Organization Type and Size Based Identification of Requirements Change Management Challenges in Global Software Development

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ABSTRACT Global Software Development (GSD) is adopted by organizations to develop quality software at relatively low cost. Requirement Change Management (RCM) plays a key role in overall success of a GSD project. The objective of this study is to identify the challenges of RCM process by adopting systematic literature review (SLR) and validate them by employing questionnaire survey approach in real world practices. A total of 25 challenges were identified through SLR and empirical study. We have further classified the identified challenges into client and vendor organizations with an aim to understand RCM challenges in the context of both types of GSD organizations. The identified challenges were also categorized into three core types of the organization size (small, medium, large), that highlights the significance of each challenge for specific organizational size. The results indicate that there is a moderate correlation between the ranking of these challenges in the literature and the survey results. The finding of this study has the potential to help the GSD organizations in addressing the problems related with RCM in GSD projects.

INDEX TERMS Global software development (GSD), requirements change management (RCM), challenges, systematic literature review (SLR), size-based classification, client, and vendor.

I. INTRODUCTION

Change is a challenging aspect of requirements engineering process [1]. In the real world, software professionals face problems in identifying an extensive set of system requirements that reflect contemporary situations and adjust to changing needs [1]. One of the most important issues that software businesses have to address is the dynamic change in process requirements [2]. Several factors such as customer needs, market dynamics, global competitors, and government regulations contribute to the change in system requirements. Hence, Requirements Change Management (RCM) in software development is highly important and essential to the success of a software project [3]. In this paper, we adopt Nurmuliani’s [4] definition as follows: “the tendency of requirements to change over time reacting to the evolving needs of customers, stakeholders, organizations, and the work environment.”

Managing requirements changes is a challenge in colocated software development projects and is more complex in the global software development (GSD) environment [5]. The key practices to the successful management of requirements include communication and coordination between stakeholders [5]–[7]. Inappropriate management of requirements changes can lead to disastrous effects on system development in terms of high software cost, delayed schedules, volatile requirements, and endless testing, ultimately cause project failure [7], [8].

Global software development (GSD) is a modern software development paradigm in which development activities are carried out at geographically distributed locations around the globe [9]. To achieve economic and strategic
benefits, there is growing interest in software industries in adopt GSD [6]–[8]. A survey conducted by the US-based Standish Group showed that approximately 20% of client firms of the 1,000 major software development organizations are globalizing their businesses. Outsourcing development activities to vendor organizations in low-cost countries has become increasingly important owing to the significant low development costs [10].

However, GSD introduces several issues for practitioners that do not exist in collocated software development environment [10]–[12]. In a GSD project, development teams are located in different physical locations, hence, the differences in ethnicities and time zones have a potentially negative impact on communication and coordination tasks [13], [14].

According to a study conducted by the Standish Group on approximately 13,500 software products, 29% of the products were successful, 18% were unsuccessful, and 53% were uncertain in the context of GSD [15]. Consequently, inadequate management of requirements change is one of the key reasons for low project success rate. According to Khan et al., the main reason behind the low projects success rate is the insufficient attention given to RCM problems in the domain of GSD [16].

Recently, a number of RCM models have been developed to assist software organizations in efficiently managing the requirements change management activities. For example, Niazi et al. [17] proposed an RCM model to apply the specific practices (SP) of capability maturity model integration, Level 2 (SP1.3-1). Minhas and Zulfiquar [6] proposed a framework to describe the change commencement, assessment, and selection procedures of RCM.

Similarly, Lai and Ali [14] introduced a framework for requirements management to create and manage a requisites warehouse, produce a traceability matrix, and discuss information on requirements. Sinha et al. [18] proposed a tool to assist communication and coordination activities during RCM. Bhatti et al. [19] proposed a formal change management process model that consists of tasks of every stakeholder mentioned at each steps movement. Kumar and Kumar [7] proposed a model addressing the challenges arising from requirement management in distributed software development. They prepared the requirement management work by means of knowledge management. However, most previous studies have considered RCM in the context of collocated software development rather than GSD, which has yielded limited RCM efforts.

Despite the importance of RCM in the GSD environment, limited attention has been given to the development of RCM programs and the factors that can influence RCM practices in the GSD environment. Consequently, the value of RCM in a GSD context motivated us to develop software requirements change management and implementation maturity model (SRCMIMM) that can assist GSD organizations in modifying and improving their RCM activities. The findings of this study will contribute towards the development of only one component of proposed maturity model i.e. RCM challenges in the context of GSD. The understanding of these reported challenges will be helpful for practitioners to develop the new strategies in order to accomplish the RCM activities in GSD.

**RQ1:** What are the challenges as discussed in the literature for implementing RCM activities in GSD?

**RQ1.1:** Are the identified challenges related with the firm’s size?

**RQ1.2:** Are the challenges investigated in the literature related to client and vendor organizations?

**RQ2:** What are the challenges as identified in empirical study for implementing RCM activities in GSD?

**RQ2.1:** Are the challenges identified in the empirical study associated with the size of firms?

**RQ2.2:** Are the challenges investigated in the empirical study associated with the client and vendor organization?

**RQ3:** Does any differences exist between the challenges identified in literature and empirical study?

**RQ4:** What are the most critical challenges identified in SLR and empirical studies?

**RQ5:** How can be the identified challenges classified into a robust framework?

The rest of the paper is organized as: Section 2, explain the motivation for this paper. The employed research methodologies are discussed in section 3 and the results and discussion of this study will be discussed in section 4. The summary of the research questions is discussed in section 5 and in section 6 limitation of this study will be discussed. Study implication is specified in section 7 and future work of this research is discussed in section 8. Finally, the conclusion of this study will be summarized in section 9.

**II. MOTIVATION**

There have been several studies to understand RCM in GSD projects. For example, Nurmuliani et al. [20] conducted a case study in multi-sites environment and highlighted that the main reasons of the requirements changes are: “changes in customer needs, change in market demands, developers understanding of the products, and changes in the organizational policy”. Similarly, Lindquist [21] reported that 71% of the software projects were unsuccessful due to the improper management of RCM activities. Komi-Sirviö and Tihinen [22] conducted a survey study based on European software firms and reported that 40% of software projects were fail due to poor requirements management. A number of frameworks and models have been developed in order to improve the RCM process [23].

However, limited attention has been given to develop standards and models for RCM programs in GSD environment [7], [14], [24], [25]. For example, Ramzan and Ikrar [26] highlighted that less consideration has been given to develop the RCM standards and models for both client and vendor GSD organizations. It has been reported that eight out of ten organizations that have outsourced the software development activities to vendor organizations face various challenges due to improper planning.
of requirements change and unavailability of RCM models [27], [28].

The RCM challenges in the domain of client and vendor GSD organizations are distinct. The geographically distributed nature of GSD projects makes the RCM process more challenging as compared to collocated development [28]. Most of the existing research reported the significance of change management activities in the collocated environment and there is a need to discuss the RCM issues and implementation in the distributed development. The initiation of RCM program is more puzzling in both client and vendor GSD organizations [26]. In summary, few empirical research studies have been conducted that highlights the significance of the RCM process in GSD environment and particularly the challenges of change management face by the geographically distributed teams.

In this paper, we have conducted a tertiary study to identify the key challenges faced by the practitioners while adopting GSD paradigm. Minhas and Zulfiqar [6] reported the six factors that can negatively impact the RCM process in GSD. They also underline the importance of a robust framework for the successful implementation of RCM problem in GSD projects. Akbar et al. [29] conducted a literature review study to identify the RCM challenges in GSD context. They also analyzed the RCM challenging factors in the context of organization size and type. They mention that the challenges are vary with respect to the size and type of GSD organizations. In current study, we have identify the RCM challenging factors of GSD domain. Moreover, Verner et al. [30] and Niazi et al. [31] shed light that most of the existing literature focus on vendor rather than client GSD organizations. We have tried to fill this gap by categorizing the identified challenges in both client and vendor GSD organizations. The key purpose of the categorization is to indicate the significance of each challenge in the domain of client and vendor GSD organizations [11]. Moreover, Khan et al. [32] conducted an SLR study and reported the significant differences between the success factors of offshore vendor selection based on the organization size. They have found that the identified success factors are equally important for all types of organization sizes. Similarly, Khan et al. [10] have analyzed the critical factors of software process improvement program based on the organization size. They have classified the factors in the small, medium and large size organization categories. The same concept of organization types (client and vendor) and organizational size-based classification is followed in this study in order to fill the research gap in the domain of requirements change management.

III. RESEARCH METHODOLOGY
SLR and empirical study (questionnaire survey) were used in this study. The SLR is a form of secondary study in which primary studies (which investigate a particular research field) are examined to identify, evaluate, and investigate facts to be used in the questionnaire in a neutral and iterative manner [33], [34]. A questionnaire is used to gather responses from RCM and GSD experts. Both methodologies are briefly discussed in subsequent sections.

A. SYSTEMATIC LITERATURE REVIEW
A process of systematic literature review (SLR) [35] is a method of data collection. SLR is a well-defined and precise method to identify, evaluate and analyse published primary studies in order to investigate some particular study questions. SLR is different from ordinary surveys being properly planned and logically performed. All existing evidences on a particular study question in findings, evaluating and summarizing, an SLR present a greater level of validity through its findings. The protocol of systematic review was written to explain the review plan, and the said protocol is specifically illustrated in a technical report [36]. The main phases SLR methodology are: develop search terms SLRs are used to identify, classify, and assess the existing literature related to a specific research field using inclusion and exclusion methods [30], [35]. Kitchenham and Charters [35] described that there are three key phases in an SLR i.e. planning, conducting, and reporting the review (Table 1).

The researchers have been utilized the SLR process in different domains [10], [32], [34], [37]. To conduct the SLR study, all authors have participate in three key phases (i.e. planning, conducting and reporting the review) of the SLR. Inter-rater reliability analysis was conducted during the first and last selection phases of SLR to eliminate personal biasness. The results of the inter-rater reliability analysis were appeared in Section 3.2.2. We were followed all of the stages concerning with three phases of SLR, as shown in Table 1.

