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RESEARCH ARTICLE

Quality Requirement Change Management's Challenges: An Exploratory Study Using SLR

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ABSTRACT Requirement change management plays an important role in the business world where management in the business scenario is a hard-hitting assignment because of continuously changing customer choices in respect of requirements. Giving no attention to requirement change management challenges result in consumers' discontent. Main cause of business products is that there is no planning regarding requirement change management. Furthermore, it also affects market value. Dealing in requirement change management, it's far important to cope with those challenges to undertake the requirement of the business consumers. This article focuses on documentation and control of quality requirement challenges by using an approach of systematic literature review. The main goal of this article is to classify critical challenges being faced by vendor companies in global software development. A total of fourteen challenges have been documented which have a severe effect on the management of quality requirements. Challenges documented like 'Incomplete requirements', 'Lack of Communication & Coordination, etc. are the key challenges harming managing quality requirement changes. Among these fourteen challenges, nine challenges are marked as critical challenges whose ratios are above 25%. The identified challenges were analyzed decade wise where we categorized them into three decades i.e. first decade (1992-2002), the second decade (2003-2012), and the third decade (2013-2021).

INDEX TERMS Outsourcing software development, requirement change management, systematic literature review, challenges and vendor organization.

I. INTRODUCTION

The main target of OSDO (offshore software development outsourcing) is to achieve a quality product at a low price [1]. Business outsourcing can be defined as an agreement between organizations that offer services and client organizations who receive services after paying desired compensations to the selling organizations [2].

For an organization's existence, it is mandatory to develop a system. To achieve this goal, there should be a focus on bringing internal and external changes to the system. Without bringing change in a system due to changes in the surrounding, an organization becomes rigid [3]. Requirements are continuously changing for handling a variety of challenges like inaccurate growth in requirement process, requirements not counted, technologies not growing, unforeseen complications, vital fluctuations, out-of-place stakeholders, unduly positive budget or schedule, border not sufficiently well-defined, variations in customers' wishes and wills and the life cycle of product development not touched in a better way [3].

As software outsourcing has a no-denied role in developing a quality product. But it is also not free from threats to

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business activities [4]. Certain challenges like Inferiority Software Products, nonskilled labor and unusual Methodologies, high-cost estimation, Organizational modifications, Factor Models, miss management and miss communications, no access to the marketplace, ineffective methods, etc. affect the quality of the desired product [5]. In signing a contract between clients and vendor organizations, key challenges affect negatively the contract. These hurdles are no trust between the two parties, mismanagement, no flexibility in agreement, etc [6].

A big challenge in the business scenario is the change in requirement change management. This change may come in the form of the customer will, technological change, cultural differences, time zone differences, language differences, and so on [7]. Handling this type of severe change is mandatory with the help of quality requirement change management techniques for achieving business goals [8].

A quality product must have the best features to compete in the market in respect of quality requirement change management. These features are completeness in all perspectives, free from uncertainty, consistent, accuracy, practicality, predictable, evident, and reliable [9]. To install requirement change management practices effectively, there must be a common understanding amongst shareholders [9]. Achieving a business goal in the shape of a quality product will be useless unless we follow proper RCM methods. It will result in high estimated costs and suspension in required tasks [10]. When there is no plan in requirement change management process, business goal can't be achieved. This means unless we have not defined a proper plan in establishing a business goal, we will not be able to achieve a quality product, as proper plan is just like a road in reaching us the desired destination in quality requirement change management paradigm. Grouping requirement change management challenges are just like a schedule for business researchers to find a solution to a specific requirement change management problem [11]. An excellent product is prepared with the procedure followed in a well-structured way. Hence it is important to give full attention to the requirement change management procedure [12]. Figure 1 shows details of the requirement change management process [13]. We can infer from the figure, that in the required change management process, the consumer asks for the demand, then the change control board analyzes the request and make a decision based on a change in requirements. When change is accepted, documents are updated. At the last stage the tester verifies the requirement change.

It is proved by the study that most of the business plan fails due to a lack of management of business requirements. A report showed by the Standish group says that when a business plan fails, there are five main factors behind this. These factors are: re-work, rolled back out of production, problems found by end users, poor requirements management and, over time and cost. Figure 2 shows details [10].

Standish group conducted another survey saying that the main factors behind project failure are: incomplete

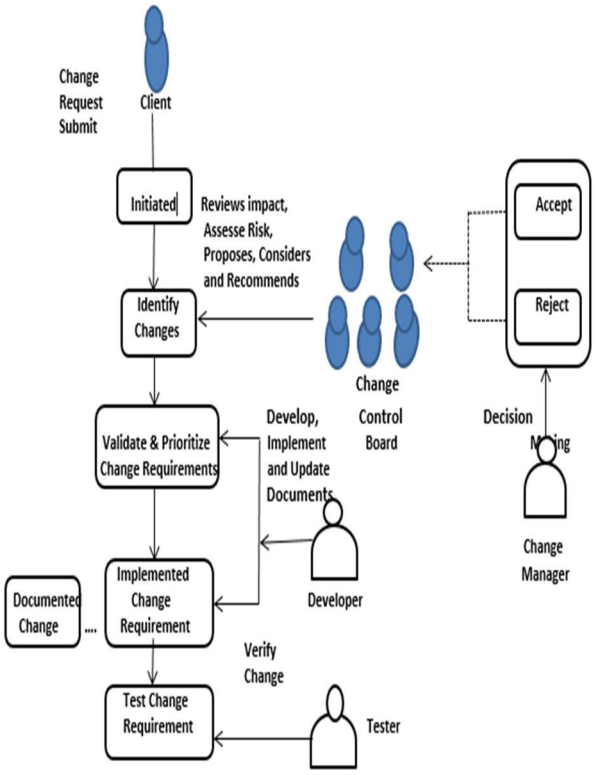

FIGURE 1. RCM process.

