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Toward successful project management in global software development

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Abstract

Project management in the context of global software development (GSD) is challenging due to a number of issues. This paper has a two-fold objective: (1) to identify the factors from the literature related to the successful project management in GSD and to validate the identified factors in the real-world practice; (2) to map the identified factors to 10 project management knowledge areas of PMBOK. Our results show a positive correlation between the ranks obtained from the literature and the survey. The results of *t*-test (i.e., $t = 1.979$, $p = 0.061 > 0.05$) show that there is no significant difference between the findings of the literature and survey. Our mapping shows that most of the success factors are related to human resource knowledge area. It is anticipated that the identified success factors can be helpful to practitioners for developing strategic implementation of project management activities in GSD environment.

Keywords: Global software development; Project management; Systematic literature review; Empirical study; Knowledge areas

1. Introduction

Low-cost software development has always been the priority of many organizations. If this low-cost development comes with the added advantage of a high-quality product, then it further increases the long-term benefits enjoyed by the organization (Khan et al., 2009). The search for high-quality and low-cost development has led many organizations to use the global software development (GSD) model (Bush et al., 2008; Khan et al., 2011a; Schneidera et al., 2013). GSD is the process whereby a company either has its software developed by geographically distributed teams or contracts all or parts of its software development activities in return for remuneration (Ali-Babar et al., 2007). The majority of companies have adopted GSD to gain several perceived benefits, such as reduced development time, access to skilled human resources at relatively low cost and increased product quality (Ali-Babar et al., 2007; Bush et al., 2008; Khan et al., 2011a). Furthermore, GSD has the potential to shorten the project lifecycle using different time zones to organize a 24/7 development model.

However, the cultural differences associated with geographically distributed teams and different time zones have caused problems for GSD-based projects (Jain and Suman, 2015; Kandjani et al., 2015; McLaughlin, 2003). The following key GSD challenges are faced by such projects: lack of client involvement, lack of knowledge transfer, hidden costs, lack of trust among the outsourcing companies, lack of coordination mechanisms and communication issues (Daim et al., 2012; Damian et al., 2007; Khan et al., 2012, 2011b; McLaughlin, 2003; Miyamoto, 2015; Nidhraa et al., 2013; Parka et al., 2012; Yang et al., 2015). A major challenge is that many organizations endorse global contracts prior to testing their project management

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readiness for a global development activity (Khan et al., 2010b, 2011b). Despite the importance of this issue, little research has been conducted toward improving an organization's project management readiness for GSD. We believe a better understanding of the factors associated with successful GSD project management can assist in improving organizations' project management readiness for GSD projects.

This paper has a two-fold objective: (1) to identify the factors, via a Systematic Literature Review (SLR), related to the successful project management in GSD and to validate the identified factors in the real-world practice; (2) to map the identified factors to 10 project management knowledge areas of PMBOK. This in-depth review provides GSD researchers and practitioners with a body of knowledge by uncovering multifaceted success factors of managing projects in GSD. In addition, the mapping of success factors to project management knowledge areas will inform practitioners what factors are important in each knowledge area for successful project management in GSD. Moreover, the identified success factors can be helpful to practitioners for developing strategies to guide the strategic implementation of project management activities in GSD environment. This review is a first step toward the development of a comprehensive readiness framework for facilitating factor-based project assessment in the context of GSD. We published the initial results of this topic as a short paper at a conference in (Niazi et al., 2013c). This paper is an extended version in which we present the results from our empirical study on the project management success factors in GSD projects. Moreover, the questionnaire survey findings (real-world practice) are included in this paper. We also compare the success factors identified through the Systematic Literature Review (SLR) and real-world practices. Identifying these factors will facilitate the successful completion of GSD projects and lasting relationships between geographically distributed organizations. To this end, we intend to address the following research questions:

Phase 1 objective:
The objective of this phase is to identify project management success factors in GSD organizations from the literature.

RQ1: What success factors are essential for project management success in GSD organizations as identified in the literature?
RQ1.1: What success factors, as identified in the literature, are specifically related to client or vendor organizations?

Phase 2 objective:
The objective of this phase is to validate the findings of phase 1, i.e., SLR.

RQ2: What success factors are essential for project management success in GSD organizations as identified in real-world practice?
RQ2.1: What success factors, as identified from real-world practice, are specifically related to client or vendor organizations?

Phase 3 objective:
In this phase, we are interested in examining whether there are any differences between the results of phase 1 and phase 2.

RQ3. What are the differences between the success factors identified through the literature and real-world practice?

Phase 4 objective:
The objective of this phase is to map the identified success factors to 10 project management knowledge areas of PMBOK.

RQ4. What success factors are specifically related to the 10 project management knowledge areas of PMBOK?

Phase 5 objective:
In this phase, the best practices that can be used to successfully implement project management success factors are identified.

RQ5. What are the best practices for the implementation of project management success factors?

The remainder of this paper is organized as follows: Section 2 describes the motivation. In Section 3, we give an outline of our research methodology. Section 4 describes the research results. Section 5 compares the results of the SLR and the questionnaire survey. In Section 6, we provide the limitations of this study. Section 7 provides conclusions and discusses how the findings from this study can be further used in future research endeavors.

2. Motivation

Client organizations benefit from offshore outsourcing because vendors in developing countries (offshore vendors) typically cost one-third less than onshore vendors and even less when compared with in-house operations (Khan et al., 2010a; Tariq and Khan, 2012). Among the many other reasons for outsourcing, client organizations usually outsource their software development work to offshore locations to reduce development costs and to access highly skilled human resources (Chen et al., 2005; Pokharel, 2011). However, a multitude of risks are involved, such as temporal incompatibility, coordination problems, cultural differences and hidden costs (Chen et al., 2013; Khan et al., 2011b; Piri et al., 2009; Tariq and Khan, 2012; Yang et al., 2015). There are many reasons and solutions for these problems (Khan et al., 2009, 2011b; Laplante et al., 2004; Schneidera et al., 2013). One of the major issues facing organizations is that many clients endorse global contracts with their vendors prior to testing their project management readiness for a global activity (Carmel and Abbott, 2006; Khan and Niazi, 2012). For example, a recent Systematic Literature Review concluded that the Global Software Engineering field is still nascent, and comparatively few empirical studies that can help resolve the problems in this domain have been conducted (Smite et al., 2010). Understanding the issues related to an organization's global project management readiness will help ensure the successful outcome of projects and to maintain long-lasting relationships between clients and vendors in different geographical locations (Minevich and Richter, 2005; Niazi et al., 2013a).