1) PLANNING THE REVIEW
We proposed research questions for this review related to our study objectives. So, we selected the suitable data warehouse, described the search strings, defined criteria for inclusion/exclusion articles, and also defined quality assessment criteria. We defined below all of these in more detail.

a: RESEARCH QUESTIONS
The present study focused on the challenges of RCM process implementation in GSD context. We have discussed the research questions in section 1.

b: DATA SEARCH PROCESS
In order to address proposed research questions of the study the potential primary studies are significant. Afzal et al. [38] suggested that appropriate search process is important for searching the related studies. They further highlighted that the appropriate searching mechanism helpful for the collection of related material which is effective to address the research questions of the study. In search process, selection of appropriated data sources and search mechanism is important. The search process is consists on Data sources and search string.

Data Sources: The automated literature research process refers to explore the digital libraries. In practice, several existing SLR studies of software engineering e.g [39] have
also used manual search process. However, by following the suggestion of Zhang et al. [39], in this study we apply both automated and manual search methods.

**Manual Search:** For applying the manual search process we followed the concepts of Quasi-Gold Standard (QGS) [40]. The QGS renders those primary studies that are perfectly related to the domain of the research questions. Initially, we reviewed the data available on Research Gate (https://www.researchgate.net/) for manually searching the related studies. We also reviewed paper of specials issues published in the journals and conferences related to our study domain. The studies were also searched with contact authors. In addition, we apply snowballing approach to select the primary studies by scanning the references of the primary studies selected in manual search and automated search.

**Search From Digital Libraries:** The second source of data collection adopted in this study is automated search. In automated search process an optimized search string is used to retrieve the most related literature [39]. Therefore, a total of seven digital repositories were selected based on our research experience and suggestions provided by Chen et al. [41]. The selected digital sources are as follows:

I. IEEE Xplore (http://ieeexplore.ieee.org)
II. ACM Digital Library (http://dl.acm.org)
III. “Springer Link (link.springer.com)
IV. Wiley Inter Science (www.wiley.com)
V. Science Direct (www.sciencedirect.com)
VI. Google Scholar (scholar.google.com)
VII. IET software

c: SEARCH STRINGS
For extracting the related literature from the selected digital libraries, we develop an appropriate search with respect to the proposed research questions of this study. Zhang et al. [39] by following the guidelines of the search strings were developed using the key search terms used in the research questions and their alternatives. The alternatives of the search terms were based on the existing research articles of RCM and GSD select with manual search process [1], [7], [42]–[44]. The main keywords and their alternatives were concatenated using the Boolean “OR” and “AND” operators to formulate the search strings. The search mechanisms of the selected digital sources are not same. Therefor the search string is formulated according to the requirement of a particular digital library.

d: INCLUSION CRITERIA (IC)
By following criteria used by other researcher [9], [32], [45], we have applied the following conditions for data inclusion: (i) articles should be in conference, journal or book chapter, (ii) articles should describe requirements change management and requirements engineering process in GSD domain, (iii) articles that describe the challenges, best practices and success factors of requirements change management process in GSD environment (iv) articles that describe the relationship between requirements change management project quality, minimize failure risk, and customer satisfaction (v) articles that describe motivation in adoption of software requirements change management process.

e: EXCLUSION CRITERIA
In order to exclude the irrelevant literature which is collected in data collection process we used the following data extraction criteria: To exclude the collected articles following criteria were used [9], [32], [45]: (i) Articles that are unrelated according to the research questions, (ii) Articles that do not describe software requirements change management process in detail, (iii) Articles that do not describe challenges, best practices or success factors of requirements change management process in the context of GSD, (iv) Articles were rejected that were not in English (v) redundant articles were not considered as well.

f: STUDY QUALITY ASSESSMENT
The quality assessment (QA) of the selected studies and data extraction were conducted simultaneously. A checklist was created to evaluate the quantitative and qualitative assessments of the selected primary studies.

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**TABLE 1.** SLR phases.

| Steps                | Stages                                      |
|---------------------|---------------------------------------------|
| Planning the review | “Research questions”                        |
|                     | “Data Sources”                              |
|                     | “Search strings”                            |
|                     | “Inclusion and exclusion criteria”           |
|                     | “Quality criteria for study selection”       |
| Conducting the review | “Primary study selection”                   |
|                     | “Data extraction”                           |
|                     | “Data synthesis”                            |
| Reporting the review | “Documenting the extracted results”          |

**TABLE 2.** Elements of used search string.

| Related topics                  | Used keywords and alternatives           |
|---------------------------------|-----------------------------------------|
| SS1 (Challenges)                | “barriers” OR “obstacles” OR “hurdles” OR “difficulties” OR “impediments” OR “hindrance” OR “challenges” |
| SS2 (Requirements management)   | “RCM” OR “requirements change management” OR “requirements engineering” OR “RE” OR “requirements management” OR “requirements changes” OR “requirements volatility” OR “requirements elicitation” OR “impact of requirement change management”, OR “effect of requirement change management” |
| SS3 (Global software development) | “global software development” OR “GSD” OR “distributed software development” OR “offshore software development” OR “outsourcing” OR “Multi-site software development” OR “global software teams” OR “collaborative software development” OR “collaborative software engineering” |
| SS4 (Practice)                  | “procedure” OR “form” OR “method” OR “perform” OR “exercise” |

Table 2 shows the element of the search string. A sample of the search string is provided below.

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TABLE 3. Study quality assessment criteria.

| QA Questions | Checklist Questions |
|--------------|---------------------|
| QA1          | “Do the adopted research method addresses the intended research questions?” |
| QA2          | “Does the study discuss any challenges of RCM?” |
| QA3          | “Does the study discuss RCM framework and its implementation in GSD?” |
| QA4          | “Is the collected data related to RCM in GSD?” |
| QA5          | “Are the results justify the research questions?” |

The format of the checklist is summarized in Table 3 and was created according to the instructions provided in [35]. The QA checklist contains five questions (QA1-QA5). For all questions, the assessment was made as follow: (i) if an article covering the full answer of the checklist questions then we assigned 1 score, for partial answer to the checklist questions we assigned 0.5 score and if the article not covering the questions provided in checklist then we assigned 0 score.

The purpose of quality assessment is to check the potential of selected primary studies towards the assessment of study research questions. Therefore, the score assessed for each primary study is given in Appendix-A.

2) CONDUCTING THE REVIEW

Collection and Selection of Primary Studies: The data was collected in four different phases. Tollgate approach proposed by Afzal et al. [38] was used to refine the total selected studies which are collected in all the phases (Figure 1, Table 4).

In first phase, we select primary studies through manual search by using Research-Gate. In second phase, we apply search string on the selected digital libraries. After selecting the total studies from both Research-Gate and through digital libraries we follow the guideline of Afzal et al. [38] and find the contacts of the selected primary study’s authors. In final phase we apply snowball primary studies. In snowball sampling, we apply both forward (the studies in which the paper is cite) and backward sampling (studies cited in the paper i.e. reference list of the paper). The tollgate approach was applied on all the studies collected in four phases. The final selected studies along with selection criteria are presented in Figure 1.

Initially, 2113 studies were collected from the selected digital repositories by applying the search strings (Section 2.1.3), inclusion criteria (Section 2.1.1.4), and exclusion criteria (Section 2.1.1.5). The tollgate approach [38] shortlisted 69 primary studies, which correspond to 3.27% of the total extracted studies, as shown in Figure 1. Finally, the quality of the selected studies were evaluated using the selected QA criteria (Section 2.1.1.6). A list of primary studies is given in Appendix-A. Every selected primary study was labeled as [LT] to indicate it as the SLR study.

To answers the research questions, we extracted the following data from each of the selected primary studies.

- Publication year (section 3.1.3.2)
- Used research methods (section 3.1.3.3)
- Organization size (section 4.1.2)
- Type of organizations (section 4.1.3)
- Study title (appendix A)

Through the tollgate approach, a list of RCM challenges related to the GSD was created using data obtained from the 69 selected primary studies. The research questions were addressed using the data obtained from the selected studies.

To provide answers to the aforementioned research questions, we extracted the following data from each selected primary study. Six studies were randomly selected by three autonomous external analysts in the first phase (Ph-1) of the tollgate process [38]. Then, the selection phases (Ph-2 through Ph-5) of the tollgate procedure and QA criteria were applied. A list of the 54 selected studies is presented in the Appendix-A.

Inter-rater reliability analyses were conducted to eliminate interpersonal bias. Three independent external reviewers randomly selected eight studies from the first phase (Ph-1) of the tollgate process [38], and then applied the selection phases (Ph-2 to Ph-5) of the tollgate procedure and QA criteria. We calculated the values of Kendall’s nonparametric coefficient of concordance (W) [38] to assess the inter-rater agreement among reviewers. The values of W ranged from 0 to 1, where W = 0 indicates complete disagreement and W = 1 indicates total agreement among reviewers. For 10 randomly selected studies, W = 0.80 (p = 0.003), which indicates significant agreement between the authors and external reviewers. Through the tollgate approach, a list of success factors in the SRCMP was created using data obtained from the 107 primary selected studies. The research...
questions were evaluated using the data obtained from the selected studies.

3) REPORTING THE REVIEW

a: QUALITY ASSURANCE OF PRIMARY SELECTED STUDIES
The QA score for each selected primary study was calculated based on the five QA questions (Section 3.1.1.6), which are provided in Appendix A. The cumulative score of each QA question was calculated and given in Appendix-A. The results shows that 88% of the selected primary studies scored $\geq 60\%$ against the QA questions which indicated that the selected primary studies are important enough to address the research questions of this study.

b: TEMPORAL DISTRIBUTION OF SELECTED STUDIES
To check the publication trend in the domain of RCM domain, we have extracted the publication years of the selected studies. The extracted publication years are categorized in tow sub-periods i.e. first sub-period (2004-2011), and second sub-period (2012-2019) (Figure 2). The frequency analysis shows that out of 69, 28 (40\%) and 41 (60\%) were published in first and second sub-periods, respectively. This shows that there is an increasing trend towards the publication of research articles in the domain of RCM and GSD.

c: RESEARCH METHODS USED IN SELECTED STUDIES
The final SLR articles consisted of 9 (13\%) questionnaire surveys (QS), 35\% case studies (CS), 24\% grounded theories (GT), 10\% content analyses (CA), 9\% action research (AR) studies, and 13\%) mixed methods (MM) studies, as shown in Figure 2. This indicated that the questionnaire survey and case study are most commonly used research approaches in requirements change management in the domain of GSD.