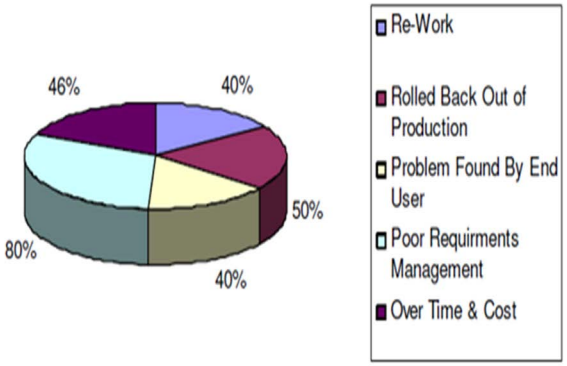

FIGURE 2. Past project management report [10].

requirements with 13.1%, low customer involvement with 12.4%, lack of resources with 10.6, unrealistic expectations with 9.9%, lack of management support with 9.3, change in the requirements with 8.7, lack of planning with 8.1% and useless requirements with 7.5%. Figure 3 shows it graphically [10].

Global software development is a business scenario focusing on preparing a quality product with the help of experts who have different cultural, time zones, and language backgrounds [14].

Working on this platform is not free from challenges. These challenges include a change in quality requirement management. It becomes more challenging when someone

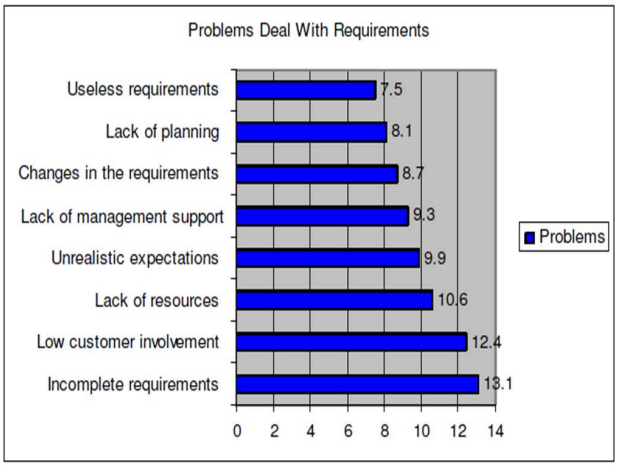

FIGURE 3. Requirement factors impacting project failure.

deal with it in a global software development platform. It is because experts with different time zone, cultural differences, and language barriers as compared to developing a product at a single site [15].

The business team who prepare business quality products face challenges in the shape of communication issues, material management, different time zone, and cultural dissimilarities [3]. Despite it, it has its rewards on project success while facilitating communication, different time zones, and cultural hurdles.

To address the challenges being faced by vendor organizations, different models and tools have been developed in a change in quality requirement management.

Categorizations of challenges harming quality requirement change management in the GSD paradigm is the key objective. Examining different phases of a business product in reverence of quality requirement change management is another key objective of this study. The products' stages may be pre-stage, mid-stage, and post-stage. Additional particulars have been discoursed in the succeeding Research Questions.

RQ1. What types of challenges would be deliberated by vendor organizations in managing quality requirement change in the GSD platform?

RQ2. What types of most critical challenges would be deliberated by vendor organizations in managing quality requirement change in the GSD platform?

RQ3. Do the documented challenges, as recognized in the research study, change from decade to decade in GSD paradigm?

It is found through literature review that quality change management is the critical issue in software development and maintenance. Most of the software contract failed due to poor requirement change management. Our study focuses on to bridge this gap. This paper is one component of our proposed model that will assist vendor organization to gauge their status for quality requirement change management in context of quality software development. This paper will help in avoiding critical challenges in order to achieve quality product in software outsourcing quality requirement change management paradigm. This paper will also show whether these challenges are changing decade to decade. Objectives of the current paper is relevant and important as we have used different methodologies, conducting secondary studies, focusing on overall challenges, used synthesis on the basis of these findings, proposed a model which will have various levels and conducted case studies, session groups for the evaluation of the proposed model and finally using fuzzy AHP technique to evaluate the weightage of the various identified factors of the proposed model.

Current literature has touched on one challenge or another related challenge in one context or another context. We have covered the overall challenges being faced by vendor organizations in the quality requirement change management scenario that is defined in the literature. It may possible that they have used a concept of primary studies to dugout the new challenges. We have used secondary studies where we use systematic literature technique to identify the various challenges as discussed in primary studies. These challenges are grouped together on the basis of correlation and find out the total frequencies of the identified challenges by showing how many researchers have pointed out these challenges. The identified challenges are then validated with the help of an empirical method such as questionnaire survey [16], case studies, fuzzy AHP, and session groups. On the basis of our defined procedure for these factors it is novel, innovative and different from the existing literature.

The structure of the rest of the paper is as follows. Section 2 discusses Background and Motivation. Section 3 discusses a Systematic literature review (SLR). A result-oriented section is discussed in unit 4. The discussion session is discussed in Section 5. Study limitations in discussed in unit 6. Conclusion and Future work have been discussed in unit 7.

