedly. The questions are asked to determine the quality of papers. The answer columns show the evaluation level of the questions asked.

Table 3.3: Quality assessment checklist, adopted from Kitchenham work [32]

Number	Question	Answer
1	Are the goals clearly mentioned?	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 goal of study is defined clearly; P (Partly), the goals are implicit; N (no), the goals are not defined.

_ QA2: Y, the findings of the study is persuading and reliable as it depends on comprehensive set of peer reviewed published work; P, the findings of the study is based on minimum number of papers which are even not published in peer reviewed journals and conferences; N, the findings are not trustworthy and significant as it is based on assumptions

_ QA3: Y, the strategies and methodologies are clearly described and validated by the study; P, the identification techniques are mentioned but not defined clearly; N the Identification strategies are not defined properly.

_ QA4: Y, the knowledge of the previous referred studies is widening by the study by giving high level contribution to the area of research; P, the knowledge of the referred studies are discussed but no significant contribution is performed; N, The study is not enhancing the data and it is not understanding with respect to previous studies.

_ QA5: Y, the area of research is explored by the researchers distinctly by looking into different factors; in short multiplicity of the idea is explored; P, the study is exploring the idea but some parts are diversely investigated and some are ignored; N, the study is not examining the context of examination differently.

_ QA6: Y; the data mentioned in study is in understandable and traceable manner where every explanation and results are clear and easily be connected; P, the study is using the data extracted from the other studies but it is not easy to trace that data because the organization is not appropriate; N, there is lack of connection between data, its interpretation and its results.

_ QA7: Y, the study is discussing the concept in depth and the complexity of the study is clear to the reader; P, the study is discussing the concept and the complexity of the study is in general; N, the study is not discussing the data details in depth.

In total 25 papers (after applying inclusion and exclusion criteria) were randomly distributed among three groups. Each group was provided with 3 papers. In specific every member of the group was given 3 papers to assess its quality, based on the above-mentioned checklist, as shown in Table 4. The scoring procedure was Y = 1, P = 0.5, N = 0. Against each question of the checklist there is feedback and it was recorded and given the values accordingly.

Scores are gathered against each paper. We selected those papers whose accumulated summed values were either 5 or above 5. It is found that among 25 papers 24 papers were having accumulated summed value above 5. So, remaining 24 papers that were having accumulated summed values above or equal to 5 were selected and reviewed for identification of communication medium factors that could affect communication in GSD environment. The tables showing the quality scores of the selected studies are shown in Appendix A.

The evaluated 24 papers are explored and communication challenges for agile GSD are identified.

1.32. Data Extraction

The data extracted from each of the paper was Paper source (database, conference, journal, book) with its full reference, Paper Title, Authors, Year of publications and communication challenges. Table 3.4 shows the information from the data source.

Table 3.4 consist of source id, Title, Author, Year of publication, Type of paper, methodology and challenges. We tabularized all the data sources in similar information forms. The study in the table will show the data source id (which is unique for each of the data source), title, author, publication year, publication type (Journal, Conference, standard etc.) and the identified data units from the data source. The extraction form of all papers is attached in Appendix B.

Table 3.4: Sample study information form

Data Extraction	
Id	
Title	
Author	
Year of Publication	
Type	
Methodology	
Challenge	

1.33. Survey

The second selected methodology is an industrial survey. The aim of selecting this method as our research methodology is basically to propose the resolution strategies that will help to overcome the communication medium challenges while implementing Agile in global software development.

A survey is conducted by following the guidelines of Kasunic[33] published by Software Engineering Institute (SEI). We will follow his work as it is most commonly and famously used handbook for conducting resourceful survey in the field of software engineering.

1.33.1. Research Objectives for Survey Conduction

The survey conduction has following objectives:

Objective 1: To identify the solution strategies for the medium challenges faced during implementation of Agile in GSD.

1.33.2. TARGET AUDIENCE

This study focuses the software development industries that are implementing Agile regarding GSD. For appropriate identification of target audience, we focuses on certain questions adapted from the work of Kasunic [33].

1.33.3. SAMPLING

A sample can be defined as subset of total population, having characteristic of population. In this study, the questionnaire is sent online or to the physical location both for survey. The sample size is decided based upon the target audience. The criteria for short listing the companies are based on the factor that they all are implementing Agile using GSD platform.

1.33.4. QUESTIONNAIRE DEVELOPMENT

A questionnaire is considering Kasunic[33] guideline to identify the solution strategies regarding communication medium challenges.

1.33.5. PILOT TEST QUESTIONNAIRE

The questionnaire development process includes pilot study. It is used for modifications and eliminations related to the information. It is also used for questions mentioned in questionnaire until the final questionnaire was designed.

The pilot study is conducted with 30 participants of selected sample. The modified questionnaire is attached in appendix C.

1.33.6. QUESTIONNAIRE DISTRIBUTION AND DATA COLLECTION

The survey package is sent to the target audience, after completion of pilot study.

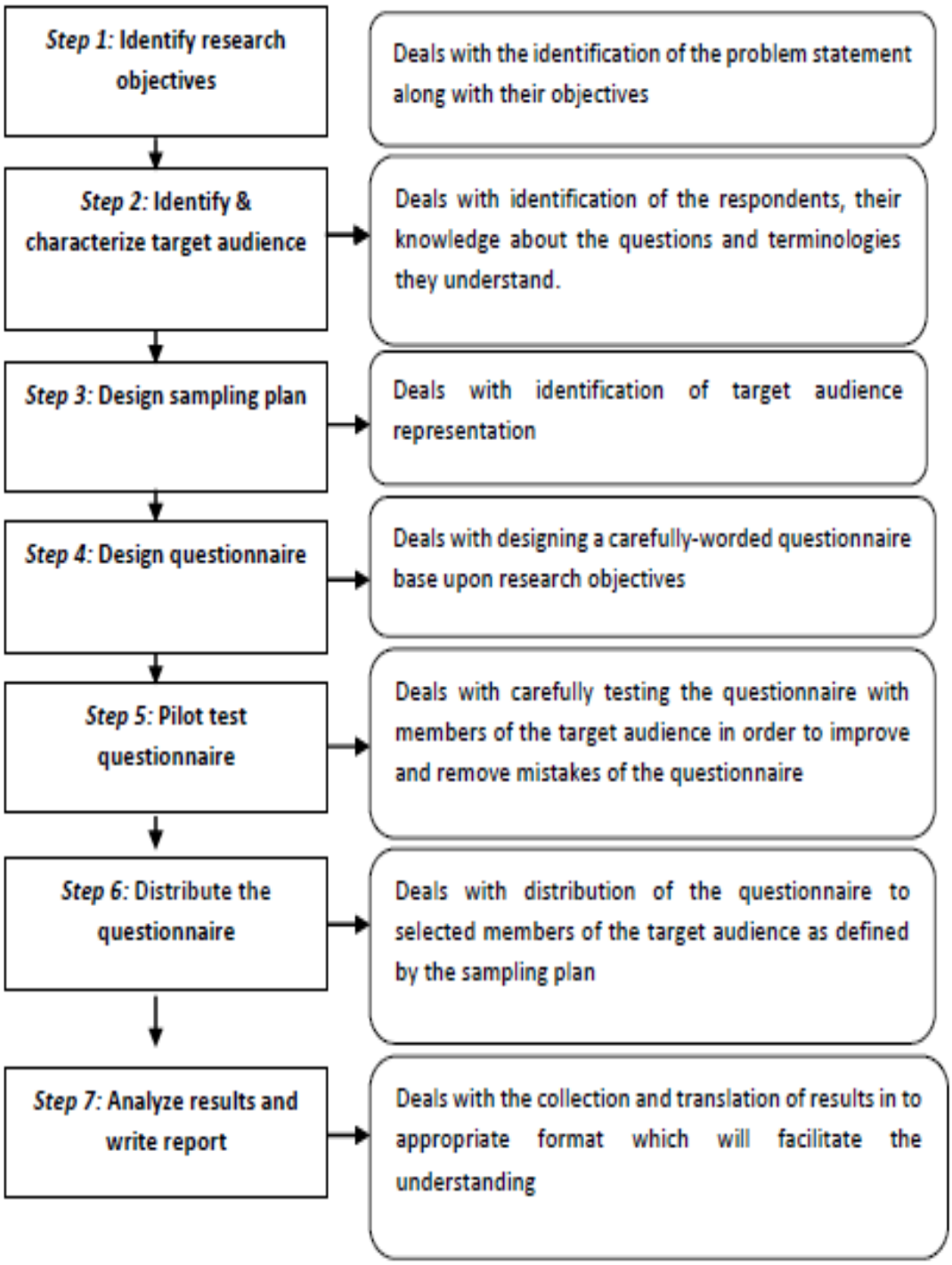

Figure 3.2: Steps for survey conduction, adopted from work of Kasunic [33]

The survey is conducted in the software industry specifically those who are implementing Agile in distributed teams

- Participants having at least 5 years' experience of Agile implementation is selected for the survey approach
- Software developer's organizations is the target having projects on GSD with Agile

The details of the selected respondents are attached in Appendix F.
The results of the SLR and survey are reported in chapter # 4 and chapter # 5 of the report.

1.34. Summary

In this chapter, the methodologies chosen for achieving the research objectives has been mentioned and explained thoroughly. The reason for choosing SLR for achieving our 1st objective has been described which identified the literature gap. Survey details are also mentioned to explore the solution strategies for the identified gap. Selection criteria for the survey and SLR is explained.

CHAPTER 4

Communication Medium Challenges for Implementation of Agile in Global Software Development

1.35. Introduction

We have conducted SLR and the protocol of SLR is already reported in ChapteRes_3 Communication medium challenges for Agile GSD are identified. The metadata of the identified challenges is shown in Appendix D.

1.36. Distribution of papers on basis of Year

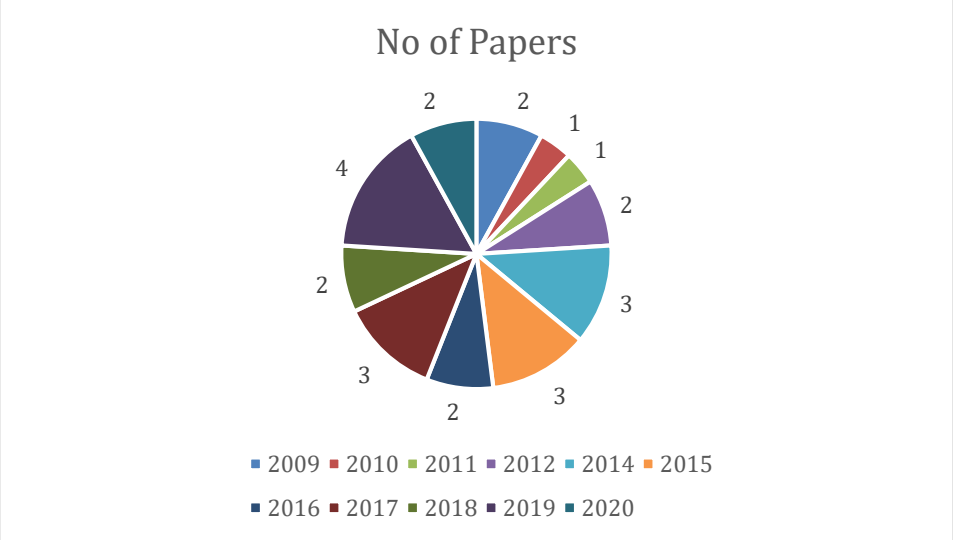

Figure 4.1: Distribution of papers on basis of year

As shown in figure 4.1, four studies are published in year 2020, two studies are published in year 2009, 2012, 2016, 2018, and 2020. Three studies are published in 2014, 2015, 2017.