B. EMPIRICAL DATA COLLECTION

1) QUESTIONNAIRE DEVELOPMENT
We have developed an online survey questionnaire in order to validate the findings of the literature (section-3) and explore additional challenging factors of RCM. The survey method enables to collect data from large targeted population [33]. Moreover, survey method is capable to collect the data that is difficult using the observational research approaches [46]. The close and open-ended questions of RCM challenges were included in the questionnaire, in order to collect the data from the practitioners and the researchers. The survey questions were based on the 31 challenges investigated during the literature review. The five-point Likert scale was used with the following possible responses: “strongly agree, agree, neutral, disagree, and strongly disagree”. According to Finstad [46], it is important to consider the neutral response in the five-point Likert scale as it is possible that respondents might have neutral feelings about a specific statement or question. If there is not neutral option, then it is possible to force the survey respondent for biased decision (negative or positive) [33], [46].

2) PILOT TESTING
Piloting of the survey instrument was conducted in three different GSD organizations. The questionnaire was updated based on the feedback received during the pilot study. The final survey questionnaire consists of the respondents’ Demographic details and the challenges of RCM activities. It was make sure that the collected data was only used for the research purpose and do not share with the third party under any circumstances. The survey questionnaire sample is provided in Appendix B.
3) DATA SOURCES
The aim of this study was to investigate the challenges of requirements change management in the domain of GSD. It was critical to collect the data from the practitioners having expertise in requirements change and GSD. The data sampling was conducted using the snowball sampling technique [47]. Different methods were used to approach the population of this study, i.e., email, Facebook, LinkedIn, and Research-Gate. The online data was collected from November 2019 to February 2020. We have collected total 77 survey responses and was manually checked to identify the incomplete entries. The position of the survey participants included: software practitioners, academic researchers, and organizational management experts. The bibliographic analysis of the survey respondents is provided in appendix-C.

4) SURVEY DATA ANALYSIS
A frequency analysis method was employ to organize the descriptive data. The frequency tables were used to represent the frequencies and percentages of the data extracted from the selected primary studies. Frequency analysis is useful for the investigation of variable groups and for ordinal and numeric information [48]. To assess the importance of the investigated challenges, we checked the respondents’ agreement to each identified challenge. The frequency analysis method has been utilized by different researchers in a variety of domains [31], [49], [50].

IV. RESULTS AND ANALYSIS
The findings of the SLR and empirical study are briefly discussed in this section.

A. RESULTS FROM SLR
In this section the findings of the SLR are summarized.

1) CHALLENGES IDENTIFIED USING AN SLR
In the SLR approach, a total of 25 challenges were identified from the 69 selected primary studies. To address RQ1, the frequency and percentage of the identified challenges are summarized in Table 5 and Figure 3.

CH1 (RCM Strategic Inflexibility): was reported by 32% of selected studies. Anwer et al. [LT5] underlined that “the strategic is an integrated set of choices that uniquely positions the firm in its industry to create sustainable advantage

![FIGURE 3. Frequency analysis of identified challenges.](image-url)

| S.No. | Challenge factors | F  | %   |
|-------|-------------------|----|-----|
| CH1   | RCM strategic inflexibility | 22 | 32 |
| CH2   | RCM activities management issues at overseas sites | 16 | 23 |
| CH3   | Roles and responsibility issues at overseas site | 19 | 28 |
| CH4   | Lack of technical capability | 23 | 33 |
| CH5   | Language and cultural issues | 20 | 29 |
| CH6   | Incompatibility in technologies | 27 | 39 |
| CH7   | Communication and coordination gap | 37 | 54 |
| CH8   | Lack of formal implementation of RCM practices | 13 | 19 |
| CH9   | Lack of top management commitment | 35 | 51 |
| CH10  | Lack of interactions between client and overseas practitioners | 41 | 59 |
| CH11  | Lack of change impact measurement mechanism at overseas sites | 32 | 46 |
| CH12  | Budget constraints and hidden cost | 38 | 55 |
| CH13  | Time pressure | 27 | 39 |
| CH14  | Lack client organizational infrastructure awareness and visit | 23 | 33 |
| CH15  | Lack of trust between overseas practitioners | 18 | 26 |
| CH16  | Lack of good relationships in distributed team members | 21 | 30 |
| CH17  | Differences in offshore government and organizational policies | 16 | 23 |
| CH18  | Lack of risk analysis and management mechanisms | 23 | 33 |
| CH19  | Lack of RCM process awareness sessions | 19 | 28 |
| CH20  | Intellectual property/confidentiality and privacy issues at overseas sites | 21 | 30 |
| CH21  | Internal and external political factor | 22 | 32 |
| CH22  | Low visibility of work among distributed sites | 23 | 33 |
| CH23  | Lack of experts project management | 31 | 45 |
| CH24  | Opportunistic behavior of overseas practitioners | 33 | 48 |
| CH25  | Lack of standards and tools | 43 | 62 |

TABLE 5. List of identified challenges.
and superior value relative to the competition”. They also discussed how leaders sometimes approach strategy through ineffective viewpoints, such as equating strategy to vision or to a plan. Hoffmann et al. [LT17], argued that the change management strategies should be flexible in an organization.

**CH2 (RCM Activities Management Issues at Overseas Sites):** was underlined by 23% of the selected studies. The management of RCM activities at GSD sites are hard to manage, as there is physical distance between the development teams. Hanisch et al. [LT13] also highlighted that the base development site could quickly become overloaded with work, while remote development sites could remain nearly idle [LT31, LT42]. To some extent, the absence of personal contact can be replaced by formalization and discipline.

**CH3 (Roles and Responsibility Issues at Overseas Site, 28%):** was reported as a barrier for the effective execution of RCM activities in GSD environment. The assignment of proper roles and responsibilities of distributed sites and to each individual practitioner is important for the successful implementation of RCM activities in GSD sites. Khan et al. [LT44] also highlighted the importance of the assignment of roles and responsibilities as an issue for the change management activities in GSD context.

**CH4 (Lack of Technical Capability, 23%):** was reported as a challenge in the selected studies. Romero et al. [LT47] highlighted that most of the software organizations do not consider the change management as a major activity in software development life cycle. They further stated that the lack of change technical experts of RCM causing the miscalculation of the effect of demanded change, and that causes the time and cost overrun.

**CH5 (Language and Cultural Issues):** was indicated by the 29% of the selected studies as a challenge for the execution of change management activities in GSD context. Due to the language and cultural difference between the overseas practitioners the frequent communication become hard [LT1, LT4, LT33]. Though CH7 (communication and coordination gap 54%) was found to be the critical challenge for RCM implementation in GSD. Khan et al. [LT11] define these “3Cs” as the process of knowledge transmission among the geographically distributed team members and the mode of transfer they adopt to enhance this interaction. Effective communication channels are demanded to assist RCM process improvements. Communication refers to the sharing of information among development team to accomplish a goal [LT9]. Control refers to “the process of adhering to goals, policies, standards or quality levels” [LT9]. Control includes the basic structures needed for RCM implementation, namely, timelines, budgets, and software development of desired quality. Control and coordination are correlated with each other and both depend on communication [LT13]. However, 3Cs plays a significant role to manage the demanded requirements changes successfully, but due to the lack of attention to address the face hurdles it become a critical challenge, especially in GSD.

**CH9 (Lack of Top Management Commitment, 51%):** was observed as the fourth most commonly quoted challenge to RCM process execution in GSD. As described by Yaseen et al. [LT46] organizational support is “the extent to which the higher and lower level management in an organization support, finance, realize and participate in RCM program.” Wiredu [LT32] highlights that the dedication and cooperation of organizational administration is necessary for effectively executing RCM processes. Furthermore, he points out that GSD organizations can complete RCM programs only with appropriate support. Alsahli [LT39] indicates that lack of awareness among managerial staff leads to insufficient managerial support during the RCM process.

**CH10 (Lack of Interactions Between Client and Overseas Practitioners, 59%):** was reported as an important challenging factor for the successful implementation of RCM practices at overseas sites. The requirements collection and change management activate are required more communication and collaboration between the client and developers [LT13]. For the elicitation of potential and pure requirements the interaction and friendly environment between the practitioners is significant. The lack of client and practitioner’s interaction hinder to investigate the root cause of the demanded changes effectively and accurately [LT34]. Khan et al. [LT11] also highlighted the significance of client and practitioner’s interaction for the effective implementation of RCM in GSD.

**CH11 (Lack of Change Impact Measurement Mechanism at Overseas Sites):** was highlighted by 46% of the selected studies. The impact analysis is important to determine the effect of demanded change on time, cost and overall structure of the project. The lack of impact analysis causes the lack of effort, cost and time that ultimately lead the project mismanagement and to failure [LT34].

The results of the SLR show that **CH12 (Budget constraints and hidden cost, 55%):** was the second most commonly quoted challenge. It is hard to engage experts in RCM process improvement due to budgetary limitations. Although management of an organization may struggle to execute the RCM process advancement program effectively [LT54]. Hoffmann et al. [LT17] report that the execution of RCM programs maximizes the financial pressure on small firms as a result of budget constraints. Small firms may be unable to reserve a large budget for RCM activities, as they have to maintain low expenses to be competitive.