II. BACKGROUND AND MOTIVATION

RCM keeps focusing on preparing business products complete in all aspects to the customers. Its purpose is to keep priority in product delivery as well as satisfy customers' demands regarding requirement change [9]. The concept of change in requirements can lead an organization to the peak. Without monitoring proper requirement change, the business milestone cannot be maintained. Nurmuliani [17] presents his thoughts by saying that requirements are changing due to changes in customer wishes, changes in market values, change in business policies, and changes in product quality. Lindquist [17] presents his views by saying that without proper management of requirement change management business activities, 50% of products cannot achieve their desired goal. A survey conducted by Sirvio and Tihinen [18] tells that nearly 40% of business activities fail by reaching their target due to unplanned RCM tools. Lai et al. [19] and Ramadan et al. [20] presents their views by saying that less attention was given to establishing well-defined tools and techniques in a global software development scenario. Researchers in the field of quality requirement change

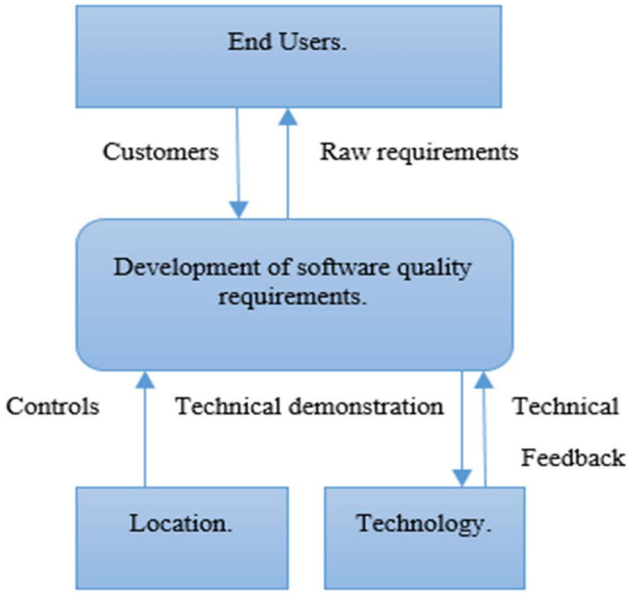

FIGURE 4. Development of requirements.

management have done minimum work regarding the role of challenges that have a negative impact on it.

Why does someone deal with and develop a software quality requirement and what is the objective behind its development? The main idea behind it is to keep in touch and study different requirements [21]. Figure 4 presents it in detail. It is clear from the diagram that requirements can be developed and modernized to meet the customers' criteria. Any variations come in the form of variations in market value, updates that come in the form of tools and techniques may have a positive impact on quality requirement change management.

Feedback will be taken from the customers when there come raw requirements as they are not arranged in a good fashion. After taking views from the end-users, it has now become a part of complete requirements.

A. COMPERISON WITH EARLIER STUDIES AND RESEARCH CONTRIBUTIONS

A model developed by Minhas and Zulfiqar focuses on managing requirements in a particular domain. But it has no role in GSD atmosphere [10]. The business model developed by Niazi implements special practices of CMMI but lacks coordination issues in the global environment [22]. Akbar built up a framework that focuses on different stages of product development but lacks a schedule in the required change management development process [23]. Additional model about change management developed by Keshta has well performance in small organizations but fails in recovering requirement changes in large organizations [24]. A model developed by Bhatti has also no part in the confirmation process of the quality requirement change management process [25]. A similar situation in a model developed by Ice has also no role in the confirmation process of software requirement change management process [26].

The models and tools discussed so far are not outsourcing techniques. When there is a need for frequent change in global software quality requirements, help is taken from the Global Requirement Change management (GRCM) model. Its focus is only on developmental stages [27]. A model developed by Kumar also does not touch communication issues in global software development [28]. Although abia's model handles all problems related to global software development, a validated option is not added [28]. Niazi's model in global software development does not handle culture and language obstacles [29]. A framework developed by Lai also does not describe quality factors clearly [19]. A tool called EGRET developed by Sinha does not touch on time constraint issues [14]. A framework developed by Sultana in global requirement change management also fails in covering time and culture issues that are not addressed clearly [30]. An approach called the tracing-based requirement approach by Heind et al [31] does not handle major issues like time, culture and coordination, and communication.

Similar to Ice's model, the Spiral model has no decision power in the global requirement change management process. similarly, no test option is added [32]. A model developed by Simon Lock does not offer facilities when changes come at the preliminary phase.

Classification of Challenges has been done Global Software Development [33]. But this classification of challenges fails in the identification of challenges having a negative impact on quality requirement change management in the global software development paradigm. Challenges identified in this research work help global software development researchers to recognize, classify and realize challenges quality requirement changes.

III. SYSTEMATIC LITERATURE REVIEW

Assistance was taken from systematic literature review (SLR) for the accreditation of challenges software outsourcing quality change management [34]. Other researchers also use this protocol for the same determination [35]. Sometimes there comes a misperception in identifying the difference between a systematic literature review and an ordinary literature review. SLR is a protocol that supports achieving the same data to a topic along with search string and RQs. SLR's findings are more accurate, less partial, and more reliable than an OLR. This unit is used for gathering related data to the RQs set in the literature. It is used for gathering challenges having a negative impact on quality requirement change management. [36]. Phases of SLR are exposed in Figure 5.

A. TRIAL SEARCH

Initially, the following trial search string was used. ((''Software Outsourcing'' OR ''Information Systems Outsourcing'' OR ''IT Outsourcing'') AND (''Software Evaluation'' OR ''Software Analysis'' OR ''Software Estimation'' OR ''software estimation'' OR ''Software Inquiry'' OR ''software

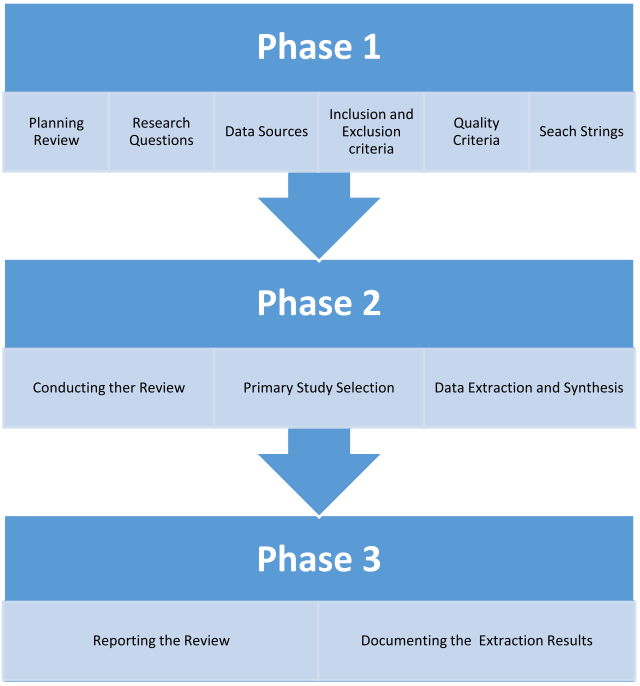

FIGURE 5. Stages of SLR.

