Analyzing Factors That Influence Offshore Outsourcing Decision of Application Maintenance

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ABSTRACT Application maintenance consumes a considerable amount of an organization's time and resources each year. Almost 60% of IT budget is spent alone on application maintenance. The reason of offshore outsourcing of application maintenance is not only the reduction of maintenance cost but to free up the resources and to keep the focus on core products. Offshore outsourcing is a common business strategy that is used by companies to achieve cost savings about 20-50%. However, the decision making process of application maintenance is a complex phenomenon. It is based on a set of influencing factors, clients' requirements and nature of the project. Hence, the current study is aimed at the in-depth investigation of the complex sourcing decision process of application maintenance. Accordingly, a systematic literature review is performed to determine the influencing factors and critical success factors that will be used by the decision makers for the evaluation of projects before making the outsourcing decisions. A total of 15 influencing factors out of 52 selected papers were identified. Based on the defined criteria, amongst the identified factors, only 10 factors were ranked as critical success factors, which are employees' skills, cost, legal requirements, infrastructure, communication, knowledge transfer, maturity level, project management, language barrier and frequent requirements changes. Consequently, a sourcing model was proposed based on the identified critical success factors that help the IT managers and domain experts in making appropriate outsourcing decisions.

INDEX TERMS Application maintenance, critical success factors, influencing factors, offshoring, outsourcing, outsourcing decisions.

I. INTRODUCTION

Global Software Development (GSD) makes use of globally dispersed resources to develop software. Companies have followed this approach for the last two decades to get cost efficient solutions. It is a business strategy to achieve high quality products with low cost by utilizing resources of low wage countries as well as to access highly skilled and global pool of resources. The idea of GSD paradigm is to collaborate and perform a project together by software engineers and developers from different time zones and different geographical locations with cultural diversity [1]–[3].

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In offshore outsourcing, an organization contracts out the whole software or a portion of its application to a vendor that is based in another country. In other words, offshore outsourcing is a form of outsourcing where the contracted vendor is located in another country. It is a common strategy that companies use to achieve cost savings of about 20-50%. The companies of leading countries such as US, UK, Japan and Australia are getting services and act as clients. Whereas the companies based in low wage countries like China, India, Ireland, and Russia that provide services and act as vendors. Outsourcing covers a range of business services, including Information Technology (IT), financial services, logistics, and management of human resources. IT outsourcing has further sub categories such as application development,

the management of infrastructure, application maintenance and business process outsourcing [3]–[6].

The process of software restoring to its original position is called software maintenance. Software maintenance is broadly categorized as preventive, corrective, perfective and adaptive. It deals with addressing the problems in the operational system as well as it bridges the gap between the system and the requirement specifications. Today, most of the organizations' IT budget is consumed by application acquisition and software maintenance services. Only the cost of software maintenance is approximately 60% out of the total IT budget. In order to reduce this high cost of application maintenance, organizations have started to adopt the offshore outsourcing strategy. It is a common business strategy for quality software development and maintenance at low cost. The strategy of offshore outsourcing is used by companies to achieve cost savings of about 20-50% [4].

However, the decision making process of application maintenance is a complex phenomenon. It is based on a set of influencing factors, clients' requirements and nature of the project. In spite of the importance of offshore outsourcing of application maintenance and the complexity involved in the process of outsourcing decisions; the literature shows that very little research has been focused on the offshore outsourcing decision of application maintenance. Especially, scared systematic literature reviews can be seen in literature in the domain of offshore outsourcing decisions of application maintenance that focus on the identification of factors that have a high impact on sourcing decisions. Thus, a comprehensive study is needed in order to investigate and analyze the factors that have a high impact on the offshore outsourcing decision of application maintenance. To address the research gap a systematic literature review is performed in order to provide an in-depth understanding of the outsourcing process's complexity by identifying a set of influencing factors. The identified factors will help the experts, decision makers and IT managers in making appropriate decisions that may ensure the successful outsourcing of projects.