**CH25 (Lack Standards and Tools, 62%):** was found to be a significant challenge to RCM process implementation. Belias et al. [LT64] highlighted the need for a successful RCM execution process in GSD. The author suggests this methodology should include a complete improvement approach to requirements-management procedures with RCM activities, processes, and progress measures. Having worked in the GSD domain, most experts on RCM acknowledge that the lack of formal RCM execution strategies and procedures could hinder the fruitful implementation of RCM activities [LT16]. Fewer standards and models for RCM implementation have been produced for use in GSD compared to traditional
TABLE 6. Categorization of challenges based on the organization’s size.

| S.No. | SSO (N=9) | MSO (N=12) | LSO (N=17) | Chi-square Test (Linear-by-Linear Association) \( \alpha = 0.05 \) |
|-------|-----------|-----------|-----------|----------------|
|       | F %       | F %       | F %       | \( X^2 \) df | p     |
| CH1   | 0 - 5     | 42        | 9 - 53    | 5.676        | 1     | 0.017 |
| CH2   | 2 - 22    | 5 - 42    | 10 - 59   | 2.565        | 1     | 0.109 |
| CH3   | 5 - 56    | 4 - 33    | 7 - 41    | 0.622        | 1     | 0.430 |
| CH4   | 3 - 33    | 8 - 67    | 9 - 53    | 0.966        | 1     | 0.326 |
| CH5   | 5 - 56    | 5 - 42    | 5 - 29    | 1.049        | 1     | 0.306 |
| CH6   | 2 - 22    | 6 - 50    | 11 - 65   | 3.273        | 1     | 0.070 |
| CH7   | 3 - 33    | 7 - 58    | 11 - 65   | 1.455        | 1     | 0.228 |
| CH8   | 1 - 11    | 5 - 42    | 6 - 35    | 0.843        | 1     | 0.359 |
| CH9   | 7 - 78    | 9 - 75    | 11 - 65   | 0.358        | 1     | 0.550 |
| CH10  | 6 - 67    | 4 - 52    | 8 - 47    | 1.173        | 1     | 0.279 |
| CH11  | 2 - 22    | 5 - 42    | 9 - 53    | 1.679        | 1     | 0.195 |
| CH12  | 3 - 33    | 7 - 58    | 13 - 76   | 3.519        | 1     | 0.061 |
| CH13  | 4 - 44    | 7 - 58    | 9 - 53    | 0.324        | 1     | 0.569 |
| CH14  | 2 - 22    | 6 - 50    | 6 - 35    | 0.064        | 1     | 0.800 |
| CH15  | 0 - 9     | 7 - 55    | 12 - 71   | 6.033        | 1     | 0.014 |
| CH16  | 2 - 22    | 5 - 42    | 8 - 47    | 0.978        | 1     | 0.325 |
| CH17  | 6 - 67    | 4 - 33    | 7 - 41    | 1.688        | 1     | 0.194 |
| CH18  | 3 - 33    | 7 - 58    | 11 - 65   | 1.455        | 1     | 0.228 |
| CH19  | 2 - 22    | 8 - 67    | 10 - 59   | 1.688        | 1     | 0.194 |
| CH20  | 4 - 44    | 7 - 58    | 9 - 53    | 0.324        | 1     | 0.569 |
| CH21  | 0 - 5     | 4 - 52    | 5 - 29    | 1.426        | 1     | 0.232 |
| CH22  | 1 - 11    | 5 - 42    | 6 - 35    | 0.843        | 1     | 0.359 |
| CH23  | 2 - 22    | 7 - 58    | 9 - 53    | 1.173        | 1     | 0.279 |
| CH24  | 2 - 22    | 3 - 25    | 7 - 41    | 2.256        | 1     | 0.133 |
| CH25  | 3 - 33    | 6 - 50    | 8 - 47    | 0.128        | 1     | 0.720 |

SOs=small scale organizations, MSos= medium scale organizations, LSOs= large scale organizations.

Concerning the identified challenges except for CH1 (RCM strategic inflexibility, \( p = 0.017 \)) and CH15 (lack of trust between overseas practitioners, \( p = 0.014 \)).

Our results (Table 6) indicated that 22 out of the 25 identified challenges were reported to some extent in the category of SSOs. Five out of 22 reported challenges of SSOs category were quoted by \( \geq 50\% \) of the articles.

CH9 (Lack of Top Management Commitment, 78%): is the most significant challenge for RCM process implementation in the category of small organizations in the context of GSD. Okabo et al. [LT53] emphasized that the organization management should participated in RCM activities to perform accurately and effectively. According to Romero et al. [LT47], to implement the RCM activities, the organization management should be committed to provide the required resources at distributed sites. It is worth mentioning here that both challenges, CH10 (lack of interactions between client and overseas practitioners, 67%) and CH17 (differences in offshore government and organizational policies, 67%) were noted as the second highest cited challenges in the category of SSOs. This shows that small organizations face problem while conducting meeting with offshore clients and practitioner. In addition, across the border rules and policies of oversees development sites also hinder to conduct facto to face meetings. However, in the small organizations should consider these challenges more significantly to address the problems faced by RCM practitioners. All the challenges are important to address especially, that have \( \geq 50\% \) occurrence in the category of small organization.

For MSOs, we found that 13 out of the 25 challenges were reported in the SLR studies with a frequency of \( \geq 50\% \), as shown in Table 6. Our results reveal that CH9 (lack of top management commitment, 75%) and CH15 (lack of trust between overseas practitioners, 75%) are the highest-rated challenges for MSOs. Samuel [LT32] underlined that the cooperation between higher and lower level management in a firm is important in terms of financial support, providing access to confidential documents, and participation in the activities of the RCM program. Kandjani et al. [LT36] stresses that the commitment and contribution of organizational management are essential for successful implementation of RCM program in medium firms. Moreover, he indicated that RCM program could not be implemented successfully without proper support of organization management. Furthermore, Zowghi et al. [LT39] underlined the lack of trust among geographically distributed teams is a critical challenge for RCM program. CH4 (lack of technical capability, 67%) and CH19 (lack of RCM process awareness sessions, 67%) are ranked as the second most significant challenges in MSOs. All the remaining identified challenges with a frequency of \( \geq 50\% \) are the key areas to improve for the implementation of RCM activities for MSOs.

For LSOs, we found that 14 out of 25 identified challenges were cited in \( \geq 50\% \) of the selected SLR articles. The most significant challenge is CH12 (budget constraints and hidden cost, 76%), which has the highest percentage in the software development [LT16, LT32, LT33]. Furthermore, Martin et al. [LT52] stresses that in the context of GSD, due to the development of the software in different geographically distributed sites, changes occurring in requirements at a single site may affect the entire development. In this situation, after understanding the change in requirements, it is very important, as well as complicated, to assess the effect on the whole system and on the sub-system, which may be affected by the changes [LT69, LT55]. The effect of the changes can be measured when all the sites are part of the declared Gantt chart [LT35, LT55].

2) CATEGORIZATION OF THE IDENTIFIED CHALLENGES BASED ON ORGANIZATION SIZE

The sample size of our selected studies is 69. However, organization size was discussed in only 38 studies, as listed in Table 6. Therefore, by using the definition provided by the Australian Bureau of Statistics [38] regarding organization size, we divided these challenges into three categories based on organization size: “SMALL (i.e., 0–19 employees), MEDIUM (i.e., 20–200 employees), and LARGE (i.e., \( \geq 200 \) employees)”. As the nature of collected data is ordinal, therefore we have applied the chi-square test in order to determine the significant differences among the challenges for all types of organizations [14], [22], [24].
selected primary studies. Most of the organization consider the changes in requirements during development process as a hidden cost, they don’t consider the RCM activates as development phase, due to the lack of preplanned budget allocation procedure RCM practitioners phase problems [LT17]. CH15 (lack of trust between overseas practitioners, 71%) is ranked as second most significant challenge in the large GSD organizations. Yaseen et al. [LT26] indicated that due to the lack of communication and coordination causing the lack of trust among overseas practitioners. Kandjani et al. [LT36] suggested that the GSD organization should improve their communication and coordination infrastructure and create friendly environment among the practitioners. The challenges with a frequency of ≥50% are the important areas that create hurdles for the effective and efficient implementation of RCM programs in the GSD environment.

3) CLIENT-VENDOR CATEGORIZATION OF SLR CHALLENGES
We observed client–vendor relationships for the identified challenges by reviewing all of the selected primary studies. A total of 34 selected articles were conducted in the domain of client countries and 35 for vendor, as shown in Figure 4. We have used the chi-square analysis technique in order to investigate the significant differences for the identified challenges between the client and vendor organizations (Table 7).

The results illustrate that the “client and vendor” firms have more similarities in the applicability of the investigated challenges.

As indicated in Table 7, CH4 (lack of technical capability, 53% and 51%), CH5 (language and cultural issues, 44% and 41%), CH10 (lack of interactions between client and overseas practitioners, 62% and 57%), CH9 (lack of top management commitment, 62% and 69%), CH12 (Budget constraints and hidden cost, 79% and 71%), CH13 (Time pressure, 50% and 46%) and CH6 (lack of good relationships in distributed team members, 62% and 69%) respectively, are the most common challenges in both the vendor and client firms.

CH12 (Budget Constraints and Hidden Cost): is the most significant challenge for both “client and vendor” organizations. This is because RCM is rich communication dependent activity and confidential documents are needed during the requirement collection phase; hence, the support of organizational management as well as the operator is particularly important. Campbell et al. [LT18] conducted a case study, which highlighted that for the successful implementation of an RCM process, it is essential for upper management to finance, support, and participate in RCM process. Aranda [LT29] emphasized that mostly high-level management are unaware about the importance of demanded changes, with causes the trouble in providing the required resources.