1.37. Distribution on basis of type of paper

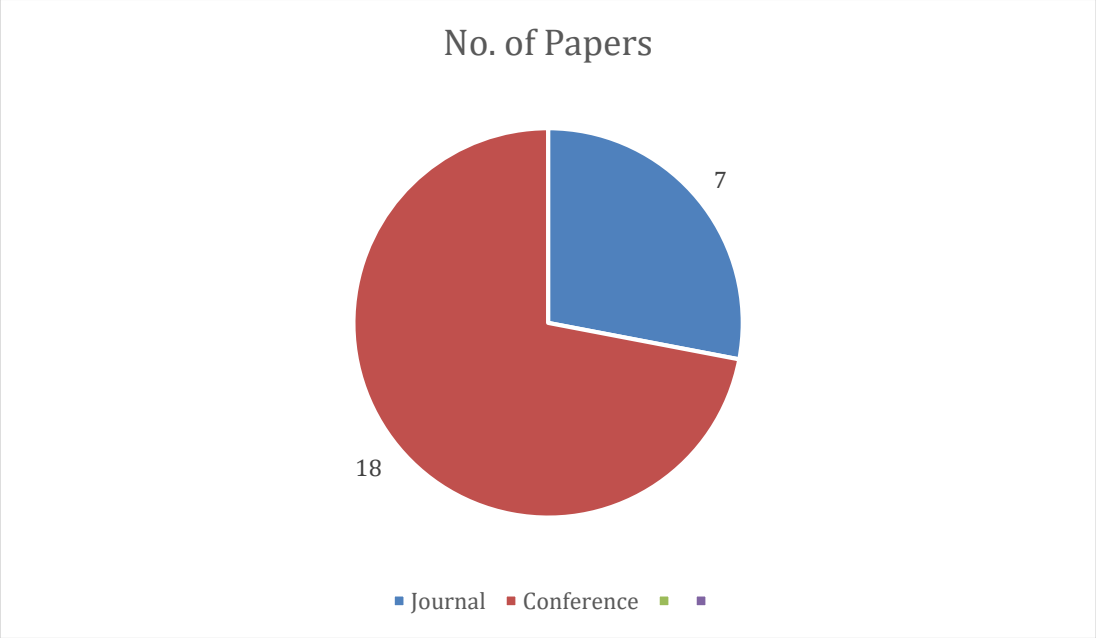

Figure 4.2: Distribution of papers on basis of their types

As shown in Figure 4.2, there are 18 conference papers and 7 Journals papers.

1.38. Distribution of paper with respect to papers published in conferences

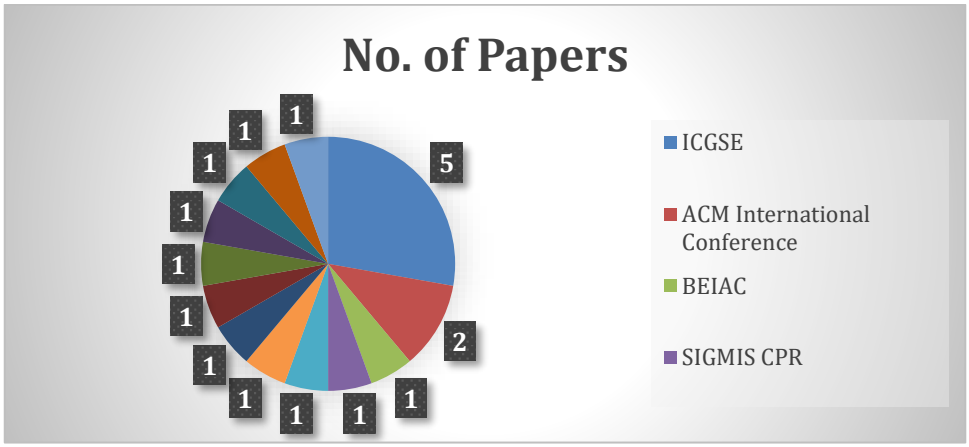

Figure 4.3: Distribution of basis of papers published in conference

As shown in Figure 4.3, here are 2 papers published in ACM International Conference. 5 Papers published in ICGSE. 1 Paper published in PACIS (Pacific Asia Conference on Information system).1 paper published in BEIAC (Business Engineering and Industrial Application Colloquium).1 paper published in ICCCA (International Conference on computing communication and automation). One is published in ICIMU (International Conference on Information Technology and Multimedia) and the other 1 is published in Conference on Human Factors. 1 paper is published in ABLAZE (International Conference on Futuristic trends in Computational Analysis and knowledge Management). The other 1 is published in SEIP (International Conference on Software Engineering in Practice).1 paper is published in ICSSP. The other one is published in OTM Confederated International Conference

1.39. Distribution of papers with respect to paper published in journals

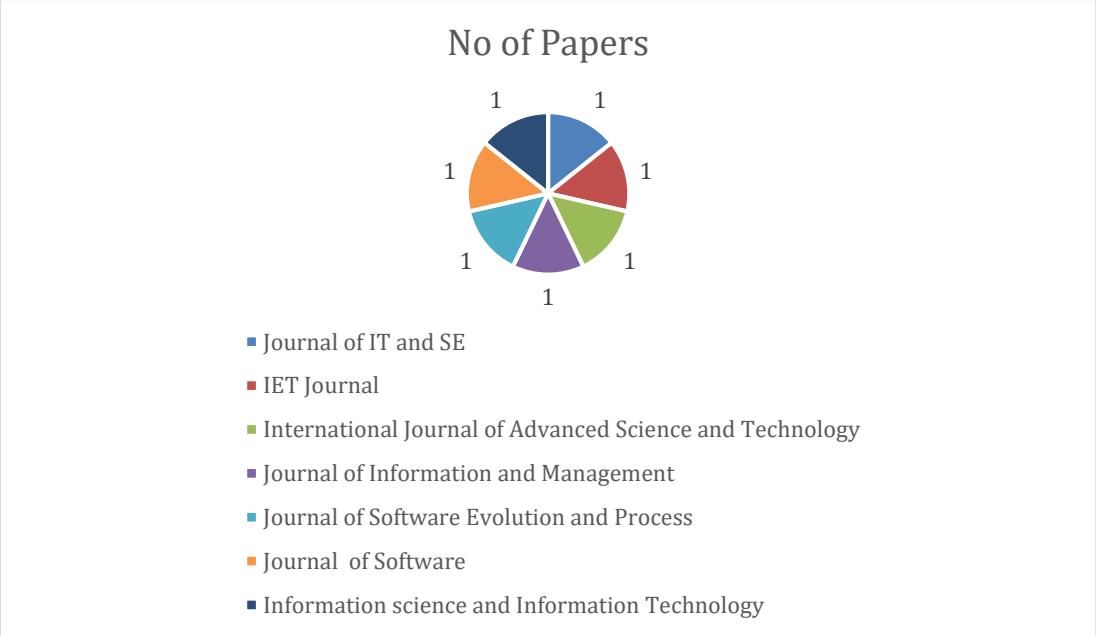

Figure 4.4: Distribution on basis of papers published in Journal

As shown in figure 4.4, there are 1 Paper published in Journal of Information Technology and Software Engineering. 1 paper is published in Institution of Engineering and Technology. 1

paper is published in journal of information and management. The other 1 is published in software evolution and process. And the other 1 is published in journal of software.

1.40. Distribution on basis of Methodology

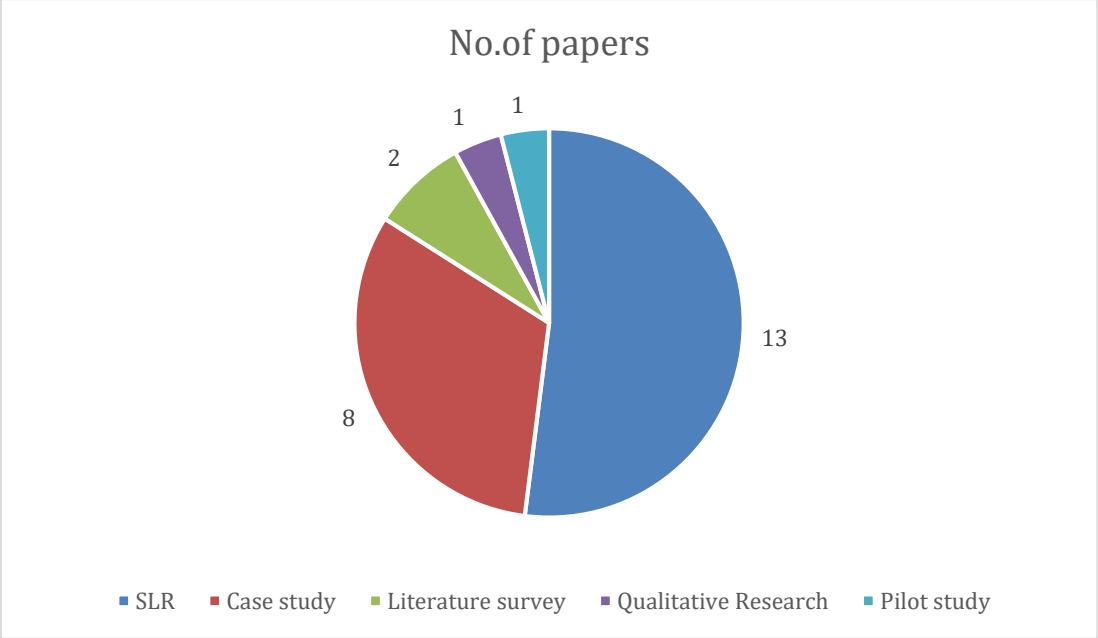

Figure 4.5: Distribution on basis of methodology

As shown in figure 4.5, 13 papers have the Systematic Literature Review Methodology. There are 8 papers having case study as methodology, 1 paper contains methodology of qualitative research and the other 1 is having the pilot study.

Several communication challenges have been identified from 25 research papers regarding literature review.

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1.41. Communication medium challenges for agile global software development:

The unique list of challenges after removing implicit /explicit duplication is shown in table 4.1. Table 4.1 consist of columns namely C-id, Challenge name and Papers id like P1, P2, P3, P4 up to P25.