The issues that are fundamental to the success of GSD can be broadly categorized as the 3 Cs — cultural, coordinative and

communicative (Minevich and Richter, 2005). Coordination complexity increases when developers are distributed (Gallivan and Oh, 1999; Yang et al., 2015) and is significantly affected by temporal, geographic and cultural distances between development sites (Carmel and Abbott, 2006). The base development site could quickly become overloaded with work, while remote development sites could remain nearly idle (Oza, 2006). To some extent, the absence of personal contact can be replaced by formalization and discipline (Gallivan and Oh, 1999). A formal definition of roles and associated responsibilities at the start of the project is essential (Obal, 2006). Even when development sites organize their work according to their corporate culture, it is important to synchronize the inter-organizational processes at cooperating development sites. These processes can be aligned by defining common work products at the start of the project. For example, a common vocabulary and templates for requirement specifications, test scenarios, and functional designs can provide project managers with greater insight into work progress at different development sites (Smite et al., 2010).

In addition, communication is hindered by several issues, the most evident of which are language, terminology and culture (Shore and Cross, 2005; Zwikael et al., 2005). It is essential for the development sites to agree on a language that everyone understands to a satisfactory extent before the project begins (Smite et al., 2010). The lack of spontaneous and informal communication may inhibit the ability to establish good relationships and trust. It is difficult for people to trust someone they have never personally met. In agile software development, informal communication is considered to be more useful than formal communication (Layman et al., 2006). However, the opportunities for informal and spontaneous communication across development sites are rare (Shrivastava and Date, 2010). In addition, this communication is often less effective due to cultural differences, language barriers, and organizational boundaries (Nguyen et al., 2008).

Cultural differences frequently appear as one of the key challenges in GSD. Different corporate cultures exhibit diverse working habits, norms, values, patterns of behavior, work ethics, types of communication, quality standards, terminology, types of hierarchy, etc. (Ebert and Neve, 2001). Cultural differences, in turn, impede the ability of software companies to swiftly transfer best practices between development sites (Layman et al., 2006).

A few solutions have been suggested by various authors across different phases of GSD. Most of the literature breaks down the 3Cs into individual units and addressing each by suggesting various strategies or practices as implementation steps. For example, the various intricacies involved across entire project management dimensions are resolved by reformulating the entire organizational structure (Khan et al., 2003). Other authors offer other suggestions: for example, Tsuji et al. (2007) concluded that communication capabilities have a significant impact on the results of GSD projects, and Ericksen and Ranganathan (2006) described the case of one offshore software development outsourcing project that completely failed due to a lack of adequate communication.

To the best of our knowledge, no explicit study (i.e., SLR and questionnaire-based empirical study) has been conducted to identify the success factors of managing GSD projects. This in-depth study is important for both practitioners and researchers to better understand the current state-of-the-art literature in the context of GSD projects and teams. This study uncovers the success factors that assist organizations in understanding and better managing globally distributed software development teams and projects.

3. Research methodology

The objective of our study is to identify the factors that are essential to project management success in GSD organizations. The identification of such factors will help organizations in investigating, understanding and planning GSD projects. To address the research question at hand, we applied the SLR (Kitchenham and Charters, 2007) and empirical survey approaches. The SLR-based approach was first used to survey the literature published in the public domain and to identify the key factors essential to project management success in GSD. Furthermore, to complement our SLR study, we developed an empirical survey questionnaire based on the initial SRL study results. We used the empirical survey questionnaire to further collect data from practitioners. We discuss the research methodologies in detail in the following sections.

3.1. Data collection via systematic literature review

An SLR process (Kitchenham and Charters, 2007) was first used in this research as the main approach to data collection. We choose to use the SLR-based literature survey approach because it is a well-known method for identifying, assessing and analyzing published studies in the public domain. SLR differs from an ordinary arbitrary literature survey. SLR is a formally planned and methodically executed approach to finding, evaluating and summarizing all available evidence on a specific research question. Furthermore, the SLR approach provides a greater level of validity in its findings.

The SLR approach requires a formal SLR protocol before conducting the SLR-driven literature survey. Hence, a systematic review protocol was written to describe the plan for the review. The protocol is described in detail in a technical report (available on request). The major steps in our methodology are as follows:

- Construct a search strategy and then perform the search for relevant studies.
- Perform the study selection process.
- Apply a study quality assessment.
- Extract and analyze data.

These steps are further described in detail in the following sub-sections.

The SLR was undertaken by a team of four researchers, i.e., one student and three academic staff members. All team members participated in all the phases of the SLR process. To reduce personal bias and to improve the SLR process, inter-rater reliability tests were performed at the initial and final selection

phases of the SLR process. The inter-rater agreement analysis is presented in Section 3.1.4.

3.1.1. Search strategy and search

The search strategy is based on the following steps:

- Derive the major terms from Population, Intervention and Outcome.
- Find synonyms and similar spellings of the derived terms obtained above.
- Verify these terms in various academic databases
- Use Boolean operators (the AND operator is used to connect major terms — if allowed) (the OR operator is used to connect synonyms and similar spellings — if allowed).

Based on the above search strategy, we used the following search terms:

- *Population*: global software development (GSD) organizations.
- *Intervention*: project management success factors.
- *Outcome of relevance*: factors for the successful project management of GSD.
- *Experimental design*: SLRs, empirical studies, theoretical studies and practitioner opinions.

We test our terms using various academic databases, and the following terms show potential relevance to the topic:

- *Global software development*: global software development OR GSD OR distributed software development OR multi-site software development OR multisite software development OR global software teams.
- *Project management:* software project management OR software development management OR software process management.
- *Factors*: factors OR causes OR agents OR elements OR aspects OR determinants OR constituents OR ingredients.
- *Contribute*: contribute OR furnish OR provide OR supply.
- *Success*: success OR advance OR progress OR favorable OR effective.
- *Implement*: implement OR apply OR utilize OR device OR mechanize.
- *Practice*: procedure OR form OR method OR perform OR exercise.

The final search string is the following combination:

{Global software development OR GSD OR distributed software development OR multisite software development OR global software teams} AND {Factors OR causes OR agents OR elements OR aspects OR determinants OR constituents OR ingredients} AND {Contribute OR furnish OR provide OR supply} AND {Success OR advance OR progress OR favorable OR effective}.

3.1.2. Digital libraries used

Based on availability, the following digital libraries were used:

- ACM Digital Library (http://dl.acm.org)
- IEEE Explore (http://ieeexplore.ieee.org)
- Science Direct (http://www.sciencedirect.com/)
- Google Scholar (http://scholar.google.com/)
- ISI Web of Science (http://wokinfo.com/)
- Springer Link (http://link.springer.com/)

3.1.3. Inclusion and exclusion criteria

Because these libraries differ in their search mechanisms and capabilities, we tailored our search strings accordingly.