B. RESULTS OF THE EMPirical STUDY
The results of empirical investigation are presented in this section.

1) SURVEY RESPONDENT’S DEMOGRAPHIC DATA ANALYSIS
We are interested in analyzing the demographic data of survey participants. By considering the definition of Fay et al. [48], “the demographic data provides information about survey respondents and is essential for the determination of whether the participants in a particular study are a representative sample of the target population for results generalization purposes or not. Furthermore, Finstad et al. [46] highlighted that the demographic data of respondents indicated the maturity level and seriousness of survey participants. According to Altman et al. [51], the respondents’ demographic data enabled us to know “what your target population is and what they are thinking about.” In this study, we mainly concerned about analyzing respondents’ designation, work experience, and organization size.

a: RESPONDENT’S DESIGNATION
According to Finstad et al. [46], the perception and ranking of success factors varied with respect to the positions of the respondents. Niazi et al. [31] indicated that the significant level of a factor could only be ranked perfectly if the respondents deal with it frequently in their work practices. The analysis of respondents’ designations indicated that the vast number of survey participants were requirements engineers. Moreover, we observed that the most common respondents’ positions are project manager, software developer, researcher/education. The detail of the respondent position is indicated in Figure 5.

| S.No. | Client (N=34) | Vendor (N=35) | “Chi-square Test (Linear-by-Linear Association) α = 0.05” |
|-------|---------------|---------------|--------------------------------------------------------|
| CH1   | 16 47        | 18 51        | 0.130 1 0.719                                         |
| CH2   | 18 53        | 21 60        | 0.011 1 0.917                                         |
| CH3   | 20 59        | 15 43        | 1.733 1 0.188                                         |
| CH4   | 18 53        | 18 51        | 0.016 1 0.901                                         |
| CH5   | 15 44        | 14 40        | 0.118 1 0.731                                         |
| CH6   | 21 62        | 24 69        | 0.008 1 0.930                                         |
| CH7   | 23 68        | 19 54        | 1.274 1 0.259                                         |
| CH8   | 17 50        | 21 60        | 0.687 1 0.407                                         |
| CH9   | 21 62        | 24 69        | 0.347 1 0.556                                         |
| CH10  | 21 62        | 20 57        | 0.151 1 0.698                                         |
| CH11  | 20 59        | 17 49        | 0.136 1 0.713                                         |
| CH12  | 27 79        | 25 71        | 1.739 1 0.187                                         |
| CH13  | 17 50        | 16 46        | 0.121 1 0.728                                         |
| CH14  | 18 53        | 16 46        | 2.478 1 0.115                                         |
| CH15  | 24 71        | 19 54        | 3.417 1 0.065                                         |
| CH16  | 18 53        | 16 46        | 0.355 1 0.551                                         |
| CH17  | 20 59        | 17 49        | 0.718 1 0.392                                         |
| CH18  | 19 56        | 16 46        | 0.130 1 0.719                                         |
| CH19  | 15 44        | 21 60        | 1.718 1 0.190                                         |
| CH20  | 17 50        | 22 63        | 1.143 1 0.285                                         |
| CH21  | 13 38        | 9 26         | 1.227 1 0.268                                         |
| CH22  | 12 35        | 11 31        | 0.114 1 0.735                                         |
| CH23  | 16 47        | 22 63        | 1.714 1 0.190                                         |
| CH24  | 13 38        | 20 57        | 2.435 1 0.119                                         |
| CH25  | 24 71        | 19 54        | 0.160 1 0.689                                         |
We also intended to analyze the experience levels of survey participants. The calculated mean and median (6.5 and 5.0 respectively), indicated the young pool of survey respondents. But we observed a good combination of survey respondents having different experience levels related to software development activities. The detail of the respondent’s experiences levels is indicated in Figure 6.

c: ORGANIZATION SIZE
To observe the size of the respondents’ organizations, we added a query in the survey questionnaire having scale (small, medium and large) where “SMALL (i.e., 0–19 employees), MEDIUM (i.e., 20–200 employees), and LARGE (i.e., ≥200 employees)” [52]. According to Khan et al. [32], the organization size is also significant to check the awareness and maturity level of practitioners. Through survey data analyses, we observed that out of a total of 77 respondents, 17 belong to small, 33 belong to medium, and 37 participants were belongs to large organizations. The frequency analysis of respondents’ organization size is presented in Figure 7.

2) CHALLENGES INVESTIGATED IN THE EMPIRICAL STUDY
We created a link to an online questionnaire survey of RCM professionals regarding challenges investigated in the SLR. The category results are shown in Table 8.

The table columns are categorized into three types of responses: “Positive” (“strongly agree and agree”), “Negative” (“strongly disagree and disagree”), and “Neutral.” The “positive category” shows the proportion of the participants who agreed with the investigated challenging factors in...
TABLE 8. Challenges investigated from the empirical study.

| S.No. | Positive (N=77) | Negative (N=77) | Neutral (N=77) |
|-------|----------------|----------------|---------------|
|       | SA | A % | SD | D % | N | % |
| CH1   | 26 | 36 | 81 | 5  | 7 | 15 | 3  | 4  |
| CH2   | 21 | 31 | 68 | 6  | 8 | 18 | 11 | 14 |
| CH3   | 17 | 37 | 70 | 4  | 9 | 17 | 10 | 13 |
| CH4   | 19 | 39 | 76 | 5  | 6 | 14 | 8  | 10 |
| CH5   | 21 | 35 | 73 | 4  | 7 | 14 | 10 | 13 |
| CH6   | 20 | 29 | 61 | 5  | 9 | 18 | 16 | 21 |
| CH7   | 28 | 44 | 94 | 1  | 2 | 4  | 2  | 2  |
| CH8   | 18 | 34 | 68 | 5  | 12 | 22 | 8  | 10 |
| CH9   | 31 | 40 | 92 | 1  | 4 | 7  | 1  | 1  |
| CH10  | 28 | 38 | 87 | 2  | 5 | 9  | 3  | 4  |
| CH11  | 33 | 38 | 92 | 2  | 4 | 8  | 0  | 0  |
| CH12  | 25 | 36 | 80 | 4  | 6 | 12 | 6  | 8  |
| CH13  | 21 | 41 | 81 | 3  | 7 | 13 | 5  | 6  |
| CH14  | 24 | 29 | 65 | 6  | 8 | 18 | 13 | 17 |
| CH15  | 21 | 28 | 63 | 7  | 9 | 21 | 12 | 16 |
| CH16  | 17 | 32 | 63 | 5  | 7 | 16 | 16 | 21 |
| CH17  | 21 | 39 | 78 | 3  | 9 | 16 | 5  | 6  |
| CH18  | 22 | 30 | 67 | 3  | 6 | 12 | 16 | 21 |
| CH19  | 24 | 31 | 71 | 4  | 7 | 14 | 11 | 15 |
| CH20  | 24 | 36 | 78 | 5  | 3 | 10 | 9  | 12 |
| CH21  | 22 | 35 | 74 | 5  | 7 | 16 | 8  | 10 |
| CH22  | 22 | 28 | 65 | 4  | 6 | 13 | 17 | 22 |
| CH23  | 27 | 43 | 91 | 2  | 3 | 6  | 2  | 3  |
| CH24  | 25 | 29 | 70 | 6  | 9 | 20 | 8  | 10 |
| CH25  | 31 | 38 | 90 | 1  | 4 | 6  | 3  | 4  |

S.NO= Serial Number, %-%Percentage, SA= Strongly Agree, A= Agree, SD=Strongly Disagree, D=Disagree, N=Neutral

The results indicated that most of the survey participants agreed that the investigated challenges negatively affect RCM process execution in GSD context; all of the challenges exhibit a “positive” response of more than 63% as shown in Table 8.

CH7 (Communication and Coordination Gap, 94%): was considered by the survey participants to be the major challenge to successful execution of RCM process activities in GSD [LT13, LT19, LT29]. Hussain et al. [LT10] conducted a case study in the context of GSD to investigate the challenges of RCM process in a particular firm. They indicated that lack of synchronizing work across different sites was a significant challenge to the successful implementation of the RCM process in the context of GSD. According to Lopes et al. [LT10] the decisions of one site may reflect the activities of other involved sites. Hence, without work synchronization across the distributed sites, in-time and effective decisions cannot be possible [LT13]. Our results show that CH9 (lack of top management commitment, 92%) and CH11 (lack of change impact measurement mechanism at overseas sites, 92%) were the second most significant challenges according to the survey respondents.

Doval [LT8], underlined that CH9 (lack of formal implementation of RCM practices) is a significant challenge for proper implementation of RCM activities in GSD. Hanisch et al. [LT13] suggested that for effectively manage the demanded changes it is prerequisites of the organization to employ a proper RCM framework, which is helpful to manage all the activities related to implement the demanded changes in a systematic way. However, the unavailability of appropriate framework is a significant challenge especially for GSD organizations [LT18, LT31]. Umair et al. [LT18] stated that CH11 (Lack of implementation of tools and standards at GSD sites) was the most significant challenge to the successful implementation of the RCM process. The identification, validation and implementation are the key and complex activities in the RCM process, which is much more problematic without the implementation of tools and standards.

In the “Negative” category, CH8 (lack of formal implementation of RCM practices, 22%) was deemed to be the least significant challenge. Hence, according 22% to the survey respondents CH8 (Lack of formal implementation of RCM practices) did not consider to be a challenging factor to RCM implementation in GSD. The second least significant challenge was found to be CH15 (lack of trust between overseas practitioners, 21%). This may be attributed to advancements in information and communication technologies, which have mitigated the effects of time differences between distributed GSD teams. The third least significant barrier was found to be CH24 (opportunistic behavior of overseas practitioners, 20%). This indicated that, generally, distributed team members have sufficient understanding of various cultural norms and values.

CH22 (Low Visibility of Work Among Distributed Sites, 22%): was the most significant response in the “Neutral” category. CH6 (incompatibility in technologies, 21%), CH18 (lack of risk analysis and management mechanisms, 21%) and CH20 (intellectual property /confidentiality and privacy issues at overseas sites, 21%) were the second most significant responses in the Neutral category. This indicated that the significant portion of the respondents are unsure about these above stated challenges related to RCM process implementation in their firms.
3) ORGANIZATIONS SIZE BASE CLASSIFICATION OF CHALLENGES INVESTIGATED IN THE EMPIRICAL STUDY

The empirical results indicated that from total 77 survey participants, 17 from small scale organizations (SSOs), 33 from medium scale organization (MSOs) and 27 are belong to large scale organization (LSOs).

The analyses of the survey responses show that SSOs, MSOs, and LSOs have more similarities than differences with regards to the identified challenges except for CH2 (RCM activities management issues at overseas sites, p=. 044) and CH7 (communication and coordination gap, p=. 021). In addition, all respondents either strongly agreed or agreed with the findings of the SLR.

The highest scored challenges for SSOs are: CH25 (Lack standards and tools'', 82%), CH5 (language and cultural issues, 79%), CH9 (lack of top management commitment, 71%), CH10 (lack of interactions between client and overseas practitioners, 71%). CH25 (lack standards and tools) is the most significant challenge for SSOs. This shows that small organizations are faced problem of unavailability of skilled human resources. This may be due to the size of the organization, which plays a key role in the attraction and retention of skilled human resources. This represents a major problem for small organizations because skilled and experienced staff are typically attracted to large organizations due to the higher salaries and career prospects they offer.