C-id shows the id associated with each challenge as each challenge is given a specific unique id. Challenge name shows the description of every challenge. Papers id like P1, P2, P3, P4 up to P25 is showing the Papers id given to each paper

Table 4.1: Communication medium challenges towards agile in GSD

C_id	Challenge Name	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25
C1	Cultural Differences	×	-	-	×	-	-	-	-	×	-	-	×	×	×	-	-	-	-	-	-	-	-	-	-	-
C2	Temporal Differences	×	-	-	-	-	-	-	-	-	-	-	-	-	×	×	-	-	-	-	-	-	-	-	-	-
C3	Linguistic Differences	×	-	-	×	-	-	-		×	-	-	-	-	×	×	-	-	-	-	-	-	-	-	-	-
C4	Time Zone Differences		-	-	×	-	-	-	×	×	-	×	×	×	-	-	-	-	-	-	-	-	-	-	-	-
C5	Lack of Communication	×		-	×	×	×		×	×	-	-	×	×	-	-	×	-	-	-	-	-	-	-	-	-
C6	Technical incompatibility	×	×	-	×	×	×	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-	-
C7	Synchronous communication issues	-	×	-	×	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-	-
C8	Video meeting Issues	-	-	-	-		×	-	-	-	-	-	×	-	×	-	-	-	-	-	-	-	-	-	-	-

C9	Bandwidth issues	-	-	×	-	×		-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-
C10	Lack of frequent feedback	-	×	-	-	-	×	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-	-
C11	Asynchronous communication issues	-	×	-	×	-	-	-	-	-	-	-	×	×	-	-	-	-	-	-	-	-	-	-	-	-
C12	Lack of cooperation	-	×	-	-	-	-		×		×	-	×	-	-	-		-	-	-	-	-	-	-	-	-
C13	Lack of understanding customer requirement	-	×	×		-	-	-	-	-	×	-	×	×	-	-	×	-	-	-	-	-	-	-	-	-
C14	Heterogenous development environment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-
C15	Outdated Info.	-	-	×	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-	-
C16	Noise Effecting infra structure			×	×		×	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-	-
C17	Lack of proper documentation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-
C18	Software testing issues	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-

C19	Lack of resources	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-
C20	Architecture mismatch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-
C21	Hardware Configuration issues	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-
C22	Lack of component interface	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-
C23	Lack of Training	-	-	-	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C24	Communication tool issues	-	-	-	-	×	-	-	-	-	-	-	×	-	-	-	-	-	-	-	-	-	-	-	-	-

The symbol "× "is showing the existence of challenge in the respective paper and the "– "is showing the absence of challenge in the respective paper. Every challenge is evaluated on the basis of paper either it is existing in the given paper or not. The challenge named as cultural differences having id C1 is found in P1, P4, P9, P13 and P14. The challenge named as Temporal differences having id C2 is found in P1, P14, P15. The challenge Linguistic differences having id C3 is found in P1, P4, P9, P14, P15. The challenge Time zone difference having id C4 is found in P4, P8, P9, P11, P12, P13. The challenge Lack of communication having id C5 is found in P1, P4, P5, P6, P8, P9, P12, P13, P16. The challenge technical incompatibility having id C6 is found in P1, P2, P4, P5, P6, P12. The challenge synchronous communication issues having id C7 is found in P2, P4, P12. The challenge video meeting issues having id C8 is found in P6, P12, P15. The challenge Bandwidth issue having id C9 is found in P3, P5. The challenge lack of frequent feedback having id C10 is found in P2, P6, P12. The challenge asynchronous communication issues having id as C11 is found in P2, P4, P12, P13. The challenge Lack of cooperation having id as C12 is found in P2, P8, P10, P12. The challenge lack of understanding customer requirement having id as C13 is found in P2, P3, P10, P12, P13, P16. The challenge heterogenous development environment having id as C14 is found in P16. The challenge outdated info having id as C15 is found in P3. The challenge noise effecting infra structure having id as C16 is found in P3, P4, P6.P12. The challenge Lack of proper documentation having id as C17 is found in P16. The challenge software testing issues having id as C18 is found in P9, P16. The challenge lack of resources having id as C19, the challenge architecture mismatch having id as C20 and the challenge Lack of component interface id C22 is found in P16. The challenge hardware configuration issues having id C21 is found in P13. The challenge lack of training id C23 is found in P10. The challenge communication tool issues, id C24 is found in P5, P12.

The description of each challenge is as follow

1.41.1. Cultural Differences

A culture is the umbrella term consisting of life, a group of people spends, the behaviors, beliefs, values, and symbols that they accepts, generally without taking them into consideration and that are passed along by communication from one generation to the next[34]. Culture is the alternate name of communication and communication is the another name of culture[34]. According to sociologists, culture is the combination term which includes values, beliefs, systems of language, communication, and practices that people share commonly[35].Different companies hire staff from various places throughout the distributed environments. Different individuals from different cultural environments have varied behaviors, ideas, and thinking which leads towards issues across the team members distributed across the globe. Due to this cultural difference language barriers can significantly effects the communication[16]. Misunderstanding in communication can cause misuse of medium used in the communication among the different team members. [2]. An example can be defining as that some offshore team members are reluctant to discuss sensitive matters and they pass only the positive information. This also includes cultural believes and ideology conflict. Cultural difference if not tackle seriously , it may impact team collaboration and communication process including medium of communication used[5].

1.41.2. Temporal Differences

Temporal distance is the dislocation in time that is faced by two or more than two people who wanted to coordinate with each other.[12]. It can also be explained as measure of time disruption between the number of people who wants to interact [9]. Temporal distance can be caused by time zone difference or difference in patterns of time shifting [18]. Due to temporal distance differences less time overlapping occurs. Between different continents or environments the number of overlapping hours are reduced during a workday which causes miscommunication[16]. This difference in time in different locations may cause issue of delay feedback on work products and limited or miscommunication between team members across the globe[12]. The interactive media for communication between distributed environments can be very difficult due to temporal differences. In this case opportunities for synchronous communication are reduced[20]. The close time zone projects have more communication needs as compared to the projects having farther time zones so

this increases the reliability and efficiency of appropriate communication medium between team members across different locations of global software development[15].

1.41.3. Linguistic Differences

The term linguistic variation (or simply variation) refers to regional, social, or contextual differences in the ways that specific language is utilized[35]. Distributed environment comprised of different locations or countries with different backgrounds and languages. When team members from different locations collaborate with each other, it is often lead to great frustration. Example, offshore team members whose is not native English speaker often having difficulty during communication with native English speakers, due to this ,meeting sometimes takes long time because it is difficult for them to express their views [5]. Language difference can also be referring as inability to understand people's accents. So, the inability to understand people's accent has been a major issue faced by GSD team members during implementation of agile methodologies[36]. Language difference is more challenging issue while having synchronous communication between team members across the distributed environment. The use of right media for communication can affect the hindrance of language differences between GSD team members.

1.41.4. Time zone Differences

Time zone difference occurs when there is difference in time between different team members located across the globe who is involve in meetings. When team members face the time zone difference, communication gap or overhead increases. This result in difficulties of scheduling of meetings between different countries or continents[5]. The medium used for the communication between team members greatly effects the performance of team members. The reply time for emails of projects with larger time zone differences are usually large, so there is need to use any other media for communication that should reduce the time zone difference for distributed environment across the globe[15]. The overlapping of working hours at unconventional time zones creates time difference which leads towards the greatest challenge in communication among team members[36].

1.41.5. Lack of communication

Lack of communication occurs when there is lack of discussions, delays in feedback or when team members are unable to maintain momentum during meeting hours[15]. This may cause due to incompatible medium used between the team members involved in distributed environment. The inadequate communication is the one of the main hurdle in effective communication[15]. It is the crucial factor for the successful completion of software development projects. As GSD teams are physically existing at remote sites, all team members at remote sites faces this challenge [36]. The inappropriate selection of medium used between the team members can cause this challenge with high risk of badly effecting the meetings scheduled. Lack of communication is the result of low quality of communication bandwidth [5].The maximum amount of data transmitted over a communication medium in a given amount of time is called its bandwidth. The volume of data that can be sent over a communication medium with reference to measure of time. It is calculated in megabits per second (Mbps) [37]. Lack of communication can also be a great challenge due to different language, different project background, different working hours, high communication cost, unprepared communication tools, poor communication infra structure and face to face communication[5].

Lack of communication can also be caused if there is unreliable or poor transmission quality or low speed network which needs to clarify items being discussed again and again[5].Face to face communication highly depends upon the medium used in communication. It is a serious challenge and can causes ineffective communication if not tackle in time.

1.41.6. Technical incompatibilities

Compatibility is the limit of at least two or more than two frameworks to cooperate without being adjusted to do as such. Compatible software uses same data formats. Compatibility can refer to interactiveness between any two products including hardware and software, products of the same or different types, or different versions of the same product[38]. Technical compatibility is considered as a crucial factor and proper planning must be done in order to allow the dispersed teams to interact with each other. If this issue is not tackled then a lot of problems can be faced by the distributed team members. Example the transfer of data and exchanging information with the offshore site usually faces the technical issues[5]. In distributed team environment, tools and

technology is the effective source for efficient communication[28].Global teams uses various platforms and tools for development of software and its components. These components or software raises compatibility problems during integration or synchronization between other software or components. This issue also rises when software has different versions of components that are not compatible with each other between distributed environment. The team members also face technical incompatibility issues when same module is being changed by two or more developers. The compatibility issues also rises when client or vendor uses different developing tools[30].

1.41.7. Synchronous Communication issues

Synchronous communication is the type of communication which takes place in real time between different team members. It is live interchange or exchange of information between people. It requires an immediate response at the spot it is continuing. Video conferencing, face to face meeting or telephone calls is the example of synchronous communication [39]. The selection of right media at right time is the key factor for successful completion of development of software. The wrong media selection causes many problems in distributed environment which may lead to unsuccessful completion of a desired task [31]. Synchronous communication becomes great challenge for distributed team members if selection of medium is not done appropriately[9].

1.41.8. Video meeting issues

Video meeting issues is the type of synchronous communication. Formal or informal meetings using video conferencing as a communication media faces issues due to slow internet speed , time zone differences or linguistic differences[9][15].

Informal communication refers to as personal, interactive and peer oriented communication whereas formal communication refers to explicit clear communication such as agile requirements[18].In GSD, the opportunities are reduced due to temporal distance for synchronous communication [2].Therefore, effective communication between team

members becomes difficult in this case which becomes a serious challenge for GSD team members.

1.41.9. Bandwidth issues

Bandwidth can be defined as the measure of information a network can transfer from one point to another. The capacity of computer to transfer data across network in bits per second (Bps) is defined as its bandwidth[40]. Communication greatly dependent on bandwidth during interaction among GSD team members. In GSD, tools like Vsee and skype are used with open sessions while teams are working together. They help team members to see and talk with each other just like they are in the same place. In this case Vsee or skype ran on the Smartboard. Having Vsee or skype with a high frame rate requires high bandwidth rate. This created a great issue for team members while interacting with each other[28].

1.41.10. Lack of frequent feedback

There is need to coordinate and give response to the recipient while communicating between members across national or international boundaries. When there is no response or feedback is delayed due to any sort of communication medium interruption then the communication becomes ineffective and unsuccessful[18]. Lack of frequent feedback can be caused due to temporal, cultural or linguistic differences.

1.41.11. Asynchronous Communication issues

Asynchronous is the type of communication where that doesn't happen in real time for example on phone or during a live video conferencing. A type of communication where one person delivers the information, and then there is a time lag before the recipients take in the information and offer their responses or feedback[41] .It is risky and challenging situation for remote team members to use asynchronous communication tools . Email

may get lost or unnoticed. An email will be again send after couple of days if the response is not delivered in time. Therefore, the chance of misunderstanding between remote teams located across the globe is high due to asynchronous communication [16]. While having asynchronous communication between team members the team members needs to have good grasp on the language to effectively convey their views. This is challenging situation when there is any misunderstanding and causes undesired results. The selection of right medium in crucial factor for remote teams for successful completion of the task[15].

1.41.12. Lack of Cooperation

Ineffective communication may cause due to lack of cooperation between team members located across different locations[18]. Lack of cooperation can be caused by ineffective communication medium which results in lack of customer requirements between different distributed teams.

1.41.13. Lack of understanding of Customer Requirement

The lack of face to face communication may cause problem in understanding the customer requirements. The wrong selection of communication medium may create issues like lack of understanding or misunderstanding between client and developer which can be turned into serious challenging situation while implementing GSD projects [12].

1.41.14. Outdated Information

Outdated information effects the communication quality while having meeting or scheduling between team members. The teams involve in distributed environment should use the latest updated information so that they can take advantage of any new technology for enhancing the quality of their communication medium as well as for upgrading the

software quality. Therefore, outdated information is the main issue if team members are unable to upgrade themselves according to market value.