The following inclusion criteria were used:

- Conference proceedings, magazines and journals published after 1980.
- Papers published in any of the primary or secondary resources mentioned previously.
- Studies that focus on answering our research questions.

The following exclusion criteria were used:

- Duplicated or repeated studies.
- Manuscripts written in a language other than English.
- Technical reports and white papers.
- Graduate projects, Masters theses and PhD dissertations.
- Textbooks, whether in print or electronic.

3.1.4. Selection process

The process of selecting relevant articles comprises two parts (Khan et al., 2011a): "an initial selection from the search results of papers that could plausibly satisfy the selection criteria, based on a reading of the title and abstract of the papers; followed by a final selection from the initially selected list of papers that satisfy the selection criteria, based on a reading of the entire papers" (Khan et al., 2011a).

For any paper to pass the selection process, a quality assessment was performed. Four quality criteria were prepared, as shown in Table 1. We finally selected 118 articles that met our inclusion and quality criteria. From the selected papers, we extracted data to address our research questions. The following data were extracted from each paper: publication type, authors, publisher, publication name, publication date, organization size, project size, success factors and best practices.

To reduce researcher bias, the inter-rater reliability test was performed, where the three independent reviewers selected ten publications randomly from the 'total results' and performed the initial selection process. Similarly, the three independent reviewers also randomly selected ten publications from the 'initial selection' list and performed final selection and quality assessment processes.

We used the non-parametric Kendall's coefficient of concordance (W) (Eye and Mun, 2006) to evaluate the inter-rater agreement between reviewers. Kendall's coefficient of concordance (W) value has a range from 0 to 1, with 0 indicating perfect disagreement and 1 indicating perfect agreement. Kendall's coefficient of concordance (W) for the ten randomly selected publications from the 'total results' was 0.87 ($p = 0.0049$), which indicates a good degree of agreement between the results produced by the primary researchers and the independent reviewers. Furthermore, Kendall's coefficient of concordance

Table 1
Study quality assessment.

Criteria	Score	Notes
Are the findings and results clearly stated in the paper?		Yes = 1 No = 0
Is there any empirical evidence on the findings?		Yes = 1 No = 0
Are the arguments well-presented and justified?		Yes = 1 No = 0
Is the paper well-referenced?		Yes = 1 No = 0

(W) for the ten randomly selected publications from the 'initial selection' list was 0.90 (p = 0.0034), which also indicates a good degree of agreement between the results produced by the primary researchers and the independent reviewers.

3.1.5. Data extraction

The total number of articles retrieved after using the search terms in the five electronic databases is shown Table 2. After the initial round of screening by reading the title and abstract, 292 studies relating to five different electronic databases were selected. After reading the full texts in the second screening, 118 primary studies were selected, as shown in Appendix A.

The final selected papers were analyzed using the qualitative Grounded Theory approach (Strauss and Corbin, 1990) to identify the success factors. We identified, labeled and grouped the text related to success factors to general categories of success factors and calculated the frequency. Grounded theory provides an analytical approach by which concepts or factors are identified, named and categorized through the close examination of qualitative data. Furthermore, similar or related factors can be semantically compared and grouped under relevant factor categories.

Initially, 29 success factors were identified. Four researchers carefully reviewed each success factor to minimize any particular researcher's bias and improve the validity of the identified success factors. Once the 29 success factors were reviewed and validated, the relationships between the factors were identified, and the related success factors were grouped into only 18 major success factors.

3.2. Data collection via questionnaire survey

Based on the scope of the research questions and their findings identified by the SLR, a questionnaire/survey was prepared and distributed. The survey was distributed via social media forums, such as LinkedIn, Facebook, Global software development forums and other industry contacts, to various industry professionals ranging from entry-level developers to project managers working across several software and project management domains, such as Windows-based, data processing, real-time systems.

Table 2
Total study counts across literary databases.

Resource	Total results	Initial Selection	Final Selection
IEEE Xplore	639	238	92
ACM	29	14	7
Science Direct	27	10	4
Springer Link	28	13	7
John Wiley	31	17	8
Total	754	292	118

We developed a closed format questionnaire as an instrument to collect the self-reported data, and subsequently, a questionnaire (Appendix B) was developed. The questionnaire was developed using the Google Forms tool, which is available online. The use of the online questionnaire had the added advantage of storing responses in an Excel sheet for later analysis and reference. The questionnaire was based on the success factors (identified via the SLR) that are important for managing GSD projects. The questionnaire also included some open-ended questions that allowed the participants to include additional success factors or comments. The questionnaire was designed to elicit the importance of the identified factors from the participants' perspective. The survey participants were asked to note each factor's relative importance as 'strongly agree', 'agree', 'disagree', 'strongly disagree' or 'not sure'. In addition to success factors, we included a separate section to solicit best practices for the implementation of each success factor. One or two example practices were provided for each project management success factor. Each question in this section begins with the phrase "It is important in your experience of global project management that the best practice to implement a factor should be to".

The questionnaire was tested during a pilot study involving three software engineers from the industry. The final version of the questionnaire was developed based on the pilot study. The final version of the questionnaire is divided into three sections: section one collects demographic data, section two addresses the success factors, and section three is related to best practices. Participants were also assured that the data would only be accessible to the research team and that the research team would not share these data with anyone in a way that could reveal any participant's individual or organizational identity.

3.2.1. Data respondents

Invitations to participants were sent using different methods, ranging from personal contact to using LinkedIn. Next, emails with a link to the web-based survey were sent to participants who agreed to participate in our research study. The participants of the survey are largely based in the global software development industry, with their experience ranging across various domains such as data processing, real-time systems and data migration activities. Furthermore, the profiles of these participants varied, ranging from system analysts to project managers across the broad global software development industry.

All the responses gathered were subjected to cross-response examination to validate their authenticity and relevance to our field of study. We invited a total of 90 GSD practitioners to participate, of which 50 completed the survey, resulting in a response rate of 56%. The completed questionnaires were manually reviewed for correctness and completeness to prevent any irrelevant entries from being included in the survey. Four questionnaires had invalid entries; therefore, they were excluded,

leaving 46 valid responses. The sample profile is shown in Appendix C.

3.2.2. Data analysis method

We used the frequency analysis method to organize the data into group scores because this is helpful for the treatment of descriptive information (Khan and Niazi, 2012). The number of occurrences and percentages of each data variable can then be reported using these frequency tables. Frequencies are helpful for comparing and contrasting within groups of variables or across groups of variables and can be used for both nominal/ordinal and numeric data (Khan and Niazi, 2012). To analyze the identified success factors, the occurrences of success factors in each questionnaire were counted. Finally, the relative importance of each success factor was identified by comparing the occurrences of one factor with the occurrences of the other factors.