CH5 (language and cultural issues) is reported as the second most significant challenge to the implementation of RCM process activities in the GSD context. This may be attributed due to geographical distance and other challenges such as language barriers or time zone differences. CH9 (lack of top management commitment) and CH10 (lack of interactions between client and overseas practitioners) are ranked as the third most significant challenges to RCM process implementation in the GSD environment. The RCM process is a detailed activity that has a direct impact on budget and time period. It is suggested that, due to budget constraints for SSOs, it is difficult to implement the RCM process activities effectively.

According to the survey respondents the most significant challenges for MSOs are:

CH25 (lack standards and tools, 73%), CH4 (lack of technical capability, 79%), CH15 (lack of trust between overseas practitioners, 73%), CH23 (lack of experts project management, 73%).

In a GSD environment “3Cs” is a significant challenge and it is directly related to the implementation of the demanded requirements changes. Communication refers to the exchange of information among the team member of different sites working on the same task, and control refers to the process of adhering to goals, policies, standards, or quality levels. These activities are difficult due to geographical distances among the involved sites. Lack of RCM knowledge is the second highest challenge in MSOs and this may be due to lack of training and coordination among team members.

The awareness of the scope of required changes is essential to assess the effect of such changes on the entire project. This is the most significant challenge among MSOs in the context of GSD due to the involvement of various sites in a geographically distributed development environment. However, the determination of the scope of changes is the basic attribute used to calculate the required time period and budget needed to implement the necessary changes.

In LSOs, a number of development sites are involved while adopting GSD. So, the adoption of tools and standards are vital for the implementation of demanded changes in a standardized way. As previously discussed, in MSOs CH25 (lack standards and tools) is a significant challenge to the implementation of RCM process in GSD environments. To implement the RCM process, organizational support plays an important role in obtaining confidential documents, the release of funds, cooperation to conduct meetings. Moreover, according to the RCM practitioners CH1 (RCM strategic inflexibility) is also a big challenge towards the implementation of RCM process activities in geographically distributed development environment.

On average, we have found CH9 (lack of top management commitment) and CH25 (lack standards and tools) to be the most significant challenges for all size organizations (i.e. SSOs, MSOs, or LSOs).

In addition, all the investigated challenges of SLR were mapped into the categories of three different size organizations (SSOs, MSOs and LSOs), validated from the results of empirical study as shown in Table 9. The categorization is based on the frequency of the identified challenges. For example, CH1 (RCM strategic inflexibility) has been considered by 41% of SSOs, 70% MSOs and 74% LSOs. As this challenge has a high frequency in LSOs, therefore it is classified in the LSOs category (Figure 8). We calculated the percentages for all challenges and conceptually mapped them.
TABLE 9. Distribution of challenges based on organization size in the empirical study.

| S.No. | Small Scale Organizations (N=17) | Medium Scale Organization (N=33) | Large Scale Organization (N=27) |
|-------|---------------------------------|---------------------------------|---------------------------------|
|       | Positive | Negative | Neutral | Positive | Negative | Neutral | Positive | Negative | Neutral | \( \chi^2 \) | df | P |
| 1     | SA A     | SD D     | N       | SA A     | SD D     | N       | SA A     | SD D     | N       | .806      | 1  | .369 |
| 2     | CH2      | 2 6 0 6 3 | 6 17 1 3 6 | 4 14 2 4 3 | 7 13 0 3 4 | .404 | 1 | .644 |
| 3     | CH3      | 4 7 0 3 2 | 4 11 4 7 3 | 5 10 2 5 3 | 5 10 2 5 3 | 5.825 | 1 | .05 |
| 4     | CH4      | 1 3 2 7 5 | 7 19 0 2 5 | 4 10 2 4 7 | 5.280 | 1 | .230 |
| 5     | CH5      | 5 8 0 1 3 | 3 12 3 8 7 | 6 9 2 5 5 | 5 10 2 4 6 | 1.665 | 1 | .280 |
| 6     | CH6      | 1 7 2 1 6 | 8 14 0 6 5 | 6 13 0 2 5 | 2.052 | 1 | .152 |
| 7     | CH7      | 0 4 2 5 6 | 6 13 2 5 7 | 4 14 1 3 5 | 6.397 | 1 | .021 |
| 8     | CH8      | 1 5 2 3 8 | 5 14 2 2 10 | 10 5 9 2 5 8 | .007 | 1 | .931 |
| 9     | CH9      | 4 8 0 2 3 | 5 13 2 3 10 | 10 4 13 0 3 7 | .123 | 1 | .726 |
| 10    | CH10     | 3 9 1 3 1 | 4 12 0 6 11 | 5 10 2 4 6 | .066 | 1 | .797 |
| 11    | CH11     | 3 2 2 5 5 | 6 13 1 6 7 | 6 15 0 3 3 | 2.576 | 1 | .108 |
| 12    | CH12     | 0 5 1 3 8 | 3 17 0 6 6 | 5 17 0 4 3 | .022 | 1 | .881 |
| 13    | CH13     | 2 6 2 4 3 | 4 16 1 4 8 | 2 13 1 5 6 | .356 | 1 | .551 |
| 14    | CH14     | 0 4 1 4 8 | 7 14 2 5 5 | 4 11 2 3 7 | 1.927 | 1 | .165 |
| 15    | CH15     | 1 5 2 4 5 | 5 19 0 3 6 | 6 11 0 3 8 | .006 | 1 | .938 |
| 16    | CH16     | 0 6 0 3 8 | 2 15 2 6 8 | 6 11 1 3 6 | .222 | 1 | .637 |
| 17    | CH17     | 2 10 2 0 3 | 3 16 2 5 7 | 4 12 2 3 6 | .157 | 1 | .692 |
| 18    | CH18     | 3 6 1 3 4 | 9 11 3 5 5 | 4 14 1 4 4 | .229 | 1 | .633 |
| 19    | CH19     | 1 6 2 3 5 | 6 16 0 6 5 | 5 14 1 1 8 | 2.691 | 1 | .101 |
| 20    | CH20     | 2 4 1 3 7 | 7 12 4 2 8 | 6 8 4 2 7 | .160 | 1 | .689 |
| 21    | CH21     | 3 2 2 4 6 | 8 14 2 3 5 | 5 12 4 2 6 | .276 | 1 | .603 |
| 22    | CH22     | 0 4 2 2 7 | 7 11 0 6 9 | 5 8 3 2 6 | .265 | 1 | .607 |
| 23    | CH23     | 4 6 3 1 3 | 6 18 2 2 5 | 5 14 2 5 3 | .037 | 1 | .848 |
| 24    | CH24     | 3 3 2 4 5 | 11 9 5 2 6 | 6 11 3 2 4 | 1.718 | 1 | .278 |
| 25    | CH25     | 5 9 1 0 2 | 7 17 4 2 5 | 7 14 1 2 3 | .976 | 1 | .323 |

to SSOs, MSOs and LSOs categories, as indicated in Figure 8. The mapping results show that the majority of the challenges are considered in the LSOs category than to MSOs and SSOs (Figure 9). It is important for the GSD firms to effectively address all the challenges they face with respect to their organization size. The same mapping approach has been used by other researchers [53].

4) CATEGORIZATION OF CLIENT-VENDOR FIRMS CHALLENGES INVESTIGATED IN THE EMPIRICAL STUDY

During the survey, the participants were requested through the questionnaire to mark and explain the nature (“client or vendor”) of their organization in GSD context. The findings pointed out that most specialists were from underdeveloped country (such as China, India, Pakistan and Malaysia; Figure 9), so results highlighted the fact that underdeveloped countries (Asia) is a hub for GSD outsourcing.

The results presented in Table 10 demonstrated that the “client and vendor” firms have more similarities with regards to the identified challenges, with the exception of CH10 (lack of interactions between client and overseas practitioners, \( p=0.020 \)). Furthermore, the “client and vendor” firms’ practitioners either strongly agreed or agreed with the investigation of the SLR.

Moreover, vendor firms (79%) than client firms (76%) were aware of the significance of CH23 (lack of experts project management) for the proper deployment of RCM activities in GSD. CH25 (lack standards and tools) was ranked by vendor firms (71%) and client firms (69%) as the second most significant challenge. However, others more significant challenges are CH12 (budget constraints and hidden cost, 69% vendor and 72% client), CH18 (lack of risk analysis and management mechanisms, 69% vendor and 66% client), CH20 (69% vendor and 66% client).

RCM is considered as the most communication and collaboration oriented software development activity [LT11, LT17], which directly reflects due to CH24 (opportunistic behavior of overseas practitioners). Hence, our results indicated that CH24 (opportunistic behavior of overseas practitioners, client 62%, vendor 73%) is more significant for vendor firms. This may be due to the un-availability of an advanced communication infrastructure as vendor firms are usually located in developing countries. The response to CH10 (lack of interactions between client and overseas practitioners, client 69%, vendor 77%) demonstrated that vendor organizations often have greater budget constraints.

In the survey, the participants were requested to rank the organization types (“client or vendor”) of their firm in relation to GSD. The results indicate that the majority of the real-world practitioners belonged to Asian countries (such as Pakistan, India, and China; Figure 10). This indicated that Asia is a center for GSD outsourcing.

