# Key Challenges of Requirement Change Management in the context of Global Software Development: Systematic literature review

Maryam Kausar, Rabia Jabbar, Anas Wali Muhammad, Muhammad Ishtiaq

*Foundation University Islamabad, Rawalpindi Campus, Pakistan*

∗ **Corresponding Author:** Email: maryam.kausar@fui.edu.pk

## Abstract

*Software organizations worldwide are rapidly adopting the event of Global Software Development (GSD) to achieve noteworthy benefits in terms of quality and cost. However, there are many challenges faced by the GSD organizations that directly impact the Requirement Change Management (RCM) activities. The core goal of this study is to find the challenges of RCM in the context of GSD. Systematic literature review approach is used to inspect the challenges of RCM events and in total, 12 challenges have been found. Target of this study is to provide strong understanding of RCM practices, so that organizations can address these issues in an appropriate manner. The identified challenges having frequency higher than 50% are being evaluated. Findings of this study will be useful to address RCM challenges that organizations face in administrating project in GSD environment.*

**Key Words:** Requirement change management (RCM), Global software development (GSD)

## 1. Introduction

According to the traditional software development, almost all of the requirements are collected at the preliminary stage of the software development life cycle (SDLC) [1]. The requirement specification document is completed before starting the next stage. If any change in the requirement is requested by stakeholder during the life cycle, then the change control board (CCB) handles these requests.

Change is a very challenging phase of the requirement engineering [2]. Requirement change may arise at any stage of the software development process due to numerous reasons, e.g.: needs of market, budget change, and stakeholder requirement [3]. Gradually the requirement change management (RCM) is getting more complex in the environment of global software development (GSD). Basically GSD is the software development occurrence where the team members execute development events across traditional geographic distances [4]. Many organizations develop software using GSD concept [5, 6]. It is carried out by a team of practitioners physically located in different parts of the world working together to develop an operational software. Global software development is more like distributed software development except the fact that in GSD team members are global at all times.

Several issues hinder the process of GSD. Among all Global distance is one of the major issues. It can be said that global distance is a combination of linguistic, temporal, geographical and cultural distance.

In Traditional software development teams working on a viable software of a company are collocated, most of their tasks overlap and somehow depend on each other. They work together and meet often to achieve a common goal. They mostly belong to the same culture, have the same native language and can meet physically to work on the development project whenever required without the limitation of being located in an entirely different region of the world. GSD mostly uses tools and technologies that support smooth collaboration between these virtual teams.

The global software development group members face different challenges. Majority of them face teamwork coordination and communication problems that make the development events more challenging. Team coordination and communication are reflected as the main aspects that are critical for the effective execution of RCM events, causing system failure due to poor RCM [7, 8]. According to the Standish group survey among 13000 projects, 18% were crashed due to poor RCM [9].

For the successful execution of RCM process, many change management frameworks and modules have been established. Niazi et al [10] developed a model using the CMMI level 2 for the RCM. This model has five main stages: request, validate, implement, verify and update. The model

was created by the data collected from the existing literature and the industrial experimental studies directed by the RCM professionals.

Another model is introduced by Keshta et al [11], that addresses the challenges faced by the software development team in RCM. This model consists of six stages: initiate, validate, implement, verify, update and release. It delivers comprehensive recommendations to execute essential requirement changes in small and medium sized organization; however it does not report the RCM process in GSD organization. Batti et al [5] developed a model for change management process that consists of six stages: initiate, receive, evaluate, approve or disapprove, implement and configure. It just delivers a guide for the change management events. Ince's [12] highlights the events for handling the required changes. It consists of five stages: change request, rejection, batch, implementation and updating. Each and every change request is forwarded to the CCB which handles the change request and makes the final decision after evaluating the change through all stages of the model. But this model does not cover the verification stage, therefore it is very challenging to verify the modifications applied to the system. These are some structures and models which can assist an organization to manage the required changes, in reduced time and development budget [5, 13, 14].These models effectively address the RCM process. Khan et al [15] cited that the execution of RCM events in the GSD setting should be more challenging due to distributed nature of GSD projects.