4. Results

In this section, we present the identified success factors from the SLR and from the survey.

4.1. Success factors from the SLR (RQ1)

A total of 18 factors essential to project management success in a global software development environment were identified from the SLR, as shown in Table 3. These factors were then arranged in decreasing order of frequency (the frequencies were estimated based on direct as well as hinted references of every factor) from the 118 studies selected in the SLR.

Based on the frequency analysis, the following are the top 5 identified factors:

- Organization structure
- Project managers' skills
- Communication
- Requirement specification
- Cultural awareness

Organizational structure is the most commonly mentioned factor, with a frequency of 62%, i.e., 73 papers. On the global development front, the organizational structure is variably characterized based on the project scope and location. Different projects are managed globally using different structures, such as local programs of global projects, global programs of local projects and global programs (Binder, 2010). Because the organizational structure is a cluster of all these entities, it is the single most important factor to be considered for project management success in GSD.

Another essential factor vital to project management success and cited by more than 58% of the studies is the project manager's skills, which are essential for managing GSD projects. A project management team, constitutes a program manager, a project manager, and an onsite-coordinator, each having variable skills and expertise in managing GSD projects. Blaszczyk (2011), in his survey on operations research tools, cited skills such as strong quantitative aptitude, risk and cost assessment ability, asset management and experience as being essential for a project manager on a global development scale. A project manager is expected to simultaneously complete the project on time and under budget and satisfy all requirements while being transparent to the hierarchy. Jugdev et al. (2007) defined project management as a strategic asset. Other studies by Hobday (1998) and Zika-Viktorsson et al. (2006) stated that multi-project management is as an essential trait of project managers in a GSD (these projects may or may not be interdependent in nature) environment. Another ability of project managers cited by Larson and Gobeli (1988) is the ability to pull out resources from a functional or a matrix type of environment. Moreover, the project manager's prior experience plays a prominent role in the project's success.

Table 3
Factors with respective frequency occurrences (SLR).

Factors	Freq. (n = 118)	%
Organizational structure	73	62
Project managers' skills	69	58
Communication	64	54
Requirement specification	48	41
Cultural awareness	47	40
Trust building	41	35
Collaboration	40	34
Work dynamics	38	32
Shared knowledge	34	29
Team commitment and structure	31	26
Time-zone difference awareness	27	23
Cost assessment	23	19
Roles and responsibilities	17	14
Shared goals	14	12
Customer awareness	11	9
Training	10	8
Time to delivery	9	8
Incremental cycles	7	6

Communication (54%) is the third most frequently mentioned success factor in our study. Because the development sites are spread across geographical boundaries, communication between different sites is very important. Different studies have described the impact of communication on GSD projects: Tsuji et al. (2007) concluded that communication capabilities have a significant impact on the results of GSD projects; Daim et al. (2012) have explored the communication breakdown in global virtual teams; and Erickson and Ranganathan (2006) described the case of one offshore software development outsourcing a project that completely failed due to a lack of adequate communication. Communication can generally be categorized as two types: synchronous and asynchronous. By synchronous communication, we mean face-to-face meetings and discussion with team members and clients. Because GSD is different from collocated development due to the geographical separation of teams, communicating face-to-face is not possible unless team members travel between development sites. A lack of face-to-face meetings can affect other project management challenges and cause a misunderstanding of requirements, a lack of team awareness and a lack of trust in GSD. Hence, GSD relies on other synchronous and asynchronous communication channels such as e-mail, voice mail, instant messaging, teleconferencing and web conferencing to promote communication. Bannerman et al. (2012) stressed the

importance of a documented type of communication as an essential means of control for a project management team. This includes communication to all teams in relation to the availability of training and help documents for the entire project, documentation on team gathering meetings and project progress, and the utilization of asynchronous modes of communication, among others.

Requirement specification was mentioned in 41% of the articles. We believe that requirement specification is important because it is an official statement of the system requirements for customers, end-users, software developers, system test engineers and system maintenance staff. Moreover, the requirement document can act as a contract between customers and developers. The key to requirement specification is to present the idea of a shared understanding. Specifically, all parties should be able to read this document as if it were their own.

In our study, 40% of the articles mentioned cultural awareness as one of the project management success factors in GSD projects. This is because in a global software environment, the development sites are spread across the globe, which introduces cultural challenges that the project manager must address. Due to cultural differences, it is always challenging for both client and vendor organizations to communicate with each other because their native languages will generally not be the same. Messages can be misinterpreted by different cultures (Shore and Cross, 2005; Zwikael et al., 2005), which can cause confusion and misunderstandings between different teams. Hence, we can deduce that cultural awareness can improve other project management success factors such as communication and trust.

Furthermore, Fernández-Sanz and Misra (2012), in their analysis of the cultural influence on GSD projects and project management teams, stress improving cultural understanding techniques such as holding cultural meetings; assigning importance to collaborative teamwork, especially across teams from different cultures; promoting cross-cultural development; enforcing cultural understanding improvement skills; encouraging cross-cultural team discussions and recording the minutes of the discussion; and analyzing the project's progress. Similarly, Dexia (2009), in his efforts to evaluate competing Chinese firms for GSD projects, categorized various factors as macroscopically significant in project management success, among which he rated cultural understanding and awareness as critical. According to his study, an understanding of local cultures is essential for gauging the local political environment, customer preference, legal issues, etc. that play a significant role in shaping the project's future, especially in regard to the vendor, where most of the project development is carried out. Zwikael et al. (2005) have also identified significant cultural differences of project management styles in Japan and Israel.

4.1.1. Success factor categorization with respect to the client–vendor relationship (SLR)

After carefully reading each selected paper, a client–vendor categorization was made for the identified factors. Table 4 shows the client and vendor countries where research was conducted for the papers included in our SLR study. A total of 32 studies were carried out in the United States, perhaps because large and medium-to-large organizations in the USA have adopted GSD and have outsourced software development tasks to countries such as India and China. However, many studies have also been carried out in eastern Asian countries such as India, China, and Pakistan because these countries provide vendor services in GSD projects. Other geographic locations include the Netherlands and the United Kingdom, where communication is carried out in the English language, and these countries are more or less culturally similar. We categorized these countries as client and vendor organizations.

Verner et al. (2014) conducted an SLR and found that the current literature's main focus is on vendor instead of client organizations. Therefore, we performed the Fisher Exact test on the success factors shown in Table 5 to identify the viewpoints of these two important types of organizations in GSD.