inquest'') AND (''Hurdles'' OR ''Risk'' OR ''Barriers'' OR ''Threat'' OR ''Warning'' OR ''Intimidation'' OR ''Hazard'' OR ''Scratch'' OR ''Exposure'' OR ''Disclosure'' OR ''Leak'' OR ''Reveal'' OR ''Divulge'') AND (''Practice'' OR ''Solution'' OR ''Resolution'' OR ''Result'' OR ''Clarification'')).

Desired result did not come on the above string. Modified it. Updated version is as under.

((''Software'' OR ''Software Product'' OR ''Business Software'') AND (''Outsourcing'' OR ''Information Systems Outsourcing'' OR ''IT Outsourcing'') AND (''Vendor'' OR ''Seller'' OR ''Merchant'' OR ''Retailer'' OR ''Dealer'') AND (''Software Quality'' OR ''Software Excellence'') AND (''Software Requirements Change'' OR ''Software Requirement Modification'' OR ''Software Requirement Amendments'' OR ''Software Requirement Alteration'') AND (''Software Requirement Change Management'' OR ''Software Requirement Change Administration'') AND (''Software Quality Requirement Evaluation'' OR ''Software Quality Requirement Analysis'' OR ''Software Estimation'' OR ''Software Investigation'') AND (''Success Factors'' OR ''Achievement Factors'' OR ''Accomplishment Factors'' OR ''Winner Factors'') AND (''Challenges'' OR ''Hurdles'' OR ''Difficulties'') AND (''Practices'' OR ''Solutions'')). Details are shown in Table.1. This is an extended form of the paper accepted in ICGSE 2021: International Conference on Global Software Engineering, Moscow, Russia.

We have used Google scholar, Science Direct, IEEE, Explore and Springer, because these databases and search engines gave result matched to our title of our research article and RQs defined.

TABLE 1. Search engine/online libraries results.

Search Engines/Libraries	Initial selection	Primary selection	Final selection
Google Scholar-[scholor.google.com].	1530	754	97
Science Direct-[sciencedirect.com]	241	12	02
IEEEExplore-[ieeexplore.ieee.org].	930	12	09
Springer-[springerlink.com].	211	14	08
Total	2912	792	116

B. PUBLICATION COLLECTION

1) ENCLOSURE STANDARDS

Enclosure criteria is used which type of works will used for data extraction process. The following standard is used.

- Make a part of those papers written in English language.
- Conference Minutes, Periodicals and Newsletters, a journal published after 1991.
- Those papers will be included related to research topic.
- Terms specific to RQs.

2) EXCLUSION CRITERIA

Those work not related to research area will be eliminated. We have made the following criteria.

- Research papers not related to RQs.
- A research study published before 1991.
- Studies not related to the title to the research.
- Matching papers.
- Papers not in English language.

C. DATA EXTRACTION

From each publication, we extracted the following data like title, review date, references, writers, search engines, success factors (factors having positive effect on software outsourcing quality requirement change management), challenges (factors having negative effect on software outsourcing quality requirement change management), methodologies (interviews, case studies, questionnaire survey etc.), publication quality descriptions, target population, sample population, type of organizations(university, software house, research center etc.), size of company(large, medium and, small), Continent, year etc.

D. DATA SYNTHESIS

Challenge was listed from 116 papers and at first stage, total 41 challenges were listed with the help of systematic literature review. After receiving comments from supervisor, these were reduced to 14 as a final.

It is found through literature review that quality change management is the critical issue in software development and maintenance. Most of the software contract failed due to poor requirement change management. Our study focus

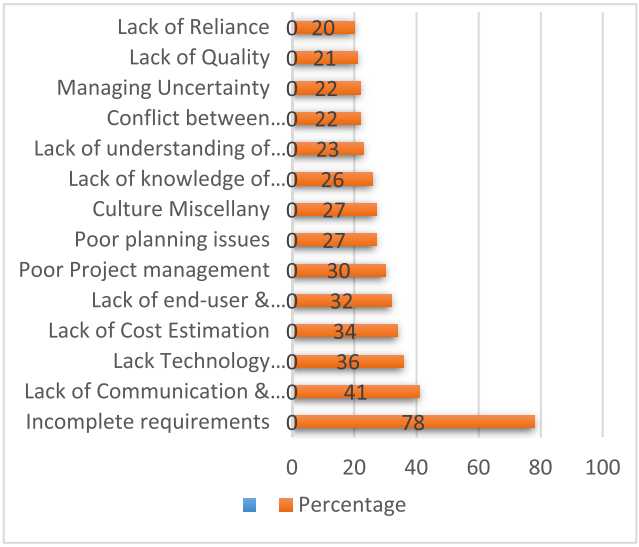

FIGURE 6. Frequency analysis of the investigated challenges.

on to bridge this gap. This paper is one component of our proposed model that will assist vendor organization to gauge their status for quality requirement change management in context of quality software development.