This study shows the challenges that will support the requirement engineering experts to understand, manage and plan requirement changes in GSD projects. Systematic literature review (SLR) process is used to conduct this study that directs the challenges of RCM in the context of GSD. The following research questions are developed to direct the research problem.

*RQ1: What key challenges are identified in the literature for the software RCM process execution in GSD environment?*

*RQ2: How are these challenges associated with organization success?*

*RQ3: What are the most severe challenges investigated in this literature review?*

This paper is organized in the form of sections. Section 2 highlights related work. In section 3 the research methodology of this study is discussed. Section 4 explains the results and discussion of the study. Section 5 shows the conclusion of this study.

## 2. Related work

Most of the researchers conducted studies to address the RCM challenges in the context of GSD environment. Ikram and Ramzan [16] directed the systematic study and described the current framework. The components of the RCM frameworks are Roles, Activities and Artefacts, that have major effects on the RCM activities. There is no proper design to manage the requirement changes, and the current frameworks do not offer a perfect relation between the activities, roles and artefacts.

Numerous experimental studies were exploring different characteristics of RCM process. Jayatilleke and Lie [2] inspected the current literature on reasons of techniques and processes that were designed to manage the requirement change issues. This study concentration on the general concepts related to the RCM process. Minhas and Zulfqar [5] directed the SLR and inspected the current RCM process frames. Recent SLR study directed by Lai and Shalinka [2] discovers the following aspects of RCM: (a) What are the requirement changes reasons? (b) What approaches are used for the RCM? (c) What are the current processes of RCM (d) How organizations make the decision for the requirement change? Advanced studies deliver the models and tools that are used in the RCM in the context of GSD.

Another study, Ali and Li [17] applied the three-stage RCM model for the GSD projects. The results revealed the usefulness of recommended approach and report some of the significant features of RCM issues. Nonetheless, their approach is insufficient in two viewpoints, first is they neglected the communication techniques across the different GSD locations with the concern of different project management methods in GSD standard and the second is they neglected the composition and implementation of CCB. Akbar et al [31] classified identified challenges on the basis of organisational size, type based on expert opinion. It provides a framework in order to tackle and solve problems related to RCM practices in the Global Software Development domain. S. Anwer [33] administered a survey and took feedback from various industrial practitioners. This study further distinguished RCM challenges on the basis of GSD and in-house development practices. M.A Akbar [35] categorised identified challenges into client-vendor organisations in order to better understand

the RCM Challenges. Results lead to the development of a robust framework which states that GSD organisations need to focus on project administration. S. Quereshi [38, 39] worked on a conceptual model that helps minimise problems associated with communication and coordination during requirement change management in the GSD environment. Domain experts were also contacted in this regard to validate the proposed model.

The literature shows that the majority of studies have worked on challenges faced during Global software development but only several studies are addressing Requirement change Management Challenges particularly. Ali et al [32] emphasised on demonstrating and understanding GSd barriers and challenges which occur at various operational tiers. These are further grouped as per company and team level. Z.Podari [34] in another study indicated major risks in GSD and how Agile development can help reduce the intensity and frequency of these challenges. J.A Khan [36] discussed present cost estimation techniques and the need of cost drivers in the GSD environment. Study identifies and lays emphasis on missing areas that would help practitioners excel in the GSD domain.In another study Fuzzy Analytical Hierarchy Process was implemented in order to rank challenges related to management in GSD Projects. Study has categorised these challenges on the basis of priority [37].

According to the understanding based on the above, only limited work is available that explores RCM challenges in the context of GSD by considering the timeline and organisational dimensions. The goal of this study is to fill this gap by identifying the key challenges in the GSD environment, thereby indicating the importance of every challenge in the field of GSD organisation [18]. This study examines the identified challenges regarding the organisational and cultural differences. The same techniques were used in the context of GSD research by Khan et al and Niazi et al [7, 19]. This study evaluated the inspected RCM challenges and defined the importance of the investigated challenges.