We have further followed the model introduced by Khan et al. [53] and Akbar et al. [43] for the GSD organization in order to classify the identified challenges in the domain of both client and vendor organizations. These reference models help us explore the challenges that need to be overcome to enable GSD organizations to achieve the
TABLE 10. Comparison of “Client-Vendor” challenges investigated in the empirical study.

| S.No. | Client (N=29) | Vendor (N=48) | “Chi-square Test (Linear-by-Linear Association) χ² = 0.05" |
|-------|--------------|--------------|----------------------------------------------------------|
|       | Positive | Neutral | Negative | Positive | Neutral | Negative | Neutral | χ² | df | P |
| SA | A % | SD | D % | N % | SA | A % | SD | D % | N % | SA | A % | SD | D % | N % |
| CH1 | 5 | 11 | 55 | 2 | 5 | 24 | 6 | 21 | 11 | 20 | 65 | 3 | 7 | 21 | 9 | 19 | .473 | 1 | .491 |
| CH2 | 4 | 14 | 62 | 0 | 6 | 21 | 5 | 17 | 6 | 27 | 69 | 1 | 7 | 17 | 7 | 15 | .105 | 1 | .746 |
| CH3 | 7 | 13 | 69 | 2 | 5 | 24 | 2 | 7 | 4 | 21 | 52 | 4 | 6 | 21 | 13 | 27 | 1.320 | 1 | .251 |
| CH4 | 5 | 14 | 66 | 0 | 3 | 10 | 5 | 17 | 7 | 17 | 50 | 3 | 9 | 25 | 12 | 25 | 1.236 | 1 | .266 |
| CH5 | 8 | 12 | 69 | 1 | 4 | 17 | 4 | 14 | 3 | 24 | 56 | 0 | 10 | 21 | 11 | 23 | 2.139 | 1 | .144 |
| CH6 | 3 | 14 | 59 | 2 | 5 | 24 | 5 | 17 | 11 | 21 | 67 | 4 | 6 | 21 | 6 | 13 | .660 | 1 | .416 |
| CH7 | 7 | 12 | 66 | 0 | 2 | 7 | 6 | 21 | 8 | 20 | 58 | 3 | 7 | 21 | 9 | 19 | 1.211 | 1 | .271 |
| CH8 | 3 | 10 | 45 | 3 | 5 | 28 | 8 | 28 | 11 | 19 | 63 | 3 | 6 | 19 | 9 | 19 | 2.795 | 1 | .095 |
| CH9 | 6 | 12 | 62 | 1 | 6 | 24 | 5 | 17 | 8 | 24 | 67 | 4 | 9 | 27 | 3 | 6 | .067 | 1 | .795 |
| CH10 | 3 | 16 | 69 | 2 | 4 | 21 | 3 | 10 | 14 | 23 | 77 | 0 | 8 | 17 | 12 | 25 | 5.369 | 1 | .020 |
| CH11 | 7 | 15 | 76 | 1 | 3 | 14 | 3 | 10 | 12 | 21 | 69 | 3 | 5 | 17 | 7 | 15 | .297 | 1 | .586 |
| CH12 | 9 | 12 | 72 | 0 | 3 | 10 | 2 | 7 | 14 | 19 | 69 | 2 | 4 | 13 | 9 | 19 | .002 | 1 | .966 |
| CH13 | 6 | 15 | 72 | 1 | 3 | 14 | 4 | 14 | 7 | 19 | 54 | 3 | 7 | 21 | 12 | 25 | 1.803 | 1 | .179 |
| CH14 | 5 | 12 | 59 | 2 | 4 | 21 | 6 | 21 | 10 | 23 | 69 | 0 | 4 | 8 | 13 | 27 | .652 | 1 | .419 |
| CH15 | 8 | 12 | 69 | 0 | 3 | 10 | 3 | 10 | 5 | 23 | 58 | 4 | 5 | 19 | 11 | 23 | .424 | 1 | .515 |
| CH16 | 7 | 13 | 69 | 1 | 3 | 14 | 5 | 17 | 9 | 16 | 52 | 5 | 9 | 29 | 10 | 21 | 2.021 | 1 | .155 |
| CH17 | 8 | 14 | 76 | 2 | 2 | 14 | 3 | 10 | 11 | 18 | 60 | 3 | 5 | 17 | 11 | 23 | .696 | 1 | .404 |
| CH18 | 4 | 15 | 66 | 1 | 3 | 14 | 6 | 21 | 8 | 25 | 69 | 2 | 4 | 13 | 9 | 19 | .011 | 1 | .917 |
| CH19 | 6 | 11 | 59 | 0 | 6 | 21 | 6 | 21 | 13 | 18 | 65 | 5 | 7 | 25 | 5 | 10 | .139 | 1 | .710 |
| CH20 | 6 | 13 | 66 | 2 | 3 | 17 | 5 | 17 | 8 | 25 | 69 | 0 | 6 | 13 | 9 | 19 | .033 | 1 | .855 |
| CH21 | 9 | 11 | 69 | 1 | 3 | 14 | 4 | 14 | 11 | 17 | 58 | 5 | 3 | 17 | 12 | 25 | .925 | 1 | .326 |
| CH22 | 6 | 14 | 69 | 3 | 2 | 17 | 4 | 14 | 11 | 14 | 73 | 0 | 3 | 6 | 10 | 21 | .703 | 1 | .402 |
| CH23 | 11 | 11 | 76 | 0 | 4 | 14 | 4 | 14 | 15 | 23 | 79 | 4 | 2 | 13 | 5 | 10 | .017 | 1 | .897 |
| CH24 | 5 | 13 | 62 | 3 | 3 | 21 | 9 | 31 | 16 | 19 | 73 | 6 | 7 | 27 | 8 | 17 | .028 | 1 | .866 |
| CH25 | 9 | 11 | 69 | 2 | 5 | 24 | 2 | 7 | 14 | 20 | 71 | 0 | 8 | 17 | 6 | 13 | .201 | 1 | .654 |

FIGURE 9. Categorization of client and vendor firms from the empirical study by country.

Successful implementation of RCM processes. However, all the identified challenges in the SLR were classified based on the significance to client-vendor firms, validated from the results of empirical study as shown in Table 10.

We calculated the frequency of occurrence (Table 10) for all identified challenges and divided them into “client” and “vendor” categories, as shown in Figure 10. For example, 55% of client firms considered CH1 (RCM strategic inflexibility) as a significant challenge for RCM process in GSD. However, the challenge CH1 was stated in 65% of vendor firms. Thus, CH1 was considered in the vendor firm’s category. Similarly, we have classified all the other challenges in both client and vendor categories (Figure 10). The mapping results demonstrate that most of the challenges are more significant for vendor firms than to clients. It is important for the vendor firms to successfully address all the challenges.
they face. Similarly, we classified 12 challenges in the vendor firm’s category. Assessing the specific challenges identified for the client organization advances our understanding of these issues.

C. COMPARISON OF SLR AND EMPIRICAL STUDY RESULTS

The aim of this comparative analysis is to check the similarities and differences between the findings of both studies (SLR and questionnaire survey study). The investigated success factors through SLR study were marked against the findings of the survey study [31], [49], [53]. The frequency was calculated for each identified success factor in SLR. Similar frequencies were also calculated based on the Likert scale (strongly agree, agree, strongly disagree, disagree, neutral) for the success factors identified through survey respondents. As the frequencies calculated through SLR study as well as through the survey study were cumulative, and subjective, respectively. Though a common measurement was required to scale these frequencies with respect to each other to investigate the correlation [31], [49], [53], as shown in Table 11 and Figure 11.

Various methods and techniques are available, but the Spearman correlation coefficient method provides us with a tidy and concise way to measure the similarities between the two datasets [53]. It provides linear dependence among two variables with the value, ranging from $-1$ to $+1$, where 1 represents a total dependency [31].

The “Spearman’s correlation coefficient” was found to be ($r_s=0.553$), which shows a moderate positive correlation among the rankings obtained from both data sets (i.e. “SLR and empirical”). The significance value, $p = 0.004$, indicated that the correlation between both data sets is statistically significant. The results are presented in Table 12 and a scatter plot is shown in Figure 12. Furthermore, “Spearman’s correlation analysis”, we applied “independent t-tests” to assess the mean difference between both data sets (Tables 13 and 14).

We ascertained the significant differences by applying Levene’s test for the challenge rankings between the both data sets. The $t$-test results of $t = 1.065$ and $p = 0.759 < 0.1$, as presented in Table 14, indicate that there is a difference between the rankings of the challenges in both data sets. For example, CH1 (differences in IT infrastructure) is ranked 16th in “SLR” and 7th in the “empirical study”. Therefore, CH1 is considered by practitioners as more significant than as discussed in the literature. Similarly, the rankings order of CH2 and CH25 is vary significantly between both data sets (i.e. “SLR and empirical”).

D. CRITICAL CHALLENGES

According to Niazi et al. [54] and Khan et al. [10], critical factors are presenting the key business areas where organi-
zation must need to focus. In this paper, we have adopted the criteria of factors having frequency ≥50% as a critical factor and similar criteria have been previously used by other researchers in different other domains [10], [49], [53].

In the current study, the criteria was utilized to ascertain the critical challenges to RCM implementation in GSD, in spite of differences between “SLR” and “empirical study”. These critical challenges were utilized to develop the component features of the proposed software requirements change management and implementation maturity model (SRCMIMM).

However, the following 5 challenges were classified as critical to RCM implementation in both data sets (i.e. SLR and empirical): CH7 (communication and coordination gap, 54%), CH9 (lack of top management commitment, 51%), CH10 (lack of interactions between client and overseas practitioners, 59%), CH12 (budget constraints and hidden cost, 55%) and CH25 (lack standards and tools, 62%).

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E. CLASSIFICATION OF THE INVESTIGATED CHALLENGES INTO A ROBUST FRAMEWORK

Ramasubbu [55] developed a framework to classify and map the identified factors of software process improvement into core six categories of: “project administration”, “coordination”, “software methodology”, “human resources management”, “knowledge integration”, and “technology factor”. The same mapping approach has also been followed in other studies [Khan et al. [53] and Shameem et al. [56] in order to scale their identified factors in the reported six categories and presented as a framework.

According to the mapping results most of the investigated challenges are related to ‘project administration’ category. This revolved that the practitioners and researchers should consider the challenging factors of project administration category on priority basis. According to the mapping results the ‘human resources management’ and the ‘coordination’ both are declared as the second most significant categories of the investigated challenges.

The mapping team consists of the first three authors of this study. The authors no four and five arbitrarily involved to verify the mapping process. We further conducted an inter-rater reliability test to check the researcher’s biases. To perform the inter-rater reliability, two experts (expert’s researchers) were invited from different empirical software engineering labs and three from industry. They perform all the mapping steps and categories the investigated factors based on their understanding.