A comparison of the success factors identified in client and vendor organizations indicates that there are some similarities and differences between the success factors. Our findings show that 'communication' (62%, and 51%), 'organizational structure' (79% and 53%) and 'project managers' skills' (69% and 53%) are the most common success factors in client and vendor organizations.

We have identified eight significant differences (i.e., $p < 0.05$) between the client and vendor organizations, as shown in Table 5. It is noteworthy that more of the vendor organizations (44%) are aware of the time-zone differences compared to client organizations (13%). Time-zone awareness is one of the important success factors in GSD, and all organizations participating in GSD should be aware of its importance. Table 5 shows that organizational structure is found to be relevant in nearly 74% of the vendor organizations, while on the client side, significance is found for only 53% of the organizations. This result indicates a significant difference in the experiences of client and vendor organizations. Other factors with a high degree of difference or low p-value are collaboration (51%, 25%) and cultural awareness (56%, 32%). This is expected because most of the vendor PMGs are situated in Asiatic locations, while clients are spread across the West. The Asian companies need to collaborate to better understand the client requirements of the West and to adapt to their work styles and cultural preferences to obtain projects and to successfully complete them. Hence, factors such as collaboration and cultural awareness exhibit a low p-value (.007 and .016). The same scenario can be

Table 4
Study count based on countries (SLR).

Client countries	Count	Vendor countries	Count
Australia	4	Brazil	6
Canada	3	China	4
Croatia	1	India	15
Finland	7	Iran	1
Germany	7	Eastern Europe	2
Netherlands	7	Malaysia	3
New Zealand	3	Mexico	1
Sweden	2	Pakistan	2
UK	13	Singapore	2
USA	32	Spain	3
Total	79	Total	39

Table 5
Fisher Exact analysis for success factors with respect to client–vendor categories (SLR).

Factors	Vendor (n = 39)		Client (n = 79)		Fisher exact test α = .05
	Freq.	%	Freq.	%	
Collaboration	**20**	**51**	**20**	**25**	**.007**
Communication	24	62	40	51	.327
Cost assessment	**12**	**31**	**11**	**14**	**.046**
Cultural awareness	**22**	**56**	**25**	**32**	**.016**
Customer awareness	2	5	9	11	.334
Incremental cycles	1	3	6	8	.423
Organizational structure	**31**	**79**	**42**	**53**	**.008**
Project managers' skills	27	69	42	53	.114
Requirement specification	20	51	28	35	.114
Roles and responsibilities	7	18	10	13	.578
Shared goals	3	8	11	14	.383
Shared knowledge	15	38	19	24	.131
Team commitment and structure	**16**	**41**	**15**	**19**	**.014**
Time to delivery	2	5	7	9	.716
Time-zone difference awareness	**17**	**44**	**10**	**13**	**.000**
Training	2	5	8	10	.494
Trust building	**20**	**51**	**21**	**27**	**.013**
Work dynamics	**18**	**46**	**20**	**25**	**.035**

Eight significant differences (i.e., $p<0.05$) between the client and vendor organizations.

observed for factors such as cost assessment (31%, 14%), team commitment and structure (41%, 19%), trust building (51%, 27%) and work dynamics (46%, 25%), which all have p-values <0.05. This may be because vendor organizations are more considerate of team structuring, cost, trust building and role sharing compared to their client counterparts, who are more concerned with the overall project completion.

4.2. Success factors from the software industry (RQ2)

In the second step of our research, we used the questionnaire survey developed using the success factors identified in the SLR-based survey study. The responses were divided into three main categories, positive, negative and neutral, as shown in Table 6. Positive refers to the responses asserting the listed factors as necessary for successful GSD project management. Negative, however, implies that a particular factor is not perceived as a success factor. Neutral implies that the respondent is unaware or unsure of the impact of the factor as a success factor in managing a GSD project.

A significant observation here is that, except for communication, none of the factors are devoid of negative influence on the overall project management success. Not surprisingly, communication also stands out as the highest rated factor. This stems from the practitioners' belief that if communication is comprehensive and transparent, it directly affects the functioning of the project management team, which is managing and guiding work at various offshore locations.

Practitioners across various experience levels have identified the roles assigned to them as a major factor in project management success. Of the total respondents, 98% agree that the roles and responsibilities assigned to them are essential for the smooth and efficient functioning of the team, especially in cases where the team is distributed across different geographical locations. This leads to increased trust and expectations of the project management team and commitment from the entire team to the project goals and project managers' objectives. This is made possible using the latest asynchronous and synchronous as well as coherent collaborative technologies. Hence, most of the respondents (93%) consider trust building as an important factor for the success of the project management team.

Most of the practitioners surveyed were part of project management teams working in tandem with other project management teams across various geographical locations worldwide. Hence, they rated project managers' skills as a highly crucial factor in project management success in GSD. Standing at a 96% positive impact rate, the skills necessary for a project manager have been identified to vary across a wide range of capabilities, such as knowledge of the project, an understanding of the current market situation and scenarios, leadership qualities, ability to understand employee problems, and an aptitude to identify project gaps. It is noteworthy that approximately 4% of the respondents who failed to identify project management as an essential factor were either junior-level respondents or people with less than 6 years of experience. Other important success factors are cultural awareness (96%), requirement specification (96%), team commitment and structure (93%) and training (96%).

Surprisingly, work dynamics, which includes the non-functional aspects of the project such as coherence, coercion and cohesiveness, was negatively and neutrally rated by 35% of the respondents. This can be attributed to the fact that most of the respondents did not have a clear idea of the degree to which these non-functional aspects have an influence on the project management team and on the product itself.

Table 6
Impact on factors based on practitioner views (survey).

Factors	Practitioners' view(n = 46)					
	Positive impact		Negative impact		Not sure	
	Freq.	%	Freq.	%	Freq.	%
Collaboration	43	93	1	2	2	4
Communication	46	100	–	0	–	0
Cost assessment	35	76	2	4	9	20
Cultural awareness	43	93	3	7	–	0
Customer awareness	40	87	6	13	–	0
Incremental cycles	30	65	6	13	10	22
Organizational structure	42	91	2	4	2	4
Project managers' skills	44	96	2	4	–	0
Requirement specification	44	96	1	2	1	2
Roles and responsibilities	45	98	1	2	–	0
Shared goals	27	59	8	17	11	24
Shared knowledge	34	74	5	11	7	15
Team commitment and structure	43	93	2	4	1	2
Time to delivery	30	65	8	17	8	17
Time–zone difference awareness	32	70	6	13	8	17
Training	44	96	2	4	–	0
Trust building	43	93	2	4	1	2
Work dynamics	34	74	1	2	11	24

Most factors were rated on-par with the findings of the SLR, and hence, the incremental cycle was yet again given a low mention and rate, with only 65% of the respondents agreeing that it has a positive impact on project management success. Very few practitioners disagree that customer awareness is essential to the project management team's objective and goals when designing a project and control steps to achieve it. Time-zone awareness is a concerning factor to 70% of the respondents, and 13% of respondents fail to consider it as a positive impact factor.