## 3. Research Methodology

In this research, systematic literature review (SLR) approach has been used. There are three stages of SLR according to the Kitchenham and Charter [20]. This study follows underlying steps in this systematic literature review:

- Planning
- Reporting & Directing

### 3.1 Stage 1: Planning

In the planning phase of the review, this study concentrated on the planned research questions that were associated with targeted study goals. This study selected the appropriate data source and defined the search strings, defined the inclusion criteria and exclusion criteria for the literature and also defined the criteria of quality assessment. We have followed the method done by Khan al [21] and Shameem al [22] to conduct the inclusion and exclusion criteria of research methodology. The details of these factors are given below.

#### 3.1.1 Research questions

Current study concentrated on challenges of RCM in the context of GSD. These research questions have been given on the introduction of this review.

#### 3.1.2 Data resource

A suitable digital source was selected on the knowledge and recommendation provided by the Chen al[23] in the domain of software engineering. The SLR studies were directed by the Niazi al [24] and Khan al[19]. The following data resources were selected for this review:

- Science direct (https://www.sciencedirect.com/)
- Google scholar (https://www.scholar.google.com/)
- IEEE Xplore (https://www.ieeexplore.ieee.org/)
- Springer link (https://www.link.springer.com/)
- IET digital library (https://www.theriet.org/)
- Wiley inter science (https://www.wiley.com/)
- ACM digital library (https://www.dl.acm.org/)

#### 3.1.3 Search strings

This study prepared the search strings as per the most used keywords gained from current literature

[25-27] and research questions. Foremost keywords and their replacements were concatenated by using Boolean operators AND / OR for search strings.

Search strings are given in to the below Table 1.

### 3.1.4 Inclusion criteria

Main points of the inclusion criteria are given below:

- Each and every study is written in English language.
- Every research should be a journal, conference or the chapter of book.
- Research studies that must be defined the RCM process in the framework of GSD.
- Research studies that defined the challenges of RCM in the framework of GSD.
- Research studies that defined the causes of negative effects that evolves on RCM activities.
- If the two studies are similar, then consider the latest version of the studies.
- Research studies that were available and published between 2006 to 2020.

### 3.1.5 Exclusion Criteria

Main points of the exclusion criteria are given below:

- Those studies that have no appropriate material of RCM process are removed.
- Studies in which the writer did not reflect the challenges and issues that are rising due to change in Requirement change management are excluded.
- Studies which are not written in English language are avoided.
- Identical research studies are not considered.

### 3.1.6 Quality assessment of nominated studies:

For quality assessment of nominated research studies, this study uses the suggestion that is provided by the Kitchenham and Charter [20]. The criteria of the quality assessment is very valuable to assess the importance of each research studies. This research directed the quality assessment and the data extraction and created a checklist that assesses the quantitative assessment and qualitative assessment of nominated research studies. The layout of following list was created according to the instruction provided in [28-30]. It contains the five checklist questions. Assessment was made for every question:

- If the study covers the answer of list questions, they were given 1 scores.
- If the study covers the half answer of list questions, they were given 0.5 scores.
- If the study does not cover the answer of the list questions, they were given 0 scores.

**Table 1:** Search String

| Keywords | Alternatives |
|---|---|
| Software requirement change management | “Software requirements change management” OR” requirement change management” OR “RCM” OR “change management” OR “outcome of RCM” OR “RCM process improvement” OR “requirements change management practices” OR “requirements updating” OR “impact of RCM” OR “negative impression on requirement change management” OR “requirement changing” OR “control change requirement” |
| Challenges | “techniques” OR “process” OR “methods” OR “problems” OR “hurdles” OR “challenges” OR “tools” OR “evaluation” OR “assessment” OR “mechanism” OR “barriers” OR “difficulties” OR “procedure” |
| Global software development | “GSD environment” OR “global software engineering” OR “GSD organization” |
| Systematic literature review | “Literature review” OR “Review” OR “Literature study” OR “Literature” |

**Table 2:** Quality Assessment Criteria

| QA Questions | List |
|---|---|
| **QA1** | Ensure the study discusses any challenges in Requirement change management? |
| **QA2** | Do the implemented research strategies address their research question? |
| **QA3** | Are the well-known results associated to the validation of the research question? |
| **QA4** | Does the study discuss requirement change management structure and its execution in the context of global software development? |
| **QA5** | Data collected is associated with the RCM in the context of GSD? |