IV. RESULTS

A. CHALLENGES RECOGNIZED THROUGH SYSTEMATIC LITERATURE REVIEW (SLR)

With the help of the data extraction process total number of challenges is 14 from primary nominated articles. Answering research question 1, a total number of challenges are documented in Table 2 which have a negative effect on software quality requirement change management. Recognized challenges are mentioned in Figure 7. To use robust association between variables, a descriptive analysis technique is used.

In this work, a descriptive analysis instead of thematic analysis. Descriptive analysis is a significant primary phase for showing statistical analysis. It gives assistance in relationship among different variables. Our proposed work has used statistical approaches like Chi- Square Test (Linear by Linear Association) and Spearman's rank correlation for our analysis as numerical data is used for data analysis.

1) CHALLENGE 1 (INCOMPLETE REQUIREMENTS)

is considered a critical challenge having 78% in a study considered for quality requirement change management of GSD process. One of the key challenges is to consider the exact requirements of the customers. This challenge is severe as most of the customers cannot communicate easily while using a computer, mobile, tablets, etc. This results in mismanagement between clients and vendor organizations. To handle such problems, customers must start computer literacy. Customers must be free in expressing their thoughts freely [37]. Requirement change Managing can easily handle this problem [38].

2) CHALLENGE 2 (LACK OF COMMUNICATION AND COORDINATION)

comes with 48% of the identified papers of quality requirement change management of the business process in the GSD paradigm. In global software development, members who work on certain projects are dispersed to different geographical locations. Therefore, it becomes a problem for them to interact easily. It becomes a hurdle for the project supervisor to manage all this activity at once [39]. As there is a culture change, one's native language is different from the other, it becomes difficult to communicate easily [40]. Another challenging factor affecting negatively lack of communication and coordination is the dissimilar stage of understanding. What the client wants to say may be misinterpreted by the other side [41]. Hence communication can be promoted with the help of synchronous and asynchronous communication channels like corresponding, voice messages, instant messenger, video conferencing, video link, google meet, etc.

3) CHALLENGE 3 (LACK OF TECHNOLOGICAL ADVANCEMENT TOOLS)

appears with 42% of the documented papers of quality requirement change management in the GSD platform. One cannot improve RCM activities unless they adopt modern technologies and updated tools and techniques. Business customers mostly change their requirements due to continuous change in technology which is a challenging task [42]. Growth in requirement always comes with growth and advancement in technological tools and techniques. According to Supha Khankaew [43], there are several factors affecting quality requirement change management. among these, one factor is the lack of advanced tools and technologies. Hence due to a lack of advanced technological tools, one will not be able to tackle the change coming in the form of quality requirement change. Therefore, it is the need of the day to use state of art technology to promptly answer the challenges coming in the shape of quality requirement change.

4) CHALLENGES 4 (LACK OF COST ESTIMATION)

falls with 34% of the identified papers of software quality requirement change management. Incorrect estimates may fall in project failure. According to Jalal Shah, among some inaccuracies mentioned in the failure of the project are lacking in the estimation of cost [44]. A key problem in project failure is the inaccurate detailed estimation. People adopt different cost estimation methods. It is therefore problematic. Some approaches first estimate size then originate struggle while other approaches originate struggle directly [45]. Estimates of cost change with the change of demand from customers in the shape of change in requirements [46]. The business organization will not achieve its goal when there is uncertainty in the estimation of cost, project completion time [47]. Lack of estimation in the distributed site is harmful in requirement change management efforts [48]. Hence software effort estimation and analysis should be used for

TABLE 2. Group of challenges.

S.No	Challenges	Freq (N=116)	%	Sources (Paper ID)
CH1	Incomplete requirements	91	78	01,02,03,04,06,07,08,09,10,11,12,13,14,15,16,18,20,21,23,24,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,49,50,54,58,60,61,62,63,64,65,66,67,69,70,71,72,73,75,76,77,78,79,80,81,82,83,84,85,90,91,92,93,94,95,96,97,98,99,100,101,102,103,104,105,106,107,108,109,110,111.
CH2	Lack of Communication & Coordination	48	41	01,02,04,05,07,08,10,15,18,19,20,24,25,30,33,34,36,37,41,43,45,50,54,55,62,64,66,73,74,77,78,80,81,82,91,93,94,96,97,98,99,104,107,108,110,114,116,118,119.
CH3	Lack of Technological Advancement Tools	42	36	01,03,04,07,08,10,12,13,16,18,20,21,24,25,29,30,31,33,36,43,44,45,52,56,62,66,69,73,77,79,80,81,85,89,91,93,94,103,105,109,115,117,119.
CH4	Lack of Cost Estimation	40	34	01,02,04,05,06,07,09,10,12,14,18,19,22,23,24,30,31,43,44,46,47,48,49,59,61,62,66,68,73,77,79,93,94,96,103,105,111,112,113
CH5	Lack of end-user & executive support	37	32	02,05,06,07,09,13,18,19,25,29,34,36,43,45,47,54,57,58,62,66,68,70,71,78,79,80,81,91,93,96,97,98,103,112,113,114
CH6	Poor Project management	35	30	01,02,04,05,07,09,10,13,14,15,21,24,27,29,30,31,33,34,35,36,41,43,47,45,50,55,56,63,64,77,82,98,111,114.
CH7	Poor planning issues	32	27	01,02,07,09,10,11,12,15,18,19,24,44,47,48,49,50,51,54,55,62,63,64,66,70,73,79,93,96,97,98,102,103.
CH8	Culture Miscellany	31	27	01,02,04,05,07,14,18,20,21,24,25,28,31,33,36,37,50,51,54,57,66,64,77,78,81,94,96,97,107,108,110.
CH9	Lack of knowledge of requirements	30	26	01,02,04,07,08,10,15,16,18,20,25,30,36,37,41,45,54,55,62,64,66,73,77,78,93,94,97,98,100,102.
CH10	Lack of understanding of standards	27	23	01,03,05,04,07,08,10,11,12,26,30,31,43,44,75,68,77,81,91,92,94,96,99,100,102,110,111.
CH11	Conflict between stakeholders	26	22	02,04,09,12,16,19,24,25,30,33,36,37,43,56,66,70,73,77,79,82,88,91,93,96,103,109
CH12	Managing Uncertainty	25	22	03,05,07,08,09,1113,16,22,26,30,33,36,43,47,49,52,56,58,70,7,7991,93,103
CH13	Lack of Quality	24	21	11,17,21,22,28,29,30,40,43,44,47,52,60,64,65,79,84,98,107,108,109.
CH14	Lack of Reliance	24	20	03,06,11,15,17,21,22,26,29,31,34,36,43,45,47,48,57,58,78,82,88,91,93,101.

accepting or rejecting the changes coming in the shape of lack of estimation of cost.