1.41.15. Noise Effecting Infrastructure

Infrastructure means the basic system or services that an organization must have in order to function properly[42]. Infrastructure often affected by noise or by distortion in noise with remote site communication. In this way, it becomes a great challenge for remote team members to communicate effectively

1.41.16. Software Testing issues

In GSD, sometimes untested modules are delivered due to time constraint pressure on development teams. [30]. It may also cause due to improper selection of communication medium that causes misunderstanding of testing module discussions resulting in delivering the untested software module to another component for completion of project. Therefore, it also becomes a challenge for GSD team members for testing the software components properly before sending or delivering the module to the next component.

1.41.17. Architecture Mismatch

Architecture mismatch decreases the knowledge sharing and communication among agile GSD teams and team members and represents a communication barrier through misunderstanding or an unnecessary flow of communication due to insufficient definition of a system and software structure.

The design of architecture decides which unit of the system will perform the specific function. In GSD, inefficient management of architecture causes many problems which are identified late during integration phase that results affecting the communication factor among team members.

1.41.18. Lack of training (Personal practice issue)

Lack of training or lack of personal practice skills is a great challenge in global software development team members. Personal practice means the difference in personal attitudes and skills of team members in distributed environment. Team members lack the practice in using the medium involved in communication which causes issues for the development teams[18].

1.41.19. Communication tool issues

Tools used for communication greatly affects the successful rate of development of software among distributed environment. Team communication can be negatively affected by the Tools if the tools which are being used not tailored and systematically deployed to fit the aim of global software development[18].

1.41.20. Lack of Resources

Lack of resources, knowledge and skills is the crucial factor in GSD environment. Lack in skilled human resources causes delays in successful completion of project[30]. Less knowledge of skills can cause hurdles in using the right communication medium at right time which creates challenges for GSD team members for development of projects.

1.41.21. Hardware Configuration

Hardware configuration greatly effects the medium of communication used in distributed environment. A high-quality internet connection cannot work properly without proper configuration of its elements. Many of other latest technological tools needs proper configuration before using them. This all creates a great challenge for GSD team members during implementation of agile projects.

4.7.22 Heterogeneous development Environment

In GSD, due to heterogeneous programming languages, operating systems and communication tools, many software components are not properly integrated. Different infrastructures are shared between different sites, which causes hinders in integration of components which are developed at those sites, it also effects the whole communication system across GSD team members.

1.41.23. Lack of Component Interface

The definition and implementation of interfaces has become more complicated issue in GSD environment. In GSD, to convey accurate data for development and integration of components, extra effort and work done is required. The team faces issues for communication and there is very less coordination among them .There is issue between the components developed by the team , this issue reflects the factors of communication in large projects[30].

1.41.24. Lack of Proper Documentation

Sometimes the document remains incomplete or doesn't explore the actual component properly. It may require extra ordinary effort for implementation and integration. This become a great challenge for GSD team members in delivering the whole content of requirements to the next client for development[30].

1.42. Summary

In this chapter, 24 communication medium challenges have been identified. The solution strategies for the 24 communication medium challenges will be explained in chapter 5 with the help of industrial survey.

CHAPTER 5

SURVEY RESULTS AND ANALYSIS

1.43. Introduction

Chapter 4 has described the list of communication medium challenges with their explanation which were identified from the literature. This list of communication medium challenges was forwarded to industry for investigating the industry respondent's practicality. Results of survey are illustrated in this chapter.

1.44. Survey Conduction

A survey was conducted by following the guidelines of Kasunic [33]. The information regarding survey steps, objectives, selection of target audience. to conduct the survey is reported in Chapter 3. Our research area specifically focused on GSD environment, so the target population of our study was the software organizations who are implementing Agile in distributed teams. The questionnaire was sent to the target companies in early June 2021. The questionnaire consists of two main sections. Section 1 was designed to get the personal information of the respondent. Section 2 of the questionnaire comprised of a literature-based list of communication medium challenges with their associated description. The respondents were asked to write down the solution strategies for the mentioned challenges, and to mention any new challenge that they thought should be added in the list. The questionnaire is attached in Appendix C.

Of the 27 emails sent to the contact persons of the companies, a total of 14 company's contact persons responded and replied that the questionnaire is forwarded to their appropriate departments to respond. The follow up emails were sent to the non- respondents of the 14 companies about one

month after the first email. This process continued and we kept on getting responses slowly. After three and a half months we got 54 responses, which were still very low in percentage. In an attempt to increase the response rate, we planned to visit some of the companies. We managed to get appointment and visited some of the software development companies located in Islamabad. We conveyed our survey objective to them. After they agreed, we forwarded the survey by email and managed to get 33 more responses. We waited till start of November 2021 and got 43 more responses with in this duration. Finally, by combining all the responses, a total of 97 responses were received. 10 among the total responses were not usable due to incomplete answers, thus resulting in 87 complete responses that were used in our data analysis. The first part of the questionnaire was to investigate about respondent's general background and personal information. The respondents were asked about their current position in the organization (designation), organization size, gender and experience.

1.45.Distribution of Respondents base upon experience in organization

According to our survey, 40% people had less than 4 years of experience among all the people participated in the survey. Rest of 32% people have had less than 3 years of experience, 16% people have had less than 6 years of experience, 5% people have had less than 8 years of experience.

1.46. Distribution of Respondents base upon their gender

All the people who participated in the survey, among them 57% people were the male and 43% population were the female. Fig 5.1 shows the distribution of respondents on basis of gender**.**

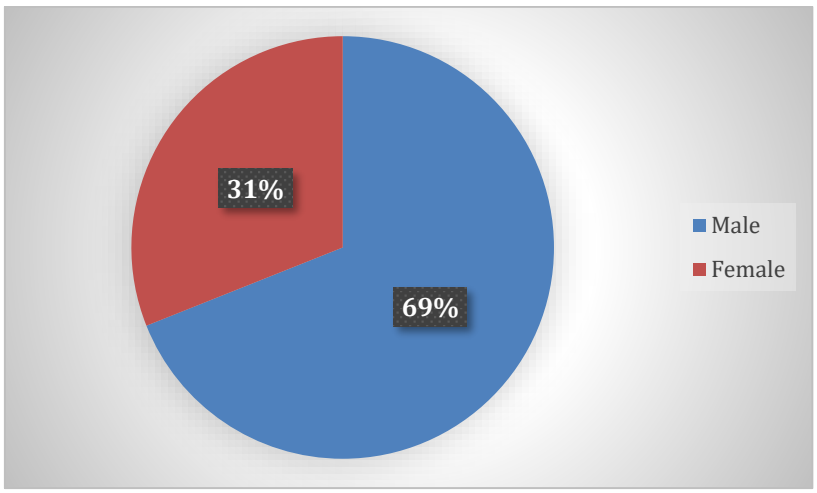

Figure 5.1: Distribution on bases of gender of respondents

Table 5.1 comprised of columns names challenges, solutions strategies and Respondents. The challenges columns show the list of identified communication medium challenges. The solution strategies are the solutions proposed by respondents against each communication medium challenge. Respondents shows the list of those respondents who gave the solutions against particular challenge. These solution strategies are collected with the help of industrial survey. The detail of the selected respondents is attached in Appendix F.

Table 5.1: Challenges with their solutions strategies against respondents

Challenge Id	Challenge	Solution strategies	Respondents
C1	**Lack of Synchronous communication**	Time scheduling algorithm must be used. Proper time table must be scheduled and strictly followed by all the teams across different sites.	RES_1, RES_3, RES_5, RES_7, RES_9, RES_11, RES_13, RES_15, RES_17, RES_19, RES_21, RES_23, RES_25, RES_27, RES_29, RES_31, RES_33, RES_35, RES_37, RES_41, RES_43, RES_45, RES_47, RES_49, RES_51, RES_53, RES_55, RES_57, RES_59, RES_61, RES_63, RES_65, RES_67, RES_69, RES_71, RES_73, RES_75, RES_77, RES_79, RES_81, RES_83, RES_85
		Difference in time zone can be minimized with the help of careful selection of synchronous methods. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting	RES_2, RES_4, RES_6, RES_8, RES_10, RES_12, RES_14, RES_16, RES_18, RES_20, RES_22, RES_24, RES_26, RES_28, RES_30, RES_32, RES_34, RES_36, RES_38, RES_40, RES_42, RES_44, RES_46, RES_48, RES_50, RES_52, RES_54, RES_56, RES_60, RES_62, RES_64, RES_66, RES_68, RES_70, RES_72, RES_74, RES_76, RES_78, RES_80, RES_82, RES_84, RES_86, RES_87
C2	**Lack of asynchronous communication**	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack Usually the response time on these applications is lower than emails	RES_1, RES_3, RES_5, RES_7, RES_9, RES_11, RES_13, RES_15 RES_17, RES_19, RES_21, RES_23, RES_25, RES_27, RES_29, RES_31, RES_33, RES_35, RES_37, RES_41, RES_43, RES_45, RES_47, RES_49, RES_51, RES_53, RES_55, RES_57, RES_59, RES_61, RES_63, RES_65, RES_67, RES_69, RES_71, RES_73, RES_75, RES_81,RES_39
		Several tools and communication software are available,	RES_2, RES_4, RES_6, RES_8, RES_10, RES_12, RES_14, RES_16, RES_18,

		f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case	RES_20, RES_22, RES_24, RES_26, RES_28, RES_30, RES_32, RES_34, RES_36, RES_38, RES_40, RES_42, RES_44, RES_46, RES_48, RES_50, RES_52, RES_54, RES_56, RES_60, RES_58, RES_62, RES_74, RES_76, RES_78, RES_80, RES_82, RES_84,RES_86
		Using new platforms like Jira, Team foundation, Microsoft team, skype	RES_77, RES_79, RES_83, RES_85, RES_64, RES_66, RES_70, RES_72, RES_87
C3	**Low quality Bandwidth**	Use high frequency bandwidth. Check hardware configuration including router before meeting starts Contact your ISP before any meeting scheduled.	RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30, RES_31
		Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Limitize the access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.	RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61
		More than one network should be available in case of one network bandwidth issue the other one will be used.	RES_62, RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, RES_70, RES_71, RES_72, RES_73, RES_74, RES_75, RES_76,

			RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87
		Check internet speed before starting the meeting in order to avoid any mis convenience	RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11
C4	**Poor communication infrastructure**	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure	RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62, RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, 670, 671, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87
		There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure	RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40
		Use Latest agile technology Training sessions for teams to make them understandable for latest tools.	RES_66, RES_67, RES_68, RES_69, RES_70, RES_71, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87

C5	**Inadequate technology**	Adoption of new techniques. Use communication technology assessment tools CTAT.Use the most updated tools	RES_46, RES_47, RES_48, RES_49, RES_50, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62, RES_63, RES_64, RES_65
		Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings	RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30
		A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance	RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45
C6	**Unprepared Communication tools**	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time	RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50
		Daily review meetings should be scheduled along with sending status updates through emails.	RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62, RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, RES_70, RES_71, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80,

			RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87
C7	**Lack of compatibility**	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning	RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62, RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, RES_70, RES_71, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87
		Compatibility of OS and tools must be configured before meeting Follow proper standards of network	RES_29, RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50
C8	**Heterogenous development Environment**	Common or compatible architecture must be used. Use of common infrastructure	RES_71, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87
		All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment	RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61,