## 3.2 Stage 2: Reporting and Directing

### 3.2.1 Study Nomination:

To improve and finalize list of main studies and articles Tollgate method developed by Afzal et al [20] was applied. This approach consists of following Phases:

- Phase 1(P1): "looking for appropriate articles using search expressions"
- Phase 2(P2): "selection and rejection are dependent on title and abstract of the articles"
- Phase 3(P3): "selection and rejection are reliant on introduction and conclusion of the articles"
- Phase 4(P4): "selection and rejection are dependent on full text of the articles"
- Phase 5(P5): "absolute nomination of major studies is added in SLR"

In first phase, studies were gathered from a selected digital source by using established search strings (section 3.1.3), then following the "inclusion" (section 3.1.4) and "exclusion" criteria (section 3.1.5). By applying Tollgate method, 22 studies were shortlisted in primary study selection which matched to 2.6 % of entire collected studies as shown in Figure 1.

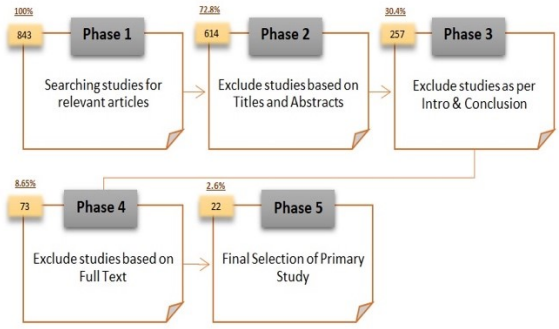


**Fig 1:** Final Selection by Tollgate Method

All nominated articles were assessed by relating them to the nominated QA criteria (section 3.1.6) [Table 3]. List of Final articles has been provided in Appendix A. Each selected articled is defined with selected literature [SL] to show its use on the SLR.

**Table 3:** Application of Tollgate Method

| Database | P1 | P2 | P3 | P4 | P5 | %Age of final primary studies (N=22) |
|---|---|---|---|---|---|---|
| ACM | 151 | 110 | 43 | 13 | 4 | 18.18 |
| IEEE | 337 | 246 | 101 | 30 | 9 | 40.91 |
| Wiley | 39 | 23 | 8 | 3 | 1 | 4.55 |
| Springer | 78 | 61 | 34 | 6 | 2 | 9.09 |
| Science Direct | 74 | 54 | 25 | 5 | 2 | 9.09 |
| Google Scholar | 141 | 111 | 42 | 11 | 3 | 13.63 |
| IET | 23 | 9 | 4 | 5 | 1 | 4.55 |
| **Total** | **843** | **614** | **257** | **73** | **22** | **100** |

### 3.2.2 Data extraction

List of challenges to Requirement Change Management is extracted from 22 primary studies. The extracted data was used to answer the Research Questions. Following data was extracted for that purpose:

- Study Title
- Study Type
- Research Methods
- RCM Challenges

### 3.2.3 Research methods used in the selected studies

List of Final primary nominated studies has been shown in Appendix A. Studies indicated that the primary nominated studies contain 5 (22.73%) Questionnaire surveys, 7 (31.82%) Case Studies, 1 (4.55%) Ground Theory, 2 (9.09%) Content

Analysis, 2 (9.09%) Action Research and 5 (22.73%) Mixed Methods: as shown in Table 4.

**Table 4:** Distribution of Primary Studies

| Database | Frequency | % |
|---|---|---|
| Questionnaire | 5 | 22.73 |
| Case Studies | 7 | 31.82 |
| Ground Theories | 1 | 4.55 |
| Content Analysis | 2 | 9.09 |
| Action Research | 2 | 9.09 |
| Mixed Methods | 5 | 22.73 |

## 3.3 Overview of Studies

For this research, 22 primary studies were studied and reviewed on the RCM challenges in GSD environment. First, the overview of primary studies was discussed. Next, this paper discussed the quality attributes of those primary studies followed by scope and studies. Finally, this paper identified Key Challenges in RCM processes. Analysis of selected studies reveals that, both Questionnaire Surveys and Case Studies are the frequent in research methodologies for scholars after 2005.