5) CHALLENGE 5 (LACK OF END-USER & EXECUTIVE SUPPORT)

falls with 32% in identified papers through systematic literature review. It plays an important role in effecting quality requirement change management. User frustration causes project interruptions and products delays in the delivery [44]. The users have a habit to modify requirements due to variations in technologies, market changes, etc. [49]. Executive management support helps in customer satisfaction regarding product quality. Nearly all end-users at the first stage of the product development do not know system scrutiny. It becomes difficult to gather information as they don't want about their wishes and also have no information about what the system will do [50]. Lack of User involvement is one of the top 3 factors affecting the project's performance. A report published by CHAOS [51]. Hence the process of user satisfaction and executive support must be maintained throughout the life cycle of project development [52]. The 3 important factors that help in achieving an organization its

business goal are user involvement, executive administration, and strong requirement statements.

6) CHALLENGE 6 (POOR PROJECT MANAGEMENT)

comes ratio of 30% is another key challenge having a negative impact on quality requirement change management process in GSD environment. The requirement change management process will not be succeeded if team members are not managed properly for handling RCM activities. It is of utmost importance that an expert who is managing RCM activities must have full knowledge of the quality requirement change management process. according to Jalal [44] software project management playing a role in developing software for years. But it is still a great challenge for software engineers in developing quality software within the said time and low cost in a GSD environment. A key factor in the failure of a project is the poor project management itself. Hence well-organized project management may be used in a way that satisfactory management measures are used for transforming consumer requirements into end products. Project management techniques can be used for avoiding time interruption [53].

7) CHALLENGE 7 (POOR PLANNING ISSUES)

falls with 27% in identified papers through SLR in the GSD environment. It is also a challenging task for managing quality requirement change. A plan is just like a road map. Without structured planning, vendor organizations cannot achieve their business target by fulfilling customer expectations. Poor planning may delay project performance at any development stage [54]. Among the top ten factors responsible for project failure, poor planning is one of them [55]. Hence, the continuous plan should be monitored to tackle the requirement changes coming from customers [56].

8) CHALLENGE 8 (CULTURE MISCELLANY)

is another most important challenge having a frequency percentage of 27 which affects negatively on quality requirement change management process in the GSD platform. In the GSD platform, squad members who work on a certain project are spread at different locations having different cultural terms, it becomes a challenge for a task supervisor to supervise all these activities at remote places [57]. When a contract is assigned between client and vendor organizations for preparing quality products, when there comes a change in requirement from the client-side, then due to culture differences it becomes a challenge to communicate easily [40]. Due to cultural differences, it is sometimes difficult to collect requirement changes from client organizations [58]. Discoordination between different shareholders occurs due to cultural challenges [59]. Cultural differences sometimes produce coordination problems [60].

9) CHALLENGE 9 (LACK OF KNOWLEDGE REQUIREMENT)

is another critical challenge with a percentage of 26%. Without complete knowledge regarding requirements, a complete business project with customer satisfaction cannot be achieved. In the GSD platform, as team members are distributed across different sites, the possibility of leaving a business job due to lack of knowledge requirement is comparatively high [41]. Several companies failed in achieving business targets due to a lack of knowledge requirement management [61]. Hence, to avoid vendor organizations from achieving their target, team members must be well trained with knowledge requirements.

10) CHALLENGE 10 (LACK OF UNDERSTANDING OF STANDARD)

is critical. Its percentage is 23 in identified articles collected through SLR. According to Abdou Karim Jallow, there is no standard way of managing software quality requirement change management [62]. There is a need for change in the standardization of methods to achieve business goals.

11) CHALLENGE 11 (CONFLICT BETWEEN STAKEHOLDERS)

is a critical challenge with 22% among identified papers through SLR. When common interest issues arise among different stakeholders dealing in the GSD paradigm, a requirement change coming from customers cannot be completed.

According to Holstrom [63], long-term distance results in conflict among different business stakeholders. A struggle started for removing hurdles among different software requirement change management companies is a far longer because of in capabilities among different stakeholders [64]. Hence, it is necessary for stakeholders to fully focus on maintenance problems coming in quality requirement change management dealing [65].

12) CHALLENGE 12 (MANAGING UNCERTAINTY)

is a critical fall with 22% among our identified challenges. The main issue while completing a product on time and set cost is the uncertainty related to the development stages of a business product [66]. Growth in development uncertainty has a direct impact on the degradation of product development. Management of uncertainty is most important for smooth run global software quality requirement change management business process.

13) CHALLENGE 13 (LACK OF QUALITY)

is another challenge having its role in effecting badly quality requirement change management process in the GSD paradigm. Lack of quality factors can affect the developmental stage of a business product preparing for customer satisfaction [67]. To avoid bad quality challenges, a mechanism must be built to assure quality management in respect of requirement change.