			RES_62, RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, RES_70,
		Written agreements must be agreed by all team members	RES_29, RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50
C9	**Lack of resources**	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability	RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60
		Prioritize and shift resources from critical to non-critical path	RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28 , RES_29, RES_61, RES_62, RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, RES_70, RES_71, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87
C10	**Architecture mismatch**	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure	RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30, RES_31,

		that all employees are aware of	RES_32, RES_33, RES_34, RES_35
		All teams should use the same development platform	RES_1, RES_2, RES_3, RES_4, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50, RES_51, RES_52, RES_53
		A solid architecture plan must be developed by the team to prepare thorough release notes and perform customer outreach. Software architecture must be reviewed to explore the heavy problems before the access of user.	RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62, RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, RES_70, RES_71, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87
C11	**Lack of cooperation**	Cooperation of members must be ensured by setting formal or informal meetings frequently. Employee incentives for obtaining new certification. Team appraisal.	RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, RES_70, RES_71, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79,
		Friendly and respectful interaction between team members must be ensured by organizations.	RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62
		Incentives with motivations. Use of common communication precise language by all.	RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20
		Develop a partnership strategy	RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87

		Encouraging members participation and by evaluating their performances. The participation of members should be increased in accordance to increase the communication.	RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41

The solution strategies against the communication medium challenges are mentioned in the above table with respect to respondents who has given the solutions. The respondents RES_1, RES_3, RES_5, RES_7, RES_9, RES_11, RES_13, RES_15, RES_17, RES_19, RES_21, RES_23, RES_25, RES_27, RES_29, RES_31, RES_33, RES_35, RES_37, RES_41, RES_43, RES_45, RES_47, RES_49, RES_51, RES_53, RES_55, RES_57, RES_59, RES_61, R 63, RES_65, RES_67, RES_69, RES_71, RES_73, RES_75, RES_77, RES_79, RES_81, RES_83, RES_85 addressed the challenge lack of synchronous communication by giving the solution of time scheduling algorithm. The other challenge lack of asynchronous communication can be tackled by using alternate communication method such as skype, google meet etc. Using live chat can address this issue. This solution is given by respondents RES_1, RES_3, RES_5, RES_7, RES_9, RES_11, RES_13, RES_15 RES_17, RES_19, RES_21, RES_23, RES_25, RES_27, RES_29, RES_31, RES_33, RES_35, RES_37, RES_41, RES_43, RES_45, RES_47, RES_49, RES_51, RES_53, RES_55, RES_57, RES_59, RES_61, RES_63, RES_65, RES_67, RES_69, RES_71, RES_73, RES_75, RES_81. The respondents RES_77, RES_79, RES_83, RES_85, RES_64, RES_66, RES_70, RES_72, RES_87 suggested the usage of new platform like Jira, Team foundation and Microsoft teams to tackle the asynchronous communication issues. The low-quality bandwidth challenge can be solved by using high frequency bandwidth. It can also be addressed by checking the hardware configuration including router before the meeting starts. Contacting ISP before scheduling the meeting can minimize this issue. This solution is given by respondents RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62, RES_63, RES_64, RES_65, RES_66,

RES_67, RES_68, RES_69, RES_70, RES_71, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87.

Poor communication infrastructure is the challenge that is addressed by RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62, RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, 670, 671, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87, RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40 respondents. According to these respondents, there must be a program designed specifically for the management of good infrastructure and by using latest IT infrastructure this issue can be resolved. Inadequate technology is the challenge faced by GSD team members during implementation of agile that can be addressed by using the reliable technology with most updated tools like CTAT , this solution is given by RES_66, RES_67, RES_68, RES_69, RES_70, RES_71, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87, RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45. Right tool in right time with the right appropriate person can address the issue of unprepared communication tools. The solution is given by RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50. Lack of compatibility is the critical issue faced by GSD team members can be addressed by deciding the common IDEs and languages, or by

following the proper standards already set by the organizations involved in the meetings. The given solution is purposed by RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62, RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, RES_70, RES_71, RES_72, RES_73, RES_74, RES_75, RES_76, RES_77, RES_78, RES_79, RES_80, RES_81, RES_82, RES_83, RES_84, RES_85, RES_86, RES_87.

Heterogenous development environment can be tackled by using the common platform is addressed by RES_1, RES_2, RES_3, RES_4, RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62, RES_63, RES_64, RES_65, RES_66, RES_67, RES_68, RES_69, RES_70. Lack of resources challenge can be minimized by tracking the resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. The solution is purposed by RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50, RES_51, RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60. Architecture must be designed by keeping in view the requirements of the system. All teams should use the same development platform. The solution is given by RES_5, RES_6, RES_7, RES_8, RES_9, RES_10, RES_11, RES_12, RES_13, RES_14, RES_15, RES_16, RES_17, RES_18, RES_19, RES_20, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_1, RES_2, RES_3, RES_4, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41, RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50, RES_51, RES_52, RES_53.

Lack of cooperation challenge can be handled by creating the friendly and respectful interaction between the team members that can be ensured by the organizations. The solution is given by RES_42, RES_43, RES_44, RES_45, RES_46, RES_47, RES_48, RES_49, RES_50, RES_51,

RES_52, RES_53, RES_54, RES_55, RES_56, RES_57, RES_58, RES_59, RES_60, RES_61, RES_62, RES_21, RES_22, RES_23, RES_24, RES_25, RES_26, RES_27, RES_28, RES_29, RES_30, RES_31, RES_32, RES_33, RES_34, RES_35, RES_36, RES_37, RES_38, RES_39, RES_40, RES_41.

The details of the purposed solutions given by 87 respondents with their respective challenges is given in Appendix F.

Figure 5.2: Communication medium challenges and solutions towards agile in GSD

CHAPTER 6

CONCLUSION AND FUTURE WORK

1.47. Overview

In this section, we conclude our research findings and summarizes the contribution to both of the research questions. This study has been done to explore the communication medium challenges towards agile in GSD environment.

1.48. Summary of contribution

RQ1: To identify the communication medium challenge towards agile in GSD?

We explored the 25 papers identified with the implementation of agile in GSD and from these papers we discovered the 24 challenges of communication medium. These challenges are then categorized in 11 major categories that are as follows, Lack of synchronous communication, Lack of asynchronous communication, Low quality bandwidth, poor communication infra structure, inadequate technology, unprepared communication tools, lack of compatibility, heterogenous development environment, Lack of resources, architecture mismatch and lack of cooperation. To validate these identified challenges

mentioned in the systematic literature analysis, survey has been conducted with the help of industry.

RQ2: To find out the solution strategies for the identified communication medium challenges towards agile in GSD?

The study's second aim is to come up with the solution strategies against the identified communication medium challenges towards agile in GSD. With the help of literature, 24 communication medium challenges were identified. They were sorted then in 11 major categories which were then validated with the help of survey. Several solutions were identified with the help of industrial survey. The solution strategies against the challenge of lack of synchronous communication includes scheduling and preplanning of meetings. There is need to follow up the strict time table in order to synchronize the all team members located at different sites having different time zones. The other issue regarding asynchronous communication involves the solution to use the live chat instead of emails which will be helpful in getting an immediate response across different team members having distributed environment. The organizations have alternate option to use their own portal for the live discussion so that team members involved in the meeting should be able to share the same platform.

The other major challenge is of low-quality bandwidth. It needs to be addressed by using high frequency bandwidth. The team members should contact their ISPs for the better bandwidth internet connection before scheduling the meeting in order to avoid any inconvenience during meeting hours. There may be any hardware configuration issue involved which slows down the bandwidth, it needs to be addressed by configuration of hardware with the router. Normally video conference solutions are bandwidth hungry, there is no perfect way to handle this challenge but few improvements definitely make the video conference experience better. Rather than playing presentation, it's better to send it so everyone has its own copy. Rather than everyone keeps the video on, it's better that only presenter stays on video and other participants stays on audio only. Rather than everyone uses its own equipment to join, it's better to have a gathering on team and join conference. Video streaming websites such as Netflix takes too much bandwidth. Bandwidth can be controlled by preventing this type of video streaming websites.

The poor communication infra structure is the major challenge face by the teams involved in GSD, it can be addressed by upgrading infra structure frequently. Making a good policy for designing the good

infrastructure can handle this issue very well. Using latest IT infra structure can minimize this issue up to great extent.

The inadequate technology issue is creating a crucial problem for the remote site teams involved in using agile methodology in GSD. Adoption of new techniques and using latest technology tools can help reducing this factor.

The unsatisfactory technology issues can be handled by using latest and updated tools and technologies. Training sessions must be held in order to make team members aware of latest technology tools and their use. Use of right tool at right time by the right appropriate person is needed in order to minimize the tools related challenges.

Organizations must follow the same set of standards in order to synchronize the tools and technologies used by different team members, hence the compatibility issue can be tackled in this case. As different team members are located at different sites so they have to face heterogenous environment in this case, which causes many problems for the team members involved in meetings. Common set of platforms should be organized for all the organizations involved in meeting in order to minimize this factor. Organizations should track the need of resources to meet up the demand of resources before meeting. The design of architecture must be done by keeping in view the requirements of the system.

Cooperation between team members must be ensured by enhancing the frequent scheduling of informal or formal meetings which makes them aware of each other ideas and views. Incentives and certifications increase the motivational level of team members which helps them to coordinate with each other keeping the friendly environment in contact.

1.49. Limitations

Similar to other SLR studies, this study has some limitations. There is possibility that researcher have not completely understood the solutions purposed by the respondents against the communication medium challenges. Although the sample size of respondents is 87, but more accurate and effective results can be obtained by increasing the sample size. While extracting the information from papers, there is possibility that some information has been missed due to lack of understanding. This study tried to cover all the relevant papers but there is possibility that some relevant papers has been missed. As a result of inclusion and exclusion criteria, only 23 relevant studies matching to our research question were selected and reviewed in detail in this study.

1.50. Future Work

Since we have proposed the solution strategies for the communication medium challenges towards agile in 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. Another future work can be a comparative study between traditional software development methodologies and agile by discussing the similarities and differences between them in terms of communication medium for the software development.