A. RESEARCH OBJECTIVE

The current study aims to address the complex phenomenon of the sourcing decision regarding application maintenance. The objective of the current paper is to identify and analyze the factors that have high impact on offshore outsourcing decision. In order to achieve the research objectives, a systematic literature review is performed. The findings of the study are analyzed based on decades and study strategy. Moreover, critical success factors are derived from the identified influencing factors through the defined criteria and a sourcing model is proposed that is based on the critical success factors.

The following defined questions are addressed in order to achieve the aforementioned objectives.

RQ1: What are the influencing factors of offshore outsourcing decisions regarding application maintenance?

RQ2: Do the identified influencing factors vary from decade to decade?

RQ3: How the identified influencing factors related to the study methodology/strategy?

RQ4: What are the factors to be ranked as critical factors amongst the influencing factors?

RQ5: How the identified critical success factors influence offshore outsourcing decisions of application maintenance?

RQ6: How to propose a model for the offshore outsourcing decision of application maintenance?

B. PAPER OUTLINE

The rest of the paper is arranged as follows: Section II explains the research background, while section III, shows the research methodology. Section IV and V present results and analysis; and study limitation, whereas section VI, contains conclusion and future research work.

II. STUDY BACKGROUND AND MOTIVATION

The outsourcing trend of IT has received a remarkable attention among the scholars as well as practitioners over the last two decades. Literature review shows that there is a vast amount of research that addressed the issues, challenges and risks of IT outsourcing and outsourcing decisions [7]. Soliman [8] conducted research on the global outsourcing decision from the vendor perspective of application services. To address this issue, a set of influencing factors were identified and a framework was developed based on identified factors. These factors are IT experts, quality of the product, cost, cultural diversity, incentives of tax and communication technology. Khan *et al.* [6] conducted the literature review as well as a questionnaire survey that identify six critical challenges and 75 practices. Consequently, a model was proposed based on the findings of both literature review and empirical study. The proposed model will be used to provide solutions for the communication issue in the GSD. Khan and Khan [9] performed a literature review to identify challenges for the management of offshore outsourcing contracts during the software development. A list of 15 challenges was determined that are faced by vendor in GSD. Only 9 challenges were ranked as critical for offshore outsourcing contract management.

A systematic review was conducted by Khan *et al.* [1] to determine critical barriers of project management for software projects in multi sourcing environment. The study presented 23 barriers for multi-sourcing, out of which 16 were tagged as the critical barriers for project management. Hanifzadeh and Ravasan [10] identified 23 factors that influence the outsourcing decision of e-banking through in-depth interviews. The findings of the study showed that 17 factors were ranked influencing for the decision of e-banking. After identification of the factors, a model was developed based on the fuzzy TOPSIS for outsourcing decision. All the previous research studies, as mentioned earlier paid attention to various issues of GSD such as contract management, vendor selection criteria, outsourcing decisions from vendor's perspective, influencing factors of multi-sourcing, factors affecting project management etc.

However, a little research has focused on exploring the offshore outsourcing decision of application maintenance. The current study focuses on critical success factors of application maintenance in order to provide assistance to IT managers and experts in making appropriate offshore outsourcing decisions.

A. STUDY MOTIVATION

The Literature review shows that a significant number of studies [11]–[18] have focused on various issues of software offshore outsourcing and IT outsourcing. Despite the discussion of the study background in section II, the following paragraph also shows the relevant research work. Khan *et al.* [1] discussed the critical barriers of project management in the offshore software in multi sourcing environment. Khan *et al.* [2] presented critical success factors for offshore software development. Rehman *et al.* [4] investigated the effects of application maintenance on global delivery by identifying a set of parameters. They adopted a case study methodology for their research. Ilyas and Khan [11] identified success factors of software integration in GSD. Ali *et al.* [12] investigated the barriers that are important for the software outsourcing partnership. Niazi *et al.* [17] conducted a systematic literature review that identifies factors regarding trust in offshore software partnership. Haq *et al.* [18] discussed issues in global software development. The literature highlighted a limited quantity of studies that examined offshore outsourcing decision of application maintenance. Snaeed [19] discussed the different techniques and tools that are required for software maintenance in distributed systems. Moreover, legal issues were discussed in contract management as well as the economics of the offshored applications. Bhatt *et al.* [20] presented the results of the analysis from 127 projects. They presented factors and their interrelationship and their influence of the activities of software maintenance.