4.2.1. Success factor categorization with respect to the client–vendor relationship (survey)

In the questionnaire, a demographic field asked for the correspondents' company role (i.e., client or vendor) in GSD. The responses gathered reflect the experiences of practitioners from client and vendor organizations spread across the globe. As most of the practitioners were contacted via personal and online social media contacts, more than 52% of the contacts were located or based in India (i.e., vendor). This is in agreement with the fact that most practitioners are working on GSD-based project companies in India (a hub for IT/GSD outsourcing), as shown in Table 7.

The questionnaire also included responses from Middle Eastern medium-scale set-ups from the countries of Saudi Arabia and Jordan (newly emergent vendors), signifying a nascent but promising interest in global software development. Approximately 15% of the responses were received from the Americas, including the United States and Canada (Clients). Table 8 gives a client–server-based analysis of each factor.

Table 8 shows that clients place greater importance on cultural differences and collaboration of the offshore sites and, hence, agree completely with cultural awareness and collaboration being crucial factors. However, vendors are more concerned with the type of work that they are assigned and the responsibilities that they undertake, hence, rating roles and responsibilities at 100%. Communication is equally important in client and vendor organizations.

An interesting observation is that we did not identify any significant differences in the experiences of client and vendor practitioners, as shown in Table 8. These findings indicate that client and vendor organizations are aware of the factors that can play a positive role in global project management and they perceive that all the identified success factors are equally important. However, the small number of respondents from client organizations may limit the likelihood of finding statistically significant differences.

4.3. Comparison of the two data sets (RQ3)

The factors identified earlier via the SLR are marked against the factors identified via real-world practice/expert experience. During the SLR, the frequency was calculated for every factor. Similar frequencies based on a 5-grade system (strongly agree, agree, disagree, strongly disagree, neutral) were calculated for factors identified through practitioners' opinions. Because the frequencies estimated via the SLR were cumulative and because the frequencies estimated via the 5-grade system were subjective, a common measure was needed to scale these frequencies with respect to one another to identify the similarities, differences and relative dependencies between the two data sets. This is shown in Table 9.

Table 7
Country-based count for industry data (survey).

Country	Count	%
Australia	1	2.2%
Bolivia	1	2.2%
Canada	1	2.2%
Germany	1	2.2%
India	24	52.2%
USA	7	15.2%
Singapore	1	2.2%
Switzerland	1	2.2%
Jordan	2	4.3%
New Zealand	1	2.2%
Saudi Arabia	6	13%
Total	46	100%

Of the various techniques available, the Spearman correlation coefficient technique provides a clear and concise approach. It gives the linear dependence between two entities, with values ranging from −1 to +1, with 1 indicating a total linear dependency.

To identify the statistical dependence between the ranks of two variables (i.e., SLR and questionnaire), the Spearman's Rank Order Correlation was conducted. The Spearman's correlation coefficient, rs, is 0.641 and that is statistically significant ($p = .004$). The rs, =0.641 shows the strong positive correlation between the ranks obtained from the two data sets, i.e., when the rank of the factors identified via SLR increases then the rank of the factors identified via questionnaire survey also increases and vice versa. The $p = .004$ shows that the correlation is statistically significant between the ranks of SLR and questionnaire.

In addition to the Spearman's Rank Order Correlation, we have compared the mean differences of SLR and questionnaire. The group Statistics for the SLR and the questionnaire are also as follows:

$$\text{SLR} : \text{mean} = 33.5, \text{std.deviation} = 20.912, \text{std.error mean} = 4.929$$

$$\text{Survey} : \text{mean} = 23.06, \text{std.deviation} = 8.003, \text{std.error mean} = 1.886$$

The independent *t*-test results, as shown in Table 10, show that the Levene's test is significant (i.e., $.001 < 0.05$), so we have to take the option for "equal variances not assumed". Based on this assumption, the results of *t*-test (i.e., $t = 1.979$, $p = 0.061 > 0.05$) show that there is no significant difference between the findings of SLR and the questionnaire. This shows the level of agreement between literature and the real-world practice.

Table 8
Fisher Exact analysis of success factors with respect to client–vendor categories (survey).

Factor	Occurrence in survey (n = 46)												Fisher exact test α = 0.05
	Client (n = 13)						Vendor (n = 33)						
	Positive		Negative		Not sure		Positive		Negative		Not sure		
	Frq.	%	Frq.	%	Frq.	%	Frq.	%	Frq.	%	Frq.	%	
Collaboration	13	100	0	0	0	0	30	91	1	3	2	6	1.000
Communication	13	100	0	0	0	0	33	100	0	0	0	0	–
Cost assessment	12	92	0	0	1	8	23	70	2	6	8	24	0.367
Cultural awareness	13	100	0	0	0	0	30	91	3	9	0	0	0.548
Customer awareness	11	85	2	15	0	0	29	88	4	12	0	0	1.000
Incremental cycles	9	69	3	23	1	3	21	64	3	9	9	0	0.214
Organizational structure	13	100	0	0	0	0	29	88	2	6	2	6	1.000
Project managers' skills	13	100	0	0	0	0	31	94	2	6	0	0	1.000
Requirement specification	13	100	0	0	0	0	31	94	1	3	1	3	1.000
Roles and responsibilities	12	92	0	0	1	8	33	100	0	0	0	0	0.283
Shared goals	7	54	4	31	2	15	20	61	4	12	9	27	0.354
Shared knowledge	9	69	2	15	2	15	25	76	3	9	5	15	0.865
Team commitment and structure	12	92	1	8	0	0	31	94	1	3	1	3	0.641
Time to delivery	9	69	3	23	1	8	21	64	5	15	7	21	0.577
Time-zone difference awareness	10	77	2	15	1	8	22	67	4	12	7	21	0.598
Training	12	92	1	8	0	0	32	97	1	3	0	0	0.490
Trust building	13	100	0	0	0	0	30	91	2	6	1	3	1.000
Work dynamics	10	77	0	0	3	23	24	73	1	3	8	24	1.000

To further analyze the two datasets, we have compared the SLR client results with the questionnaire client results. The group Statistics for the client–client are also as follows:

$$\text{SLR} : \text{mean} = 24.22, \text{std.deviation} = 15.183, \text{std.error mean} = 3.579$$

$$\text{Survey} : \text{mean} = 59.17, \text{std.deviation} = 21.582, \text{std.error mean} = 5.087$$

Table 9
Ranked frequencies for Industry and SLR data sets.