APPENDIX A

Quality Assessment Score Table

Paper Id	QA1	QA2	QA3	QA4	QA5	QA6	QA7	Total Score
P1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
P2	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
P3	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
P4	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
P5	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
P6	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
P7	Yes	Yes	Yes	Partially	Partially	No	No	4.5
P8	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
P9	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
P10	Yes	Yes	No	Yes	Yes	Yes	Yes	7
P11	Yes	Yes	Yes	Partially	Yes	Partially	Yes	6
P12	Yes	Yes	Yes	Partially	Yes	Yes	Yes	6.5
P13	Yes	Yes	No	Yes	Yes	Yes	Yes	7
P14	Yes	Yes	No	Yes	Yes	Yes	Yes	7
P15	Yes	Yes	No	Partially	Yes	Partially	Yes	6
P16	Yes	Yes	Yes	Yes	Yes	Yes	Yes	7
P17	Yes	Yes	Yes	Yes	No	Yes	No	6
P18	Yes	Yes	No	Yes	Yes	Yes	Yes	7

Paper Id	QA1	QA2	QA3	QA4	QA5	QA6	QA7	Total Score
P19	Yes	Yes	No	Yes	Yes	Yes	Yes	7
P20	Yes	Yes	No	Yes	Yes	Yes	Yes	7
P21	Yes	Yes	No	Yes	Yes	Yes	Yes	7
P22	Yes	Yes	No	Yes	Yes	Yes	Yes	7
P23	Yes	Yes	No	Yes	Yes	Yes	Yes	7
P24	Yes	Yes	No	Yes	Yes	Yes	Yes	7
P25	Yes	Yes	No	Yes	Yes	Partially	Yes	6.5
P26	Yes	Yes	No	Yes	Yes	Yes	Yes	7
P27	Yes	Yes	No	Yes	Yes	Yes	Yes	7

Appendix B

Data Extraction	
Id	P1
Title	SWOT: for scaling agile methods in GSD
Author	Richa Sinha, Mohammad Shamem
Year of Publication	2020
Type	ISEC Conference
Methodology	SLR
Challenge	Lack of knowledge sharing, Lack of temporal, linguistic, cultural difference

Data Extraction	
Id	P2
Title	Agile GSD communication challenges
Author	Yehia Ibrahim Alzoubi
Year of Publication	2014
Type	Conference
Methodology	SLR
Challenge	Architecture mismatch

Data Extraction	
Id	P3
Title	Communication in Agile Global Software Development An Exploratory Study
Author	Juan Garbajosa, Agustin yague, Eloy Gonzalez
Year of Publication	2014
Type	Journal
Methodology	Qualitative Research
Challenge	Bandwidth Issue Lack of involvement Lack of shared understanding Outdated Information Restricted access to inf Scattered Info Noise Affecting infra-structure

Data Extraction	
Id	P4
Title	The use of Kanban to alleviate collaboration and communication challenges of GSD
Author	Maureen Tanner, Marcelo Dauane
Year of Publication	2017
Type	Journal
Methodology	Case-study
Challenge	Misunderstanding in communication Cultural differences, Languages barriers, Face to face communication hurdles, Synchronous communication issues interactive media issues, Time Difference, Different working styles, Electronic hurdles Ambiguity on technical aspects, chance of loss of project artefact

Data Extraction	
Id	P5
Title	Chaos issues on communication in agile in GSD
Author	Nina Kamarina, Noor Habiba ,Azlinah
Year of Publication	2012
Type	Conference
Methodology	Literature Survey
Challenge	Miscommunication of requirements, Low quality of communication bandwidth, High communication cost, Unprepared communication tools, Poor communication infrastructure, quality of telecommunication bandwidth, Communication cost, Technical incompatibilities

Data Extraction	
Id	P6
Title	Root causes of Failure of communication in GSD
Author	Hassan Khalid, Farhat ul ain, kokab Khushboo
Year of Publication	2017
Type	Journal
Methodology	SLR
Challenge	Lack of technological cohesion, Keeping track of all communication issue, communication in offline hours, DeLay in response due to communication channel, Absence of trust, Dependency on asynchronous communication, voice call communication issues, Poor communication

Data Extraction	
Id	P7
Title	The impact on Media selection on stakeholder communication in agile global software development
Author	Tracy Hall, Anthony Fitzpatrick, Agra Junius
Year of Publication	2011
Type	Conference
Methodology	Case study
Challenge	Conference call media issues

Data Extraction	
Id	P8
Title	Empirical study of communication structure and barriers in geographically distributed teams
Author	Muneero Bano,Didar Zowghi
Year of Publication	2016
Type	Journal
Methodology	Case study
Challenge	Time zone, Face to face communication issues, Physical absence altering response time, lack of collaboration Physical distance

Data Extraction	
Id	P9
Title	Communication issues in GSD
Author	Yasir Hassan, Mushtaq Raza, Sami ul haq
Year of Publication	2012
Type	Journal
Methodology	SLR
Challenge	Inadequate communication, Time language, cultural differences, Reply time for email with larger time zone is large, Time zone difference, software testing at desperate locations, Recommending videoconferencing among GSD team can suffer pitfall of language and time zone issues

Data Extraction	
Id	P10
Title	A SLR review to identify human related challenges in globally distributed agile software development towards a hypothetical model for scaling agile methodologies
Author	Mohammad Shameem, Bibhas Chandra, Rakesh, Chiranjeev kumar
Year of Publication	2018
Type	Conference
Methodology	SLR
Challenge	Lack of effective requirement analysis Lack of customer involvement Lack of communication Lack of scaling agile awareness Lack of roles and responsibilities Lack of Management commitment Lack of knowledge sharing Lack of agile expertise Lack of training Lack of cooperation Lack of motivation

Data Extraction	
Id	P11
Title	Agile Practices in Global Software Engineering-A systematic Map
Author	Samireh Jalali, Claes Wohlin
Year of Publication	2010
Type	Conference
Methodology	SLR
Challenge	Time zone Personnel culture Trust issues Knowledge management

Data Extraction	
Id	P12
Title	Empirical studies of geographically distributed agile development communication challenges
Author	Yehia Ibrahim Alzoubi, Asif Qumer Gill
Year of Publication	2016
Type	Journal
Methodology	SLR
Challenge	Physical distance Time zone differences Cultural diversity Language differences Weak communication skills Lack of synchronization Lack of frequent feedback Lack of collaboration Lack of understanding Cross team communication Technology differences Architecture differences (system structure) Video conferencing and audio Equipment problem Communication tools Communication infrastructure Personal practice issues Project architecture difference

Data Extraction	
Id	P13
Title	Understanding the different level of challenges in global software development
Author	Nazish Saleem, Dr.Sanjay Marthrani,Dr.Nazim
Year of Publication	2019
Type	Conference
Methodology	SLR
Challenge	Less shared project awareness Problem in information exchange Knowledge management challenges Process transparency High communication cost, coordination issues Limited synchronous communication Delay in feedbacks Inconsistency in work practices Less informal communication Different terminologies Difference in work ethics Inconsistent development Difference in maturity and experience level Mismatch processes, Linguistics issues socio-cultural issues Lack of informal contacts Lack of textual information Diverse terminologies, strategic issues Tool management, version control Time overlapping

Data Extraction	
Id	P14
Title	Coping Strategies for temporal, Geographical and socio-cultural distances in agile GSD: A case study
Author	David Marcell Szabo, Jan philipp Steghofer
Year of Publication	2019
Type	Conference
Methodology	Case study
Challenge	Management complexity Trust issues (Quality of work) Temporal distance issues Delay in response Video meeting issue (slows down the local team) Linguistic issues Office politics Public holiday issues Temporal, geographical and socio culture issues Accent issues Public holiday issues Office politics issues

Data Extraction	
Id	P15
Title	From scrum to agile: A journey to tackle challenges of distributed development in an agile team
Author	Pernille Lous, Paolo Tell, Allan Ebdrup
Year of Publication	2018
Type	Conference
Methodology	Case study
Challenge	Geographical, cultural, temporal and linguistic challenges

Data Extraction	
Id	P16
Title	Software integration in global software development challenges for GSD vendors
Author	Muhammad ilyas, Siffat ullah khan
Year of Publication	2017
Type	Journal
Methodology	SLR
Challenge	Lack of communication Lack of proper documentation Lack of compatibility Architecture mismatch Lack of management & integration planning Heterogenous Development Environment Improper/no unit testing Lack of resources, knowledge, skills Lack of component interface Unclear responsibilities Configuration and versioning complexity

Data Extraction	
Id	P17
Title	Distributed agile development communication: An agile architecture Driven framework
Author	Yehia Ibrahim Alzoubi1, Asif Qumer Gill1, Ahmed Al-Ani
Year of Publication	2015
Type	Journal
Methodology	SLR
Challenge	People differences (cultural differences, people attitude, language, trust), Distance differences (time zone, geographic), Team issues (size, distribution, cross team communication, team work), Technology issues (tools, infrastructure, bandwidth, cost), Architectural issues (organizational structure, managerial structure, Project domain), Processes issues (Process control, lack of commitment), customer communication

Data Extraction	
Id	P18
Title	Systematic Literature Review in Global Software Development Risk in agile methodology
Author	Zuriyaninatasa Podari, Adila Firdaus Arbain, Noraini Ibrahim, Wan Mohd Nasir Wan Kadir, Azim Muhammad Fahm, Dayang Norhayati Abang Jawawi
Year of Publication	2020
Type	Conference
Methodology	SLR
Challenge	Communication and collaboration

Data Extraction	
Id	P19
Title	Using scrum in Distributed Agile development: A multiple case study
Author	Maria Paasivaara, Sandra Durasiewicz and Casper Lassenius
Year of Publication	2009
Type	Conference
Methodology	Case study
Challenge	Cultural differences, Time zone differences, Technical problems, Sound quality problems, Different religious and other holidays in different countries causes synchronization challenges

Data Extraction	
Id	P20
Title	Studying Communication in Agile Software Development
Author	Peitsa Hynninen, Arttu Piri, Tuomas Niinimaki
Year of Publication	2009
Type	Conference
Methodology	Pilot study
Challenge	Electronic communication issues

Data Extraction	
Id	P21
Title	Using agile practices to solve GSD problems
Author	Sarah Beecham, John Noll, Ita Richardson
Year of Publication	2014
Type	Conference
Methodology	Case study
Challenge	Geographical, temporal, cultural distance issues, Tools mismatch among team members (infra structure issues) ,Lack of coordination, Lack of informal communication

Data Extraction	
Id	P22
Title	Communication understandability enhancement in GSD
Author	Sumit Sharma, Pawan Preet Kaur,Upinder Kaur
Year of Publication	2015
Type	Conference
Methodology	SLR
Challenge	Communication issues, Language barriers, Lack of trust, personnel selection

Data Extraction	
Id	P23
Title	A Systematic Literature Review on Factors Impacting Agile Adaptation in Global Software Development
Author	Areebah Altaf, Urooj Fatima, Wasi Haider Butt, Muhammad Waseem Anwar, Maryum Hamdani
Year of Publication	2019
Type	Conference
Methodology	SLR
Challenge	Project complexity, Lack of documentation, Inappropriate architecture, customer un-availability, cultural and time zone differences

Data Extraction	
Id	P24
Title	Communication through Boundary Objects in Distributed Agile Teams
Author	Johan Kaj Blomkvist, Johan Persson,Johan Åberg
Year of Publication	2015
Type	Conference
Methodology	Case study
Challenge	Communication issues

Data Extraction	
Id	P25
Title	Communication Network in an Agile Distributed Software Development Team
Author	Paul T. Robinson
Year of Publication	2019
Type	Conference
Methodology	Survey
Challenge	Communication tools issues

Appendix C

SURVEY TO FIND OUT THE SOLUTIONS FOR COMMUNICATION MEDIUM CHALLENGS TOWARDS AGILE IN GLOBAL SOFTWARE DEVELOPMENT PROJECTS

Global software development plays an important role in field of business and software industry. Many software development companies enjoy the benefits of using agile in GSD but there are also many challenges faced by these companies including communication medium challenges. These challenges seriously compromise the stability of these GSD projects. Therefore, the aim of study is to validate the communication medium challenges and their solutions. The results of this survey is to be helpful for GSD based companies in context of communication medium issues. The major agenda of the project must be fulfilled accordingly.

SECTION -1

PERSONAL INFORMATION:

NAME: _____

EXPERIENCE: _____

ORGANZIATION SIZE: _____

GENDER: _____

DESIGNATION: _____

SECTION-2

This survey basically aims to seek the opinion of industry practitioners regarding solution strategies for the mentioned challenges. This survey is really brief and it will just take your 10 – 15 minutes. Your responses and feedback will surely make a huge contribution in my research project. I shall ever be indebted to your support for filling out this questionnaire for me

Sr.	Challenges	Description	Solutions Strategy
1	Lack of Synchronous communication (Video conferencing/face to face or Conference call)	Synchronous communication is difficult to implement when the customer is not on site due to different time zones. Incorrect selection of synchronous method causes differences in time zones, work day hours or public holidays which also slows down the communication process and delay in response as well. Recommending video conferencing among GSD team can also suffer pitfall of language and time zone difference. Conference call media lacks rehearsability	
2	Lack of asynchronous communication (email or fax)	The chance of misunderstanding between team members is high due to asynchronous communication. Email may get lost or unnoticed. Individual have doubt of whether or not a reply is coming and there is also need to resend email after number of days.	