These findings indicate that recent researches have a rising importance in using and applying Questionnaire Surveys and Case Studies methodologies and a decreased trend is noticed in using Content Analysis and Action Research method as shown in Fig 2.

### 3.3.1 Methodological Qualities

As mentioned in Section 3, quality is each primary study is assessed considering 4 quality criteria (Table 2). This criterion shows that the selected primary studies could be a reasonable input to this systematic literature review. The QA score of every principal study was determined with the help of five QA Questions (section 3.1.6).

List of Final nominated studies alongside their QA Score have been shown in Table 5. The concluding QA score for every article is accumulative score of each QA question. Tollgate Method has disregarded all inappropriate articles.

The results in Appendix A show that more than 86% of the primary studies scored equal or greater than 70%, that indicates the importance of these nominated studies to acknowledge Research Question of this study.

### 3.3.2 Scope of the Studies

The primary nominated studies had some variations in their scope, which can be categorized as under:

- Challenges of Requirement Change Management (RCM) in Global Software Development (GSD)
- Categorization of Challenges identified considering Organizational Size
- Client-Vendor categorization of Challenges
- Change Analysis of different level user

The study focus was to identify challenges if RCM in GSD, so it identifies 12 key challenges considering the scope of primary nominated studies.

**Table 5:** Quality Assessment

| Source | ID | QA1 | QA2 | QA3 | QA4 | QA5 | Total Score | % |
|---|---|---|---|---|---|---|---|---|
| ACM | SL1 | 1 | 1 | 0.5 | 1 | 0.5 | **4** | **80** |
| GS | SL2 | 1 | 0.5 | 1 | 1 | 1 | **4.5** | **90** |
| IEEE | SL3 | 1 | 1 | 1 | 1 | 0.5 | **3.5** | **90** |
| SPR | SL4 | 1 | 0.5 | 1 | 1 | 0 | **3.5** | **70** |
| GS | SL5 | 1 | 0.5 | 1 | 1 | 0.5 | **4** | **80** |
| Wiley | SL6 | 1 | 1 | 0.5 | 1 | 0.5 | **4** | **80** |
| ACM | SL7 | 1 | 0.5 | 1 | 0.5 | 1 | **4** | **80** |
| IEEE | SL8 | 0 | 0.5 | 1 | 0.5 | 0.5 | **2.5** | **50** |
| ACM | SL9 | 0.5 | 1 | 0.5 | 0.5 | 1 | **4.5** | **70** |
| ACM | SL10 | 1 | 1 | 0.5 | 1 | 0.5 | **4** | **80** |
| SD | SL11 | 1 | 0 | 0.5 | 0.5 | 1 | **3** | **60** |
| GS | SL12 | 1 | 1 | 1 | 0 | 0.5 | **3.5** | **70** |
| SPR | SL13 | 0.5 | 0.5 | 1 | 1 | 1 | **4** | **80** |
| IEEE | SL14 | 0.5 | 0.5 | 1 | 1 | 1 | **4** | **80** |
| IEEE | SL15 | 0.5 | 1 | 0.5 | 1 | 1 | **4** | **80** |
| IEEE | SL16 | 0.5 | 1 | 1 | 0.5 | 1 | **4** | **80** |
| IEEE | SL17 | 0 | 0.5 | 1 | 1 | 0.5 | **3** | **60** |
| IEEE | SL18 | 0 | 1 | 1 | 1 | 0.5 | **3.5** | **70** |
| IEEE | SL19 | 1 | 1 | 1 | 0.5 | 1 | **4.5** | **90** |
| IEEE | SL20 | 0.5 | 1 | 1 | 1 | 0.5 | **4** | **80** |
| SD | SL21 | 1 | 0.5 | 1 | 0 | 1 | **3.5** | **70** |
| IET | SL22 | 1 | 1 | 0.5 | 1 | 1 | **4.5** | **90** |