14) CHALLENGE 14 (LACK OF RELIANCE)

is the last in an identified challenge with 20%. Trust between client organization and vendor organization for developing a quality product. As team members are scattered, there is always an absence of trust among team members [68]. Hence,

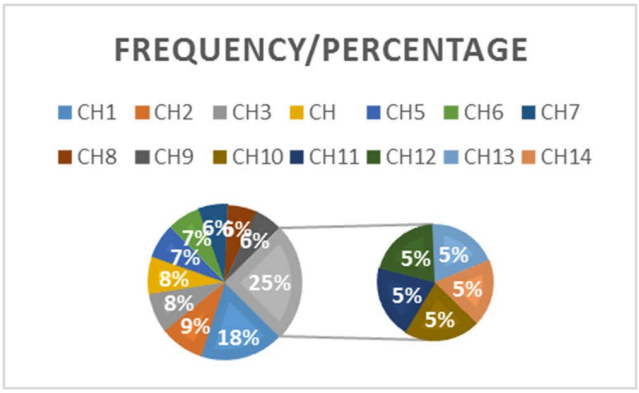

FIGURE 7. Frequency of critical challenges.

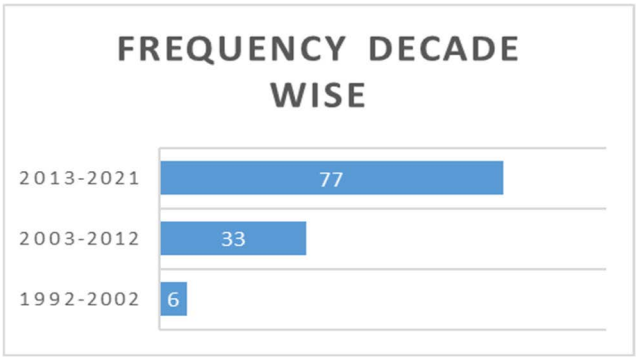

FIGURE 8. Frequency decade wise.

trust must be made for requirement success [69]. To answer RQ1 the list of challenges is underscored in Table 2.

B. CRITICAL CHALLENGES

Challenges with citation 20% or greater than 20% are deliberated as critical challenges. Our proposed work has set criteria low to bounce touch more challenges having a negative effect on quality RCM. A help is taken from Principles like this by other researchers [9], [14], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33]. All 14 challenges are considered critical challenges. The frequency with its percentages is shown in Figure 7.

C. COMPARISON OF CHALLENGES ACROSS DIFFERENT DECADES

Among the total 116 research papers extracted for quality requirement change management, decades were mentioned in 116 papers shown in Table 03. Our paper period start from 1992-2021. Our proposed work has divided periods in three parts. First period starts from 1992 to 2002. Purpose was to give touch more and more papers related to our topic and research questions.

Identified challenges were divided into three decades. Decade 1st starts from 1992-2002, decade 2nd starts from 2003-2012 and decade 3rd from 2013-2021. It can be inferred from the table that most of the papers about challenges of quality requirement change management are from the third decade. This is shown in Figure 8. 116 papers were identified with the help of SLR [70], [71], [72], [73], [74], [75], [76]. The frequency of papers in 1st decade is 06, 2nd decade is 33 while in 3rd decade, it is 97. Decade-wise papers were mentioned in all 116 papers.

Challenge Incomplete requirements has much high frequency percentage in all three decades (1st decade=%, 2nd decade=82, 3rd decade=79%). It means it plays a most important role all these decades affecting badly quality product in a way when there comes change demand from the customer side.

Challenge 12 named "Managing uncertainty" has an equal frequency percentage (21%) in decade 2nd and decade 3rd. This challenge has equal value having a severe effect on a quality product.

The utmost quoted challenge in all decades is the "Incomplete Requirements". Its total frequency in the third decade is 61. The special focus should be on managing incomplete requirements to achieve customer satisfaction and market access.

For an accurate and precise difference in identified challenges decade-wise, assistance is taken from Linear-By-Linear Association and Chi-Square Test. This technique is recycled when there is an intention to check a variance among different variables. Outcomes decade-wise are shown in Table 2.

Answering Research Question 3, detail of outcomes are shown in Table 3. It is clear from the table that challenges are changing from decade to decade.

Our primary papers with respect to decade size is shown in figure 8. From the figure, it is clear that most of the articles are related to third decade (2013-2021).

Putting on Spearman's rank correlation on challenges identified decade wise with respect to a second decade (2003-2012) and third decade (2013-2021) shows that there is a solid association among these two decades.

The coefficient of Correlation among these two decades is 0.778. It shows a strong relationship between these two decades. Details are shown in Table 4.

For checking the reliability of identified challenges, help is taken from Cronbach alpha Coefficient techniques. Its limit starts from 0-1. Conditions are mentioned in Table 5. When we applied these techniques using SPSS on our identified challenges. Test score 0.707 according to the conditions mentioned in the table, our result comes in an acceptable form.

V. DISCUSSION

The main goal of this article is to classify and analyze critical challenges being faced by vendor companies in global software development.

To answer RQ1, a total of 14 challenges were identified as hurting software quality requirement change management as mentioned in table 3. It can be inferred from the table that most of the papers were cited in the third decade. It shows that our work has taken assistance from the most recent and updated articles. To use robust association between variables, a descriptive analysis technique is used. Challenges

TABLE 3. Decade wise analysis of challenges.