		Reply time for emails with larger time zone difference are usually large	
3	Low quality Bandwidth	Sometimes a lot of time spent to clarify items being discussed because of meaning, tone and emotion were lost through communication medium thus network slows down and becomes unreliable with poor communication quality hampering communication tools Some tools like Vsee with high frame rate requires high bandwidth rate that need to reduce the frame rate or to limit the number of simultaneously opened connections.	
4	Poor communication infrastructure	Transferring data to and exchanging data with an offshore site usually reveals technical incompatibilities between different sites. Companies with poor infrastructure prohibit rich conversation between team members affects the spreading of informal news or after work meet-ups.	
5	Inadequate technology	Use of unsuitable tools, technical incompatibilities between different sites, unreliable and poor selection of transmission tools causes conflicts on preferred technology and delays in process response	
6	Unprepared Communication tools	In distributed environment, communication is the main medium of interaction. Providing the right tool to communicate are essential but some companies doesn't	

		prepare the team with suitable tools for example video conferencing or web-based conferencing facilities especially when there is scrum meetings. Unprepared tools for communication causes communication ineffective.	
7	Lack of compatibility	The GSD teams may use diverse platforms and tools for development of software components or subsystem. These components/subsystems raise compatibility problems during communication in GSD across diverse team members.	
8	Heterogenous development Environment	In GSD, many software components are not properly integrated because of heterogeneous programming languages, operating systems and communication tools. Mostly a common infrastructure is not shared across sites, which hinders the integration of components developed at those sites that effects the whole communication system across GSD team members.	
9	Lack of resources	Lack of resources, knowledge or skills directly effects the usage of communication medium across GSD members	
10	Architecture mismatch	Lack of inappropriate architecture decreases the knowledge sharing and communication among agile GSD teams and team members and represents a communication barrier through misunderstanding or an unnecessary flow	

		of communication due to insufficient definition of a system and software structure The architecture designs specify which function of the system will be performed by which unit. In GSD, lack of proper management of the architecture and lack of involvement of all concerned parties during architecture design causes many problems which are detected late during integration which affects the effective communication among GSD members	
11	Lack of cooperation	The ineffective communication medium may lead to lack of cooperation issues between different distributed teams which results in lack of customer requirements.	

Thank you!

Appendix D

Respondent_id	Challenge_id	Solution Strategy
RES_1	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	All teams should use the same development platform
	C11	Incentives with motivations. Use of common communication precise language by all.
	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting

RES_2	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	All teams should use the same development platform
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_3	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings

	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	All teams should use the same development platform
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_4	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path

	C10	All teams should use the same development platform
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_5	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_6	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.

	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_7	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning

	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_8	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.

RES_9	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_10	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience

	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
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	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_11	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning

	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_12	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.

RES_13	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_14	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.

	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_15	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning

	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_16	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.

RES_17	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_18	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.

	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_19	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning

	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.
RES_20	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Incentives with motivations. Use of common communication precise language by all.

RES_21	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_22	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.

	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_23	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning

	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_24	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
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	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team

RES_25	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_26	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.

	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_27	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning

	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_28	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
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	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team

RES_29	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_30	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure

	C5	Reliable technology should be preferred. All teams should use latest technology tools to avoid incompatibilities with different sites, Scrum meetings
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_31	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Use high frequency bandwidth. Check hardware configuration including router before meeting start. Contact your ISP before any meeting scheduled.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of

	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_32	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.

RES_33	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
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	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_34	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
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	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network

	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_35	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	Architecture must be designed keeping in view the requirement of the system. Architecture management must be ensured. Create an organizational hierarchical structure that all employees are aware of
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting

RES_36	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_37	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time

	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_38	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.

RES_39	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_40	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	There must be a program designed specifically for the management of good infrastructure. Upgrade infrastructure frequently. Use latest IT infrastructure. Make a policy to design updated infra structure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance

	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team
RES_41	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Encouraging members participation and by evaluating their performances. Increase the intensity with which members of the team

RES_42	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_43	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure

	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_44	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability

	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_45	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	A meeting should be held to discuss the advantages and disadvantages of the tools being used and how to improve the current performance
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_46	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.

	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Adoption of new techniques. Use communication technology assessment tools CTAT.Use the most updated tools
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_47	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Adoption of new techniques. Use communication technology assessment tools CTAT.Use the most updated tools
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform

	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_48	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Adoption of new techniques. Use communication technology assessment tools CTAT.Use the most updated tools
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.

RES_49	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Adoption of new techniques. Use communication technology assessment tools CTAT.Use the most updated tools
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_50	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Adoption of new techniques. Use communication technology assessment tools CTAT.Use the most updated tools
	C6	Training of latest tools. Right tool in right time should be used with the appropriate right person. Team members should be able to prepare their communication tools in time
	C7	Compatibility of OS and tools must be configured before meeting. Follow proper standards of network
	C8	Written agreements must be agreed by all team members

	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_51	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Adoption of new techniques. Use communication technology assessment tools CTAT.Use the most updated tools
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check.

RES_52		An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Adoption of new techniques. Use communication technology assessment tools CTAT.Use the most updated tools
	C6	Set up a daily review meeting and send out status updates via email
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	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_53	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
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	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	All teams should use the same development platform
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_54	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
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	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Friendly and respectful interaction between team members must be ensured by organizations

RES_55	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
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	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_56	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.

	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Adoption of new techniques. Use communication technology assessment tools CTAT.Use the most updated tools
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	All the members involve should send their work to a common platform and that platform should have an expert of dealing with this heterogeneous development environment
	C9	Track resource availability according to the need. Resources should be managed in time with sufficient amount of need of company. Manage workload allocation to track hour-by-hour availability
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_57	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
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RES_58	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
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	C11	Friendly and respectful interaction between team members must be ensured by organizations
	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.

RES_59	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	Try to use GPON connection with FTH and reserve one connection without any other load for that purpose only. Restrict access to the files and video streaming website to prevent the usage of high bandwidth from being used up like Netflix.
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	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Friendly and respectful interaction between team members must be ensured by organizations
RES_60	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
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RES_61	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
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	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them

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RES_62	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
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RES_70	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
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RES_72	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
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	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Cooperation of members must be ensured by setting formal or informal meetings frequently. Employee incentives for obtaining new certification. Team appraisal.
RES_78	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	More than one network should be available in case of one network bandwidth issue the other one will be used
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure

	C5	Use Latest agile technology Training sessions for teams to make them understandable for latest tools.
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	Common or compatible architecture must be used. Use of common infrastructure
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Cooperation of members must be ensured by setting formal or informal meetings frequently. Employee incentives for obtaining new certification. Team appraisal.
RES_79	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using new platforms like Jira , Team foundation, Microsoft team, skype
	C3	More than one network should be available in case of one network bandwidth issue the other one will be used
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Use Latest agile technology Training sessions for teams to make them understandable for latest tools.
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	Common or compatible architecture must be used. Use of common infrastructure
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Cooperation of members must be ensured by setting formal or informal meetings frequently. Employee incentives for obtaining new certification. Team appraisal.

RES_80	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	More than one network should be available in case of one network bandwidth issue the other one will be used
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Use Latest agile technology Training sessions for teams to make them understandable for latest tools.
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	Common or compatible architecture must be used. Use of common infrastructure
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Develop a partnership strategy
RES_81	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using alternate communication method such as skype, google meet etc. Use live chat as well instead of asynchronous method. Adding all the team members to chat groups on Skype, WhatsApp or Slack
	C3	More than one network should be available in case of one network bandwidth issue the other one will be used
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure

	C5	Use Latest agile technology Training sessions for teams to make them understandable for latest tools.
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	Common or compatible architecture must be used. Use of common infrastructure
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Develop a partnership strategy
RES_82	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	More than one network should be available in case of one network bandwidth issue the other one will be used
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Use Latest agile technology Training sessions for teams to make them understandable for latest tools.
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	Common or compatible architecture must be used. Use of common infrastructure
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them

	C11	Develop a partnership strategy
RES_83	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using new platforms like Jira, Team foundation, Microsoft team, skype
	C3	More than one network should be available in case of one network bandwidth issue the other one will be used
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Use Latest agile technology Training sessions for teams to make them understandable for latest tools.
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	Common or compatible architecture must be used. Use of common infrastructure
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Develop a partnership strategy
RES_84	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	More than one network should be available in case of one network bandwidth issue the other one will be used
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Use Latest agile technology Training sessions for teams to make them understandable for latest tools.

	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	Common or compatible architecture must be used. Use of common infrastructure
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Develop a partnership strategy
RES_85	C1	Time scheduling algorithm must be used, Proper time table must be scheduled and strictly followed by all the teams across different sites.
	C2	Using new platforms like Jira , Team foundation, Microsoft team, skype
	C3	More than one network should be available in case of one network bandwidth issue the other one will be used
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Use Latest agile technology Training sessions for teams to make them understandable for latest tools.
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	Common or compatible architecture must be used. Use of common infrastructure
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Develop a partnership strategy
	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting

RES_86	C2	Usually the response time on these applications is lower than emails. Several tools and communication software are available, f.x Slack, where a person can communicate with client or the other party can leave a note after sending mail to remind and double check. An organization should have their own portal where their client and working team shares a same space and can drop queries and ask question. Use of appropriate synchronous method should be used in this case.
	C3	More than one network should be available in case of one network bandwidth issue the other one will be used
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Use Latest agile technology Training sessions for teams to make them understandable for latest tools.
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs and languages at the beginning
	C8	Common or compatible architecture must be used. Use of common infrastructure
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture to identify potential problems before users see them
	C11	Develop a partnership strategy
RES_87	C1	Proper time table must be scheduled and strictly followed by all the teams across different sites. Careful selection of synchronous methods can minimize the difference in time zone. Using project management tools. Scheduling and preplanning of meeting should be done in order to synchronize the meeting
	C2	Using new platforms like Jira , Team foundation, Microsoft team, skype
	C3	Check internet speed before starting the meeting in order to avoid any mis convenience
	C4	Cloud services can be used for the advanced infrastructure. Tool infra structure should be combining with different levels of information like Vsee in smart Boards to recover poor communication infrastructure
	C5	Use Latest agile technology Training sessions for teams to make them understandable for latest tools.
	C6	Set up a daily review meeting and send out status updates via email
	C7	Organizations must ensure the system compatibility by making a policy to use the list of tools and technologies Decide common IDEs

	C8	Common or compatible architecture must be used. Use of common infrastructure
	C9	Prioritize and shift resources from critical to non-critical path
	C10	Teams must develop a solid architectural plan, prepare thorough release notes and perform customer outreach. Review the software architecture.
	C11	Develop a partnership strategy