Factors	Occurrences in SLR (n = 118)		Factors strongly agreed upon by practitioners (n = 46)	
	%	Rank	%	Rank
Collaboration	40	7	25	7
Communication	64	3	39	1
Cost assessment	23	12	10	18
Cultural awareness	47	5	34	3
Customer awareness	11	15	18	13
Incremental cycles	7	18	14	16
Organizational structure	73	1	24	9
Project managers' skills	69	2	35	2
Requirement specification	48	4	29	4
Roles and responsibilities	17	13	28	5
Shared goals	14	14	13	17
Shared knowledge	34	9	17	14
Team commitment and structure	31	10	25	8
Time to delivery	9	17	19	11
Time-zone difference awareness	27	11	17	15
Training	10	16	24	10
Trust building	41	6	26	6
Work dynamics	38	8	18	12

The *t*-test results (i.e., $t = -5.618$, $p = 0.000 < 0.05$), as shown in Table 11, show that there is a significant difference between the findings of the SLR client results and the questionnaire client results. This indicates that the client results of research and practice are not in agreement.

Similarly, we have compared the SLR vendor results with the questionnaire vendor results. The group Statistics for the vendor-vendor are also as follows:

$$\text{SLR} : \text{mean} = 36.83, \text{std.deviation} = 24.223, \text{std.error mean} = 5.709$$

$$\text{Survey} : \text{mean} = 5.709, \text{std.deviation} = 17.572, \text{std.error mean} = 4.142$$

The *t*-test results (i.e., $t = -1.150$, $p = 0.258 > 0.05$), as shown in Table 12, show that there is no significant difference between the findings of the SLR vendor results and the questionnaire vendor results. This indicates that the vendor results of research and practice are in agreement.

4.4. Mapping of success factors to 10 knowledge areas of project management (RQ4)

PMBOK has identified 10 knowledge areas of project management. Each knowledge area describes the key competencies that project managers must develop (PMI, 2014). All knowledge areas are categorized into following three categories (PMI, 2014):

- Specific project objectives knowledge area, i.e., scope, time, cost, and quality

Table 10
Independent samples *t*-test (SLR and questionnaire).

		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	
									Lower	Lower
Factor	Equal variances assumed	12.872	.001	1.979	34	.056	10.444	5.278	−.281	21.170
	Equal variances not assumed			1.979	21.875	.061	10.444	5.278	−.505	21.393

- Facilitating knowledge areas through which the project objectives are achieved, i.e., human resources, communication, risk, procurement management and stakeholder management
- One knowledge area is affected by all of the other knowledge areas, i.e., project integration management.

It is important to mention that all the knowledge areas are important. Hence we decided to map all the identified success factors to 10 knowledge areas of project management in order to inform practitioners what factors are important in each knowledge area for successful project management in GSD.

The finally selected 18 success factors were analyzed using the qualitative Grounded Theory approach (Strauss and Corbin, 1990) to identify the relevant project management knowledge area. Three researchers were involved in the mapping process in which we labeled and grouped the related success factors into a relevant project management knowledge area. Our mapping shows that most of the success factors are related to human resources and communication knowledge areas as shown in Table 13. One factor was mapped to each of scope, time and cost knowledge areas. No success factor was mapped to integration, risk and procurement knowledge areas. These results are is in line with the finding of Kwak and Ibbs (2000) in traditional project management (i.e., not in GSD projects) where risk management is the least matured and practiced knowledge area. The same applies for procumbent which scored low maturity in IT projects.

This mapping of success factors has both research and practical implications. Based on the SLR and questionnaire survey, this study provides a set of factors for project management success in GSD, which serves as a knowledge-base for both researchers and practitioners. Mapping of success factors is important for researchers, so that they can focus on further research in high priority areas of project management in GSD. It is also anticipated that the mapped success factors can be helpful to practitioners for developing strategies and policies to guide the strategic implementation of project management activities in GSD environment. In addition, the mapped success factors will guide the investment decisions in important and high priority knowledge areas. Our objective is to provide organizations with a body of knowledge that can facilitate the successful project management in GSD projects.

4.5. Best practices for the implementation of global project management success factors (RQ5)

The best practices for the implementation of global project management success factors are summarized in Appendix D. These practices were identified from software practitioners via a questionnaire-based approach. In the questionnaire, each participant was asked to provide a list of best practices that can be used to implement the identified project management success factors.

Initially, more than 200 practices were identified from the software industry through the questionnaire. Four researchers carefully reviewed each practice using the qualitative Grounded Theory approach (Strauss and Corbin, 1990) and then identified and grouped the related practices into 132 practices, as shown in Appendix D.

Table 11
Independent samples *t*-test (client–client).

Independent samples test										
		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	
									Lower	Upper
Factor	Equal variances assumed	2.790	.104	−5.618	34	.000	−34.944	6.220	−47.584	−22.304
	Equal variances not assumed			−5.618	30.517	.000	−34.944	6.220	−47.638	−22.251

Table 12
Independent samples *t*-test (vendor–vendor).

Independent Samples Test										
		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	
									Lower	Upper
Factor	Equal variances assumed	2.522	.122	−1.150	34	.258	−8.111	7.053	−22.445	6.223
	Equal variances not assumed			−1.150	31.012	.259	−8.111	7.053	−22.496	6.274

5. Discussion and summary of results

In this paper, we identified the success factors of project management in GSD projects. Our research goal is to develop a global project management readiness framework to measure organizations' project management readiness for successful GSD activities. The identified factors represent some key project management knowledge areas where practitioners should focus their attention to have better control over these factors for the successful management of GSD projects. To analyze the criticality of a particular challenge, we used the following criterion:

- The factor is considered significant if it is cited in the literature with a frequency of greater than or equal to 50% or if the question is answered as strongly agree or agree in the survey questionnaire with a frequency of ≥ 50%.

This criterion has been used in previous research studies (Khan et al., 2011a; Niazi et al., 2008).

Table 13
Project management knowledge areas and identified success factors.