Challenges	Occurrence in SLR (n=116)						Chi-square test (linear by linear association) α=.05		
	1992-2002 (N=06)		2003-2012 (N=33)		2013-2021 (N=77)		X^2	df	P
	Freq	%	Freq	%	Freq	%			
Incomplete requirements	4	67	27	82	61	79	.073	1	.787
Lack of Communication & Coordination	3	50	10	30	35	45	.710	1	.399
Lack of Technological Advancement Tools	1	17	10	30	31	40	2.001	1	.157
Lack of Cost Estimation	3	50	10	30	27	35	.026	1	.872
Lack of end-user & executive support	2	33	9	27	24	31	.040	1	.842
Poor Project management	2	33	8	24	24	31	.171	1	.679
Poor planning issues	1	17	7	21	24	31	1.463	1	.227
Culture Miscellany	0	0	6	18	26	33	5.163	1	.023
Lack of knowledge of requirements	1	17	6	18	23	29	1.731	1	.188
Lack of understanding of standards	2	33	8	24	18	23	.177	1	.674
Conflict between stakeholders	2	33	6	18	18	23	.001	1	.974
Managing Uncertainty	2	33	7	21	16	21	.251	1	.616
Lack of Quality	2	33	3	9	19	25	.816	1	.366
Lack of Reliance	2	33	11	33	11	14	4.946	1	.026

with citation of 20% or greater than 20% are considered as critical challenges. We set criteria low to bounce touch more challenges hurting quality RCM. A help is taken from Principles like this by other researchers [9], [14], [17], [18], [19], [20], [21], [22], [23], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33]. All 14 challenges are considered critical challenges. To answer RQ2, the frequency and percentage of critical challenges are shown in Figure 8.

To answer RQ3, our analysis shows that the challenges identified are varying from decade to decade. This variation is described in Table 3.

Our findings are different from the current literature as we have used different methodologies, conducting secondary studies, focusing on overall challenges, used synthesis on the basis of these findings, structured leveling, proposed a model and conducted case studies, session groups and using fuzzy AHP technique. Existing literature may have defined one or more challenges in one context or another context. We have covered the overall challenges being faced by vendor organizations in the quality requirement change management scenario. It is the possibility that they have used primary studies. We have used secondary studies. Challenges are only discussed in primary studies and now such model available as we proposed in our research study. In secondary studies, these challenges are grouped to find out the total frequencies of the identified challenges by showing how many researchers have pointed out these challenges. Findings of the research is fit in the existing theory as these identified challenges are then validated with the help of a questionnaire survey, case studies, fuzzy AHP, and session groups. These are the factors through which we can say that our research is innovative and different from the current literature.

This article is one component of our research work. Our model will be based on critical success factors and critical challenges and practices for their possible solution to assist vendor organizations to measure their position in quality requirement change management in the context of global software development.

The challenges identified through SLR in this study will support vendor organizations to handle the challenges faced by them during requirement change management in global software development. This study will ease their work and they will find their status before starting work on requirement change management in global software development.

VI. STUDYT LIMITATIONS

In this study, our focus was only on four search engines and online libraries while using SLR. There is a chance that

TABLE 4. Spearman's rank correlation.

	Sample size find through SLR(n=116)			
	Second Decade(N=33)		Third Decade(N=77)	
	% of occurrence	Rank	% of occurrence	Rank
Incomplete requirements	82	1	79	1
Lack of Communication & Coordination	30	3.5	45	2
Lack of Technological Advancement Tools	30	3.5	40	3
Lack of Cost Estimation	30	3.5	35	4
Lack of end-user & executive support	27	4	31	6.5
Poor Project management	24	5	31	6.5
Poor planning issues	21	6.5	31	6.5
Culture Miscellany	18	7.5	33	5
Lack of knowledge of requirements	18	7.5	29	7
Lack of understanding of standards	24	5.5	23	9.5
Conflict between stakeholders	18	7.5	23	9.5
Managing Uncertainty	21	6.5	21	10
Lack of Quality	09	7	25	8
Lack of Reliance	33	2	14	11

TABLE 5. Cronbach's alpha category for reliability.

Value	Result
If Cronbach's alpha is >.9	Excellent
If Cronbach's alpha is >.8	Good
If Cronbach's alpha is >.7	Acceptable
If Cronbach's alpha is >.6	Questionable
If Cronbach's alpha is >.5	Poor
If Cronbach's alpha is <.5	Unacceptable

we may miss further related research articles by not using those search engines and online libraries as the number of total primary papers was 116. It is also possible that the findings and outcomes may be biased as the research process performed by the first author. However, he was also receiving assistance from the second author in case of some errors and faults done from the first author.

It is also a possibility that we may not be able to present the requirement change management challenges in the right way. It is also possible that we may have created some biased results because of using multiple research methodologies. Help will be taken from case studies, for the authentication of our outcomes. Debate on details is shown in section 4. There came some unrelated and unclear papers regarding decade-wise.

VII. CONCLUSION AND FUTURE WORK

Total 116 papers were identified with the help of SLR. We have divided our identified challenges in three decades. Decade 1st starts from 1992-2002, decade 2nd starts from 2003-2012 and decade 3rd from 2013-2021. Purpose was to give touch more and more papers related to our topic and research questions. We can infer from the table that most of the papers about challenges of quality requirement change management are from third decade. It shows that our work has taken an assistance from most recent and updated articles.

From our extracted data, there was a total of 14 challenges as well as critical challenges identified. Challenges with 20% or above than 20% citations were considered critical challenges. Our criteria are low for considering more and more challenges in software outsourcing quality requirement change management process in GSD paradigm having a negative impact. We compared our challenges decade wise as shown in Table 3. This shows that challenges identified are varying from decade to decade.

We have only documented and identified challenges related to requirement change management at this phase. In the next phase, these challenges will be validated with the help of case studies in business outsourcing. The main idea and goal behind this work are to prepare a model called the Software Outsourcing Quality Evaluation Management model (SOQEMM) to assist vendor organizations in managing change in the quality requirement of a business product.

In this stage, we have only identified the challenges of software outsourcing quality evaluation management Model (SOQEMM). Next stage will be validation process. Validation process will be done using case study in an outsourcing business. The keynote of this research is to build a model for vendor firms to assist them in managing quality requirement change.

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having a negative impact on the quality requirement change management process.

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