In spite of the extreme importance of offshore outsourcing decision's process and its criticality, very little research has been focused on this topic. Similarly, we did not observe any comprehensive research study that combines both systematic literature review and empirical study for the investigation of offshore outsourcing decision of application maintenance. Hence, the current study is aimed at the in-depth investigation of the complex offshore outsourcing decision process through a comprehensive methodology that is comprised of systematic literature review and empirical study. Firstly, a systematic literature review will be conducted to identify influencing factors and critical success factors. Following this, an empirical investigation will be performed in the outsourcing industry in order to get responses from the outsourcing experts around the globe to validate the findings of the systematic literature review. The current study will enable us to achieve a holistic picture of offshore outsourcing decisions by identifying a list of influencing factors and critical success factors that will be used to address the complex phenomenon of the global sourcing decisions.

III. RESEARCH METHODOLOGY

In order to explore the influencing factors of offshore outsourcing regarding the application maintenance, to identify the critical success factors and to assess their impact on offshore outsourcing decision through a Systematic Literature Review (SLR), the guidelines of Kitchman and Charters [21] were followed. Other researchers [9], [22] also adopted the same methodology to identify the critical challenges and factors in the context of GSD. SLR is a widely accepted methodology to analyze and thoroughly evaluate a research problem. The available literature and published materials are selected and analyzed to address the defined research questions. The SLR differs from an ordinary literature review because it follows a pre-defined study review protocol. For the current study, a new review protocol was designed, as presented in Fig 1. The primary studies selection for performing the SLR is based on the search strings, which are constructed according to the defined research questions. Similarly, the identified primary studies are analyzed based on research defined inclusion and exclusion criteria.
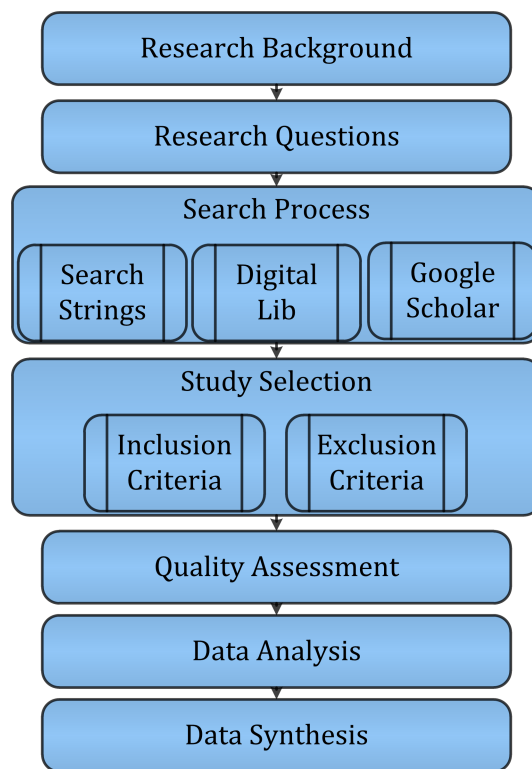
FIGURE 1. Study review protocol.

The results achieved through SLR are considered less biased, more accurate, and reliable compared to an ordinary literature review. SLR mainly consists of three phases which are the review planning phase, conducting phase of the review and the reporting phase of the review [21], [23]. The following subsections discuss the followed protocol in order to investigate the influential factors of outsourcing decision and to present analyses of the critical success factors regarding

application maintenance. The detailed discussion of inclusion and exclusion criteria for the current study is given in the following subsections.

A. LITERATURE SEARCH

In order to perform the current SLR, a proper search process was followed to find out published and most relevant materials in the well known digital libraries. The search process of the current SLR includes the construction of search strings, selection of digital libraries and to make search for relevant materials in these libraries through the developed strings. The following subsections present the search process in detail.

B. CONSTRUCTION OF SEARCH STRINGS

In order to determine appropriate published materials from the available literature, various search strings were developed. Firstly keywords and their alternatives were defined to create search strings. Following this, the keywords and their corresponding alternatives were concatenated using Boolean operators 'OR' and 'AND'.