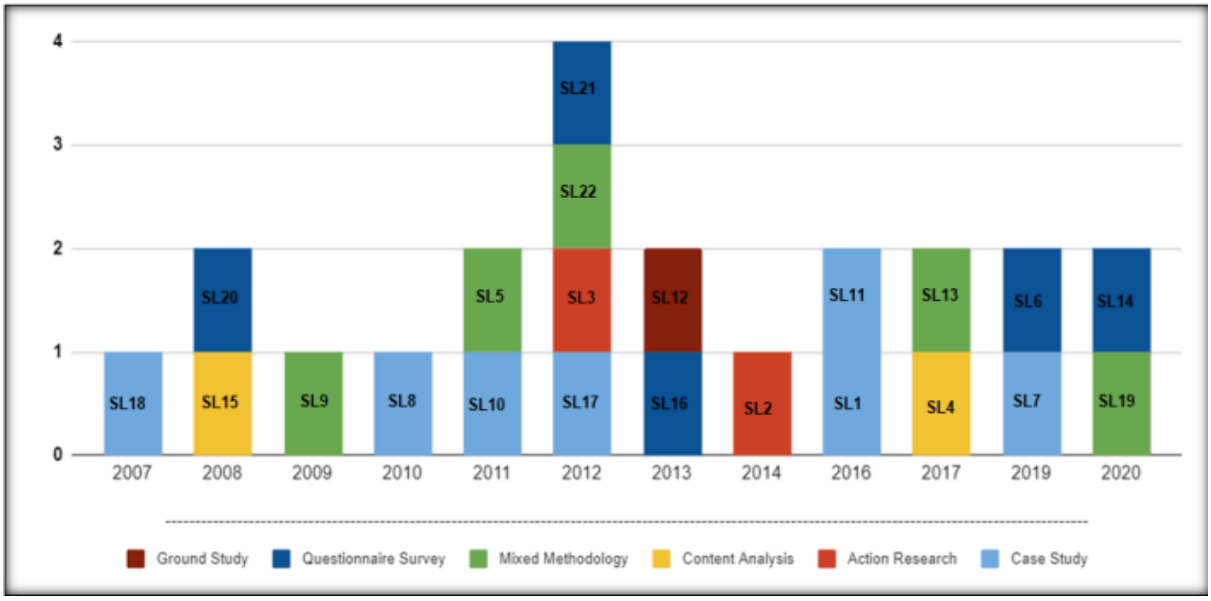


**Fig. 2:** Analysis and classification of Primary studies w.r.t year

## 4. Results and Discussion

Total of 12 major challenges (from the 22 selected primary studies), were identified using the SLR approach. To address RQ1, percentages and frequencies of the inspected Challenges (CHs) were summarized in Table 6 and Figure 3. All selected primary studies that includes in the SLR are mentioned in Table 6.

Top 4 challenges in accordance to the frequency analysis are:

- CH1: Lack of Communication and Coordination
- CH5: Lack of skilled Project Management
- CH6: Improper RCM Practices and Standards
- CH12: Improper management of Change Control Board (CCB)

**CH1**: **Lack of Communication and coordination** is found to be the most critical challenge, ranked 1st in this study, for RCM process in Global Software Development. 82% studies considered CH1 as a major challenge. Communication is key factor for building trust, faith and confidence among all the team members distributed globally. Communication greatly affects control and coordination. As control, coordination and communication are Inter related [SL16]. In a similar manner coordination between team members is very critical to achieve goals and objective of any project. It refers to group-oriented task of all team members [SL6]. Lack of expert project management can lead to unsuccessful implementation of RCM process in GSD [SL3]. Therefore, it is very crucial to properly manage communication between all stakeholders for successful completion of projects.

**CH2**: **Budget limitation and unknown cost factors** is suggested to be the most significant challenge for application of RCM in Global Software Development. Budget has a direct impact on RCM activities [SL6]. It is needed for extensive training to complete the project on time [SL9]. It is difficult to deploy RCM processes across distributed frameworks due to budget restrictions [SL14]. Furthermore, it is difficult to engage experts in RCM process improvement if there are budgetary limitations [SL19]. Most organizations fail to complete projects on time due to lack of proper budget allocation procedures.

**CH3: Delayed Responses** is reported in 59% of selected primary studies as a major challenge of RCM process. Time based differences, language barriers and cultural differences can lead to delay in response time. Delayed responses can greatly impact RCM process if frequent decision making regarding a particular change is required [SL6]. Change management program needs a lot of collaboration and delayed responses critically affect success of project [SL14].