Knowledge area	Challenge/success factors
1. Integration	
2. Scope	• Requirement specification.
3. Time	• Time to delivery
4. Cost	• Cost assessment
5. Quality	• Work dynamics
	• Incremental cycles
6. Human resources	• Trust building
	• Cultural awareness
	• Training
	• Project managers' skills
	• Roles and responsibilities
7. Communication	• Communication
	• Collaboration
	• Time-zone difference awareness
	• Organizational structure
	• Shared knowledge
	• Team commitment and structure
8. Risk	
9. Procurement	
10. Stakeholder	• Customer awareness
	• Shared goals

To answer the first research question (RQ1), an exhaustive list of success factors was compiled from the literature via SLR. Using the above criterion, organizational structure (62%), project manager skills (58%) and communication (54%) were identified as being the most important factors for project management success in GSD.

The factors identified via the SLR process were distributed across client and vendor organizations (RQ1.1). A summary of these factors is shown in Table 14. We identified three highly cited factors that are common to client and vendor organizations (Communication, Organizational structure and Project managers' skills). However, we also identified eight factors with significant differences.

One important point to be noted is that none of the factors identified via SLR have been deprecated or annulled by the real-world industry practitioners. In addition, the practitioners failed to mention any new factor in the survey. To answer RQ2, using the criterion defined above, we identified the following frequently cited factors from real-world enterprises (strongly agree):

- Collaboration (54%)
- Communication (83%)
- Cultural awareness (72%)
- Organizational structure (52%)
- Project managers' skills (74%)
- Requirement specification (63%)
- Roles and responsibilities (59%)
- Team commitment and structure (54%)
- Training (52%)
- Trust building (54%)

To answer RQ2.1, using the criterion defined above, we identified the frequently cited factors from practitioners of client and vendor organizations, as shown in Table 14.

Once the most and least-significant factors were identified from the literature and the industry study, a rank-based correlation was estimated using the Spearman correlation to answer RQ3. The following conclusions were made:

- The correlation results exhibited a Spearman correlation coefficient value of $r_s = 0.641$ and a p-value = 0.004.
- This result suggests that the two data sets or the factors identified via the SLR and the questionnaire exhibit a strong

Table 14
Summary of factors based on client and vendor categorization.

Type	No. of success factors	No. of factors above frequency threshold
SLR		
Client (n = 79)	18	3 factors: • Communication • Organizational structure • Project managers' skills
Vendor (n = 39)	18	7 factors: • Collaboration • Communication • Cultural awareness • Organizational structure • Project managers' skills • Requirement specification • Trust building
Questionnaire		
Client (n = 13)	18	All 18 factors
Vendor (n = 33)	18	All 18 factors

positive correlation and also this correlation is statistically significant, i.e., very similar to each other.

The independent *t*-test was also used to answer RQ3. The results of *t*-test (i.e., $t = 1.979$, $p = 0.061 > 0.05$) show that there is no significant difference between the findings of SLR and questionnaire. The client–client analysis shows that the results of research and practice are not in agreement. On the other hand, vendor–vendor analysis shows that the results of research and practice are in agreement. Further research is needed to find out the underlying reasons behind these results.

For our RQ4 we have mapped the identified success factors to 10 knowledge areas of project management. Our mapping shows that most of the success factors were related to human resources and communication knowledge areas; this may indicate the maturity of these knowledge areas. Furthermore, no success factor was mapped to integration, risk and procurement knowledge areas.

6. Limitations

The scope of the SLR was limited to project management success factors in GSD. We limited our SLR study to five research publication databases (i.e., IEEE Xplore, ACM, John Wiley, Science Direct and Springer Link). However, there are other related research databases that we did not consider in our study that may include relevant publications. Furthermore, with the increasing number of research papers published on this topic, some recent and relevant publications could have been missed during the consolidation of the results of the SLR. Nevertheless, we believe that our presented results are comprehensive and cover the most relevant published literature.

We did not exclude literature reviews and SLRs in our SLR study. One possible limitation is that any included literature reviews or SLR results can presumably aggregate studies that we also considered as individual studies. There is also a risk of double counting primary study results. We are fully aware of this limitation, and to ensure transparency, we performed a study strategy analysis and provided the results in Table 5, which shows the results of each study strategy used. In conducting different SLRs, we observed that it is a common practice not to exclude any SLRs (Fabio et al., 2010; Khan et al., 2011b; Nidhraa et al., 2013). However, if project managers or researchers are interested in seeing the results without literature reviews or SLRs, one only needs to exclude the "LR" or "SLR" column in Table 5.

With respect to the questionnaire survey, construct validity focuses on the measurement scales and whether they denote the attributes being measured. One possible limitation of construct validity is that the practitioners might have interpreted success factors differently. We do not have any evidence for this limitation because nobody has reported any issues in this regard. However, the factors used in our work were taken from a very large body of research (Kitchenham and Charters, 2007; Niazi and Ali Barbar, 2008; Niazi and Babar, 2009; Niazi et al., 2013b). Internal validity is concerned with an overall assessment of the results. The pilot study results provided internal validity because the factors included in the study were the result of a detailed literature review and pilot questions. Furthermore, external validity focuses on the generalization of the results for all domains (Regnell et al., 2000). We may not be able to generalize our research findings because the number of respondents from client organization is small and in addition the majority of the surveyed practitioners were from Asia. Therefore, this research should be considered as an ongoing work to be revised and extended by future researchers because these challenges are dynamic in nature.

7. Conclusion and future work

Global software development has become a well-established paradigm (Damian and Moitra, 2006). It can be asserted that managing the GSD project is expected to be far more complex and difficult because of the new challenges such as misunderstanding of the projects' requirements, cost and effort estimation, risk management, allocation of tasks and lack of coordination (Niazi et al., 2013b; Saxena and Burmann, 2014; Verner et al., 2014). Our objective is to provide GSD organizations with a body of knowledge that can facilitate the successful performance of project management activities in GSD.

Many companies are adopting GSD to reduce software development costs and improve quality. Vendor organizations are struggling to compete internationally in terms of attracting software development projects. Due to the increasing trend of GSD, we are interested in discovering project management success factors and their implementation in GSD projects. We used two research approaches to identify these success factors: SLR and a questionnaire survey. Of the 18 identified factors, we found that organizational structure, project managers' skills, communication and collaboration are the most commonly

mentioned success factors. We recommend that GSD organizations focus more on the frequently cited factors identified in both data sets. Our results show a positive correlation between the ranks obtained from the SLR and the questionnaire-based empirical study. We expect that the findings of this research will assist project management professionals in designing more effective strategies for successfully managing GSD projects. It is also anticipated that the identified success factors will help in developing strategies and policies to guide the strategic implementation of project management knowledge areas in GSD environment.

Conflict of interest

The authors do not have any conflict of interest to report.

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Appendix A. Supplementary data

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