Appendix E

Paper_id	Title	Author Name	Domain	Type	Methodology	Challenges
P1	SWOT: for scaling agile methods in GSD / 2020	Richa Sinha, Mohammad Shamem	scaling agile in GSD	ACM International Conference	SLR	Lack of knowledge sharing Cultural Differences Temporal Differences Linguistic Difference Lack of rich technological infra-structure
P2	Agile Global software development communication challenges: A systematic Review / 2014	Yehia Ibrahim Alzoubi, Asif Qumer Gill	Communication Challenges	Conference (PACIS)	SLR	Inability to have face to face conversation Lack of frequent feedback Lack of synchronization between distributed teams Lack of cooperation Lack of understanding of customer requirement When responsibility are not clear weak communication skills of

						project manager inadequate technology
P3	Communication in Agile Global Software Development An Exploratory Study/2014	Juan Garbajosa ,Agustin yague, Eloy Gonzalez	Communication in GSD	Journal	Qualitative Research	Bandwidth Issue Lack of involvement Lack of shared understanding Outdated Information Restricted access to info Scattered Info Noise Affecting infrastructure
P4	The use of Kanban to alleviate collaboration and communication challenges of GSD / 2017	Maureen Tanner, Marcelo Dauane	Communication and Collaboration challenges in GSD	Journal	Case Study	Misunderstanding in communication Cultural differences Languages barriers Face to face communication hurdles Synchronous communication issues interactive media issues Time Difference Different working styles Electronic hurdles Ambiguity on technical

						aspects chance of loss of project artefact
P5	Chaos issues on communication in agile in GSD / 2012	Nina Kamarina, Noor Habiba, Azlinah	Communication issues	Conference Business, Engineering and industrial Applications Colloquium (BEIAC)	Literature Survey	Miscommunication of requirements Low quality of communication bandwidth High communication cost Unprepared communication tools Poor communication infrastructure quality of telecommunication bandwidth Communication cost Technical incompatibilities
P6	Root causes of Failure of communication in GSD / 2017	Hassan khalid, farhat ul ain,kokab khusboo	Communication issues	Journal of Information Technology and	SLR	Lack of technological cohesion, Keeping track of all communication issue

				software Engineering		communication in offline hours, Delay in response due to communication channel Absence of trust Dependency on asynchronous communication voice call communication issues Poor communication
P7	The impact on Media selection on stakeholder communication in agile global software development / 2011	Tracy Hall, Anthony fitzatrick, Agra Junius	Media issues	Conference SIGMIS CPR 11	Case Study	Conference call media issues
P8	Empirical study of communication structure and barriers in geographically distributed teams /2016	Muneero Bano,Didar Zowghi	Barriers in communication	Journal (Institute of Engineering and Technology)	Case Study	Time zone Face to face communication issues Physical absence altering response time lack of

						collaboration Physical distance
P9	Communication issues in GSD /2012	Yasir Hassan, Mushtaq Raza, Sami ul haq	Challenges in distributed Environment	International Journal of Advanced Science and Technology	SLR	Inadequate communication Time language cultural differences Reply time for email with larger time zone is large Time zone difference software testing at desperate locations Recommending videoconferencing among GSD team can suffer pitfall of language and time zone issues
P10	A SLR review to identify human related challenges in globally distributed agile software development	Mohammad Shameem,Bibhas Chandra, Rakesh Chiranjeev kumar	human related challenges in globally distributed agile software development	International conference on computing communication and	SLR	Lack of effective requirement analysis Lack of customer involvement

	towards a hypothetical model for scaling agile methodologies /2018			automation (ICCCA)		Lack of communication Lack of scaling agile awareness Lack of roles and responsibilities Lack of Management commitment Lack of knowledge sharing Lack of agile expertise Lack of training Lack of cooperation Lack of motivation
P11	Agile Practices in Global Software Engineering-A systematic Map/2010	Samireh Jalili, Claes Wohlen	Agile practices impact in GSD	International conference on Global software Engineering	SLR	Time zone Personnel culture Trust issues Knowledge management
P12	Empirical studies of geographically distributed agile development communication challenges/2016	Yehia Ibrahim Alzoubi, Asif Qumer Gill	Communication challenges	Journal	SLR	Physical distance Time zone differences cultural diversity language differences Weak communication skills

						Lack of synchronization Lack of frequent feedback Lack of collaboration Lack of understanding Cross team communication Technology differences Architecture differences(system structure) Video conferencing and audio equipment problem Communication tools Communication infrastructure Personal practice issues Project architecture differences Team size geographical differences
P13	Understanding the different level of challenges in global	Nazish Saleem,Dr.Sanjay Marthrani,Dr.Nazim	Different level of challenges	ACM/IEEE 14th	SLR	Lack of informal communication Less

	software development/2019			Conference on Global Software Engineering (ICGSE)		shared project awareness Problem in information exchange Knowledge management challenges Process transparency High communication cost, coordination issues Limited synchronous communication Delay in feedbacks Inconsistency in work practices Less informal communication Different terminologies Difference in work ethics Inconsistent development Difference in maturity and experience level

						Mismatch processes, Linguistics issues socio-cultural issues Lack of informal contacts Lack of textual information Diverse terminologies, strategic issues Tool management, version control Time overlapping, Hardware configuration Different engineering approaches Knowledge transfer coordination issues Lack of skills and experience Interpersonal conflicts, Negligence of clients
P14	Coping Strategies for temporal, Geographical and	David Marcell Szabo, Jan philipp Steghofer	Temporal, geographical and sociocultural distances in agile	41st International conference	Case Study	Management complexity Trust issues (Quality of work) Temporal distance issues

	socio-cultural distances in agile GSD: A case study/2019			Software engineering in Practice (SEIP)		Delay in response Video meeting issue (slows down the local team) Linguistic issues Office politics public holiday issues Temporal, geographical and socio culture issues Accent issues Public holiday issues Office politics issues
P15	From scrum to agile: A journey to tackle challenges of distributed development in an agile team/2018	Pernille Lous, Paolo Tell, Allan Ebdrup	Strategies to tackle challenges	Conference ICSSP Gothenburg	Exploratory holistic case study	Geographical, cultural, temporal and linguistic challenges
P16	Software integration in global software development challenges for GSD vendors/2017	Muhammad ilyas, Siffat ullah khan	Barriers in integration of software in GSD	Journal	SLR	Lack of communication Lack of proper documentation Lack of compatibility

						Architecture mismatch Lack of management & integration planning Heterogenous Development Environment Improper/no unit testing Lack of resources, knowledge, skills Lack of component interface Unclear responsibilities Configuration and versioning complexity
P17	Distributed agile development communication: An agile architecture Driven framework/2015	Yehia Ibrahim Alzoubil, Asif Qumer, Ahmed Al-Ani	Challenges regarding agile implementation in GSD	Journal of Software	SLR	People differences (cultural differences, people attitude, language, trust), Distance differences (time zone, geographic), Team issues (size, distribution, cross team communication, team work), Technology issues (tools, infrastructure,

						bandwidth, cost), Architectural issues (organizational structure, managerial structure, Project domain), Processes issues (Process control, lack of commitment), customer communication
P18	Systematic Literature Review in Global Software Development Risk in agile methodology/2020	Zuriyaninatasa Podari, Adila Firdaus Arbain, Noraini Ibrahim, Wan Mohd Nasir Wan Kadir, Azim Muhammad Fahm, Dayang Norhayati Abang Jawawi	Issues regarding agile in GSD	International Conference on Information Technology and Multimedia (ICIMU 2020)	SLR	Communication and collaboration
P19	Using scrum in Distributed Agile development: A multiple case study/2009	Maria Paasivaara, Sandra Durasiewicz and Casper Lassenius	Problems associated with using scrum in distributed environment	International Conference on Global Software Engineering (ICGSE 2009)	Case study	Cultural differences, Time zone differences, Technical problems, Sound quality problems, Different religious and other holidays in different

						countries causes synchronization challenges
P20	Studying Communication in Agile Software Development/2009	Peitsa Hynninen, Arttu Piri, Tuomas Niinimaki	Discussing the challenges of communication in Agile GSD	Conference	Pilot study	Electronic communication issues
P21	Using agile practices to solve GSD problems/2014	Sarah Beecham, John Noll, Ita Richardson	Discussion of solutions of issues regarding agile in GSD	International Conference on Global Software Engineering (ICGSE 2014)	Case study	Geographical, temporal , cultural distance issues, Tools mismatch among team members(infra structure issues) ,Lack of coordination, Lack of informal communication
P22	Communication understandability enhancement in GSD / 2015	Sumit Sharma, Pawanpreet Kaur,Upinder Kaur	Communication hurdles involves in GSD using Agile methodology	Conference (ABLAZE 2015)	SLR	Communication issues, Language barriers, Lack of trust, personnel selection
P23	A Systematic Literature Review on Factors Impacting Agile Adaptation in Global	Areebah Altaf, Urooj Fatima, Wasi Haider Butt, Muhammad	Factors effecting agile in GSD	Conference (ICCCM 2019)	SLR	Project complexity, Lack of documentation, Inappropriate architecture, customer un-availability,

	Software Development/2019	Waseem Anwar, Maryum Hamdani				cultural and time zone differences
P24	Communication through Boundary Objects in Distributed Agile Teams/2015	Johan Kaj Blomkvist, Johan Persson,Johan Åberg	Communication issues regarding distributed agile development in GSD	Conference on Human Factors	Case study	Communication issues
P25	Communication Network in an Agile Distributed Software Development Team/2019	Paul T. Robinson	Use of different tools in distributed environment while implementation of agile methodology	International Conference on Global Software Engineering (ICGSE 2019)	Survey	Communication tools issues

Appendix F

Respondent-id	Gender	Experience (years)	Organization size
RES_1	Male	5	20
RES_2	Female	6	150
RES_3	Male	3	40
RES_4	Female	1	23
RES_5	Male	4	20
RES_6	Female	3	50
RES_7	Male	2	45
RES_8	Female	12	100
RES_9	Male	3	90
RES_10	Female	7	76
RES_11	Male	5	12
RES_12	Female	7	23
RES_13	Male	2	45
RES_14	Female	5	32
RES_15	Male	6	67
RES_16	Female	3	54
RES_17	Male	1	34
RES_18	Female	4	23
RES_19	Male	3	45
RES_20	Female	2	65
RES_21	Male	1	56
RES_22	Male	1	89
RES_23	Male	1	34
RES_24	Male	2	12

RES_25	Male	5	34
RES_26	Male	6	23
RES_27	Male	3	12
RES_28	Male	1	10
RES_29	Male	4	12
RES_30	Male	3	5
RES_31	Male	2	56
RES_32	Male	5	45
RES_33	Male	5	35
RES_34	Male	5	32
RES_35	Male	5	34
RES_36	Male	5	10
RES_37	Male	5	10
RES_38	Male	5	10
RES_39	Male	2	9
RES_40	Male	5	8
RES_41	Male	6	12
RES_42	Male	3	5
RES_43	Female	1	5
RES_44	Female	4	34
RES_45	Female	3	23
RES_46	Female	2	12
RES_47	Female	Nil	10
RES_48	Female	Nil	12
RES_49	Female	Nil	5
RES_50	Female	Nil	56
RES_51	Female	1	45

RES_52	Female	1	35
RES_53	Female	2	32
RES_54	Female	1	34
RES_55	Female	3	10
RES_56	Female	1	10
RES_57	Female	4	12
RES_58	Female	2	34
RES_59	Female	2	23
RES_60	Female	2	12
RES_61	Female	1	10
RES_62	Female	2	12
RES_63	Female	Nil	5
RES_64	Female	1	56
RES_65	Female	3	45
RES_66	Female	8	35
RES_67	Female	4	32
RES_68	Female	3	34
RES_69	Female	5	10
RES_70	Female	2	10
RES_71	Female	5	12
RES_72	Male	6	34
RES_73	Male	1	23
RES_74	Male	10	12
RES_75	Male	4	10
RES_76	Male	4	12
RES_77	Male	15	5
RES_78	Male	3	56

RES_79	Male	2	45
RES_80	Male	6	35
RES_81	Male	9	32
RES_82	Male	12	34
RES_83	Male	2	10
RES_84	Male	1	10
RES_85	Male	5	12
RES_86	Male	1	12
RES_87	Female	5	10

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