**CH4: Improper identification of roles and responsibilities** is stated as an obstacle for active execution of RCM processes in GSD environment. Identification and assignment of proper roles and responsibilities to each individual involved is very critical to the success of projects in GSD sites

[SL19]. Culture can cause high effect on understanding of assigned roles and responsibilities. Along with this, lack of partner's visibility can cause bad impact on assigned roles and tasks [SL20].

**CH5: Lack of skilled Project Management** is ranked as 2nd biggest challenge for RCM processes in GSD environment.77% studies measured CH5 as a major challenge. Expert project management team is significant for effective execution of RCM activities [SL3]. GSD organizations can fulfil RCM programs only with appropriate management [SL19]. In GSD, managers are sometimes reluctant to hold meetings and collaborate with remote sites which can lead to conflict of interest [SL20]. Lack of expert project management can be the ultimate cause of project downfall in GSD environment.

**CH6: Improper RCM Practices and Standards** is rated as 3rd significant challenge for RCM processes, recorded in 73% studies. Notwithstanding the importance of RCM in GSD sites, only limited importance is given to RCM practices, standards and tools. Inadequate prominence is given to development of models, procedures & factors that can impact RCM practices [SL6]. Different processes and standard create problems for development teams in project knowledge exchange between remote sites [SL13]. Dissimilar RCM Standards affect the correctness of RCM activities. This could even lead to a failure of whole RCM program [SL14]. Lack of standardized RCM implementation practices can obstruct fruitful implementation of RCM activities [SL19].

**CH7: Work synchronization issue** is declared as one of the most critical challenges in implementing RCM process in GSD sites [SL3, SL14]. Synchronizing work between sites is key challenge in large organizations [SL18]. It is very important to ensure work synchronization framework among all GSD sites, because decisions taken at one location might affect activities at any other distributed location due to work synchronization issues. Team members have to make sure of proper collaboration among all locations specifically in executing RCM activities and avoid work synchronization issues [SL14]. Time zone difference increases the possibility of work synchronization issues which can result in delayed execution of programs [SL20].

**CH8: Absence of Standard RCM Tools** is also evaluated as a critical challenge in RCM processes. It is crucial for RCM specialists to use state of the art technologies for all RCM processes in GSD environment. Absence of standard technological tools can lead to RCM Program failure [SL6]. The use of different tools brings additional challenge for development teams [SL13]. Absence of standard RCM tools is more significant for software developers as compared to researchers and organizational management [SL14]. Due to divergence in tools and standards of RCM, data used or recorded by one team mostly becomes incompatible for another team in a GSD environment [SL12]. Thus, non-standard compliance of RCM tools and techniques can lead to incoherencies in completion and delivery of Final product [SL20].

**CH9: Improper Impact Analysis** is considered to be a key challenge reported in many primary studies. Incorrect change impact analysis in GSD can hinder the successful implementation of RCM processes. Accurate impact analysis of any particular change request is very important to estimate its effect on quality, time and cost of the system [SL6]. Improper impact analysis can destabilise whole RCM process which may lead to ultimate project failure. Improper estimation of impact analysis at GSD sites causes poor scope estimation of demanded change requirements, which can further lead to Project failure [SL14].

**CH10: Difference of Time Zone** greatly affects communication and coordination processes, which results in decreased communication and coordination among development teams [SL12]. In Global software development, teams are dispersed geographically and thus face a lot of time zone differences [SL17]. A lot of Time zone differences are faced by geographically scattered team members in GSD sites [SL3]. Bad management of Time zone differences can hamper RCM processes in GSD [SL1]. Global requirement engineering issues are also faced due to different time zones [SL9]. Time zone differences adversely affect Communication and coordination processes in GSD [SL13, SL14].

**CH11: Lacking Organization support** is reported as a significant challenge by many studies. It is the limit to which organization provides support in terms of finances and shows participation in RCM activities. GSD teams cannot implement RCM program without organizational support [SL6]. It affects the launch and implementation of RCM activities as suitable support and motivation of organization is needed [SL14]. In GSD, activities are divided among various sites due to which even small change requirement can affect project greatly if organizational support is not available. In fact, organizational politics can further worsen the situation [SL3].