By considering the mapping results of study authors and external experts, we have calculated the non-parametric Kendall’s coefficient of concordance (W) [57]. The value of W=1 shows the complete agreement, and W=0 shows the disagreement between the mapping of both teams. The calculated results (W=0.91, p=0.004) show the significant positive agreement between the mapping results of both teams. This indicated that the mapping process is unprenjudiced and factor categorization is consistent. We believe that this classification will be used as knowledge for the practitioners working with RCM in the GSD environment and will help them to focus on the challenges in their specific categories. In addition, mapping of the challenges is also significant for the researchers as they can focus on future research in the most priority areas of RCM in the GSD domain. The objective of our mapping is to provide the organizations with the body of knowledge that can help for the successful implementation of RCM activities in GSD projects.

V. SUMMARY AND DISCUSSION

The aim of this study was to identify the challenges of requirements change management in the domain of GSD. The findings provide a body of knowledge to both researchers and practitioners that can help them to successfully execute the RCM activities. The identified challenges represent certain key areas that practitioners need to focus in order to improve the implementation of the RCM process in GSD environment. The ultimate objective of this study is to propose a model that could help the software development firms towards the successful implementation and management of RCM activities in the GSD environment. In order to address RQ1, we have thoroughly investigated the existing literature and identified 25 challenges of the RCM process in the domain of GSD. The reported challenges highlight the areas of RCM process that need to address in order to effectively manage the requirements change activities. We have further conducted an empirical study with the RCM practitioners and researchers to validate the findings of the literature. The detail summary of the findings is given in Table 15.

VI. THREATS TO VALIDITY

A number of threats need to validate for this study. As, most of the SLR and empirical results were extracted by the first author of this study. It might be a threat towards the validity of this study because the results of a single researcher could be biased and may constantly extract the wrong data. However, this threat was tried to be reduced by the participation of the other authors to arbitrarily examine the phases of SLR and empirical study in order to find any issue that might exist.

Most of the selected studies have not discussed the key causes of the identified challenges and it could be the internal validity threat to this study. It is possible that in certain studies, there might be a trend to report a particular type of factors.
Furthermore, the majority of the researchers of 69 selected primary studies and about 50% of survey respondents are in the academic field; therefore, they might have lack of knowledge about the real-world practices of RCM processes in the software development industry.

We have noticed that only 38 primary studies out of 69 have provided organization size information and due to this limitation, we were not able to completely provide the organizational size information of all the selected primary studies. However, all the 77 survey respondents mention the size of the organization. So, on the behalf of the empirical study, we can generalize the results of this study to all sized organizations to consider the respective challenges.
TABLE 14. Independent sample t-tests.

|                          | Levene’s Test for Equality of Variances | t-test for Equality of Means |
|--------------------------|----------------------------------------|-------------------------------|
|                          | F           | Sig.           | T   | df  | Sig. (2-tailed) | Mean Difference | Std. Error Difference | “95% Confidence Interval of the Difference” |
| Equal variances assumed  | 0.095       | 0.759          | 1.065 | 60  | 0.291          | 1.61290         | 1.51448               | -1.41651 4.64232 |
| Equal variances not assumed | 1.065 | 59.997        | 0.291          | 1.61290         | 1.51448               | -1.41651 4.64232 |

FIGURE 13. Categorical classification of the identified challenges.

In the primary studies selection and data abstraction we have employed the “inter-rater reliability tests” in order to minimize the researcher’s bias. Though, it is difficult for the secondary reviewers to check each and every study.

Construct validity means a scale of measurement defines the features being measured, accurately. The considered factors were obtained from a wide range of literature [31], [53], [58] and by conversations with practitioners of RCM. The reactions of the practitioner’s specified that all the identified challenges relate to their work. Internal validity means the overall assessment of the results. The results of the pilot research presented an adequate internal validity level. External validity means to generalize the study results. In this research, due to most of the survey participants were from Asian countries, we are not able to generalize the results. Thus, the results are not essentially presentable of participants from other continents. Though, we are assured that the data sample was adequately illustrative.

Owing to limited available means we are not able to resources that we have used all the available digital repositories e.g. Scopus. However, the used repositories sufficient to generalize the results of our study.

Lastly, some significant literature might have been overlooked because of the extensive number of publications about RCM and GSD. Anyhow, this is not a systematic lapse, as in other SLR studies [14], [22], [24].

VII. STUDY IMPLICATIONS

This study shed light the state of the art overview of the challenges faced during the software requirements change management process in the domain of GSD. This study provides the framework of RCM challenges which presents the key categories of the challenging factors that can serve as a knowledge base for researchers and practitioners working on RCM programs in the domain of GSD. This framework will assist them to focus on the challenging factors with respect to their specific categories.

In addition, this study provides deep understanding of the identified challenges in relation to organization type (client, vendor), organization size (small, medium, large) and experts’ position (software practitioners, academic researchers, organizational management). The reported challenges can assist the RCM practitioners to consider the most relevant challenging factors with respect to the organization.
TABLE 15. Summary of the research questions.

| Research questions | Discussions |
|--------------------|-------------|
| RQ1.1: “How are these challenges related to the size of organizations?” | A total of 38 out of 69 primary selected studies mentioned organizational size. 22 out of 25 identified challenges were reported to some extent among SSOs. Five out of the 22 SSO reported challenges were quoted by ≥50% of the articles shown in Table V. For MSOs, almost all the challenges were reported to some extent. Thirteen out of 25 challenges appeared in ≥50% of the literature as shown in Table V. For LSOs, we found that 14 out of 25 total identified challenges were cited ≥50%. However, there was no significance difference between the challenges identified among the SSOs, MSOs, and LSOs apart from CH1 (RCM strategic inflexibility) and CH15 (lack of trust between overseas practitioners). |
| RQ1.2: “Are the challenges identified in the literature related to client or vendor organizations?” | All of the challenges were identified in the SLR. However, there was no significant difference between the challenges identified by the client and vendor organizations. The most common challenges cited in the client–vendor organizations were CH4 (lack of technical capability), CH5 (language and cultural issues), CH10 (lack of interactions between client and overseas practitioners), CH9 (lack of top management commitment), CH12 (budget constraints and hidden cost), CH13 (time pressure) and CH6 (lack of good relationships in distributed team members). |
| RQ2: “What challenges to RCM implementation in GSD environments are identified in the empirical study?” | All the challenges were identified in the SLR. However, we found significant differences among the SSOs, MSOs, and LSOs for two challenges CH2 (RCM activities management issues at overseas sites) and CH7 (communication and coordination gap). |
| RQ3: “Are the challenges identified in the empirical study related to the size of organizations?” | All of the 25 challenges were identified in the SLR. However, we found significant differences among the SSOs, MSOs, and LSOs for two challenges CH2 (RCM activities management issues at overseas sites) and CH7 (communication and coordination gap). |

FIGURE 14. Architecture of the SRCMIMM model.

VIII. FUTURE WORK

The ultimate aim of this research study is to develop a software requirements change management and implementation maturity model (SRCMIMM) that could assist the practitioners to manage the RCM process in GSD environment. In this study, we have only discussed the single components of the proposed model i.e. challenges of RCM. We believe that the findings of the present study can be useful to address the issues related with the RCM process implementation, which is significant for the progress of GSD firms.

The complete architecture of SRCMIMM is provided in Figure 14 and it is based on the concepts of existing maturity models (CMM, CMMI, IMMM, SOVRM etc.) and the factors that could impact the change management activities in the GSD organizations. The proposed model consists of...
three core components, i.e. maturity level component, factors component (critical challenges, critical success factors) and assessment component. The Figure 14 shows the relationship between the key components of SRCMIMM. The maturity level component considered to evaluate the maturity level of an organization regarding the change management process and the factors component consist of the critical factors that represent the key areas of RCM program that organization need to manage. The assessment component used to assess a specific maturity level of an organization and suggest the best practices to improve the RCM capabilities of an organization. In future, we plan to conduct in depth case studies to identify the additional challenges and success factors of RCM in GSD context and to validate the framework with real world practitioners.

IX. CONCLUSION

Presently, GSD phenomenon is adopted rapidly by software organizations. The increasing trend in GSD encouraged us to investigate the challenges that can destabilize the RCM process in distributed development environment. We use the SLR and survey questionnaire approaches to investigate 25 challenges. In both methods, five out of the 25 challenges are identified as critical. The critical challenges can be helpful for improving the execution of RCM process activities in GSD firms.

We have also categorized the investigated challenges based on their significance to client and vendor GSD firms. The results revealed that the challenges faced by client and vendor firms during the RCM process have more similarities. Most of the survey participants are agreed with the investigation of SLR. Further, although we observed a moderate correlation among the rankings of challenges in both data sets (i.e. SLR and empirical), we investigate significant variances among the rankings of the challenges in both data sets. The key motivation for the client–vendor categorization was to provide an understanding of the challenges that arise when implementing activities of the RCM process in client and vendor organizations. Both client and vendor firms can consider the challenges with respect to their specific categories.

We have further classified the identified challenges based on the size of the organization: small scale organizations (SSOs), medium scale organizations (MSOs), and large-scale organizations (LSOs). The findings demonstrated that MSOS and LSOs presented more similarities than differences in terms of the challenges for the implementation of RCM activities in a GSD context. Moreover, SSOs experienced somewhat different challenges compared with those of MSOS and LSOs. Most of the survey participants are in the favor of SLR findings. Though, on average, we found CH9 (Lack of formal implementation of RCM practices) and CH25 (3Cs “communication, coordination & control”) to be the most significant challenges for all sized organizations. The organizational based categorization provided an overview of the challenges that arise during the RCM process in the domain of SSOs, MSOS, and LSOs.

Moreover, the identified challenges are presented in the form of robust framework by categorizing the challenges into six different categories (section 4.5). Most of the challenges were classified into the project administration category, which means that project administration category is the most significant challenges category. The GSD organizations should strongly focus on the challenges reported in the project administration category.

We believe that the results, analysis and conclusions of this study could be used to tackle the problems associated with the requirements change management, which is important for the success and development of GSD firms.

APPENDIX

Appendix-A: Selected studies and quality assessment score: https://tinyurl.com/r4wwuej

Appendix-B: Sample of survey questionnaire: https://tinyurl.com/roll2gf

Appendix-C: Bibliographic information of survey participants: https://tinyurl.com/swadlxm

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