**CH12: improper management of Change Control Board (CCB)** is a critical challenge reported in 68% primary studies. It is evaluated as 4th major challenge in RCM processes. CCB management deals with change sanction and customer queries [SL3, SL7]. Estimation of cost, time and resources can be problematic due to lack of CCB management. Development activities are geographically distributed with cultural differences; hence CCB management in GSD is very challenging activity [SL3]. Change control board evaluates the technical part of the project and change builders calculate the impact of change requirement on other requirements [SL2].

## 5. Conclusion

Rapid increase in the application of Global Software Development (GSD) motivated the researchers to explore and investigate the challenges that could have an impact on Requirement Change Management (RCM) processes in a GSD environment. Requirement Change Management is an important part of Requirement Engineering and plays a vital role for the success of a Project. In this Study, SLR approach has used to evaluate and identify challenges from 22 primary nominated studies. By using SLR approach, this study was able to identify, a total of 12 Key challenges that have adverse effect on project success, out of which this study highlighted 4 challenges that are the most critical.

The results revealed that critical challenges need more attention to address the fruitful accomplishment of RCM activities in a GSD environment. This study intends to conduct a literature review that demonstrates all major factors and challenges that can influence a project negatively. After applying all standard practices of SLR approach, this study is confident that the results of this research will be helpful to address RCM challenge faced by management team in geographically distributed sites, as it is very important for successful implementation of project worldwide.

**Table 6:** List of Inspected Challenges

| Sr. No | Challenges | IDs of Primary Studies | F (N=22) | % |
|---|---|---|---|---|
| **CH1** | **Lack of** Communication and coordination | **SL1, SL2, SL3, SL4, SL5, SL6, SL7, SL9, SL10, SL11, SL12, SL13, SL14, SL17, SL18, SL19, SL20, SL22** | **18** | **82** |
| CH2 | Budget limitation and unknown cost factors | SL3, SL6, SL7, SL9, SL12, SL14, SL17, SL18, SL19, SL20, SL21 | 11 | 50 |
| CH3 | Delayed responses | SL3, SL6, SL5, SL7, SL9, SL11, SL12, SL13, SL14, SL18, SL19, SL20, SL21 | 13 | 59 |
| CH4 | Improper identification of roles and responsibilities | SL1, SL2, SL3, SL6, SL7, SL8, SL9, SL10, SL11, SL12, SL13, SL14, SL14, SL19, SL20 | 15 | 68 |
| CH5 | Lack of skilled Project Management | **SL1, SL2, SL3, SL6, SL7, SL9, SL11, SL12, SL13, SL14, SL15, SL17, SL18, SL19, SL20, SL21, SL22** | **17** | **77** |
| CH6 | Improper RCM Practices and Standards | **SL2, SL3, SL4, SL5, SL6, SL12, SL13, SL14, SL15, SL16, SL17, SL18, SL19, SL20, SL21, SL22** | **16** | **73** |
| CH7 | Work synchronization issue | SL1, SL3, SL5, SL6, SL9, SL11, SL13, SL14, SL16, SL18, SL19, SL20 | 13 | 55 |
| CH8 | Absence of Standard RCM Tools | SL1, SL5, SL6, SL8, SL11, SL12, SL13, SL14, SL15, SL18, SL19, SL20, SL21 | 13 | 59 |
| CH9 | Improper Impact Analysis | SL1, SL3, SL4, SL6, SL7, SL8, SL11, SL14, SL19, SL20 | 10 | 45 |
| CH10 | Difference of Time Zone | SL2, SL3, SL4, SL5, SL6, SL9, SL11, SL12, SL13, SL14, SL16, SL17, SL19, SL20 | 14 | 68 |
| CH11 | Lacking Organization support | SL2, SL3, SL4, SL6, SL7, SL9, SL12, SL13, SL14, SL16, SL17, SL19 | 12 | 55 |
| CH12 | Improper management of Change Control Board (CCB) | SL2, SL3, SL4, SL5, SL6, SL7, SL8, SL9, SL14, SL16, SL17, SL18, SL19, SL20, SL22 | 15 | 68 |

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