The keywords and alternatives are [(Factors: Barriers, challenges, issues, parameters, hurdles, problems, critical factors, important factors, influencing parameters) and (Application maintenance offshoring: Software offshoring, distributed software, offshore outsourcing of software, application outsourcing, distributed systems, distributed software development, global software development, global software maintenance, IT outsourcing and application maintenance)].

Initially, a search string was developed by concatenating the aforementioned keywords and alternatives, i.e. [Application maintenance offshoring OR Software offshoring OR distributed software OR offshore outsourcing of software OR application outsourcing OR distributed systems OR distributed software development OR global software development OR global software maintenance OR IT outsourcing OR application maintenance) AND (Factors OR Barriers OR challenges OR issues OR parameters OR hurdles OR problems OR critical factors OR important factors OR influencing parameters].

A trial search was performed on the basis of the developed string that showed huge lists of 114631 papers and 475321 papers in IEEEXplore and ACM respectively, while SpringerLink did not work on the same string. The trial search was used as a guide to develop other specific strings for the chosen libraries. We gradually, made modifications and improvements in the search strings in order to develop the suitable strings for each digital library and to identify relevant primary studies. Since the selected digital libraries such as IEEXplore, SpringerLink and ACM operate on different string size and syntax, therefore, a different search string was created for each library. The details of the results based on these search strings are given in subsection D, i.e. study selection process.

String1: ['application maintenance outsourcing' OR 'software maintenance offshoring' OR 'offshore outsourcing decision of application maintenance' OR 'outsourcing decision

of software' OR 'software maintenance in global delivery' OR 'globally distributed software' AND 'influencing factors' OR 'critical factors' OR 'important factors' OR 'barriers' OR 'challenges' OR 'obstacles' OR 'risks' 'parameters' OR 'hurdles' OR 'characteristics' OR 'problems'].

String2: ["Factors of IT outsourcing OR application maintenance AND offshoring OR offshore outsourcing"].

String3: [application maintenance" OR "application maintenance outsourcing" OR "software maintenance" AND "offshoring" OR "benefits of IT outsourcing"].

The developed strings were shared with the secondary reviewers in order to validate the strings based on the already known relevant papers. The secondary reviewers conducted searches in the chosen digital libraries and found the relevant in hand papers in the search process.

C. SEARCHING DIGITAL LIBRARIES

This section describes the study selection criteria used to perform the SLR. The inclusion and exclusion criteria for data collection are discussed in the following subsections. In addition, the Fig 2, shows the number of papers excluded as well as the final selected papers.

D. STUDY SELECTION PROCESS

The primary studies were selected from the chosen data sources based on the defined study inclusion and exclusion criteria. The digital libraries were searched for the year 2000 to 2020 by using the constructed strings. However, the length of the strings as well as searching mechanism varies in these libraries. The constructed search string was applied to IEEEXplore that resulted in 432 publications, whereas SpringerLink did not work on the same string size and thus, the string was modified. The literature search in Springer was performed based on the modified string, i.e. "Factors of IT outsourcing OR application maintenance AND offshoring OR offshore outsourcing" that gives a total of 414 publications. Similarly, we have to change the constructed string for ACM as well. The ACM was searched through "application maintenance" OR "application maintenance outsourcing" OR "software maintenance" AND "offshoring" OR "benefits of IT outsourcing" that produced a set of 124 materials. Similarly, the snowballing technique was used to get the most relevant publications that were mentioned in the identified papers references' lists. The whole process of the primary study selection, i.e. inclusion, exclusion and searching process is shown in Table 1 and Fig 2.

We collected a total of 1050 papers based on the defined search strings. In the first phase of the filtering process, we shortlisted a list of 368 papers by reading the titles. In the second phase, we refined the collected materials' list by reading the abstract and conclusion of each paper that created a list of 154 relevant papers which is followed by a third phase of contents reading that resulted in a final list of 52 papers.

In order to verify the publication selection process and to reduce the researcher bias the inter ratter reliability test was performed. The initial publications list was forwarded

TABLE 1. Total collected articles, selected data sources and their publication years.

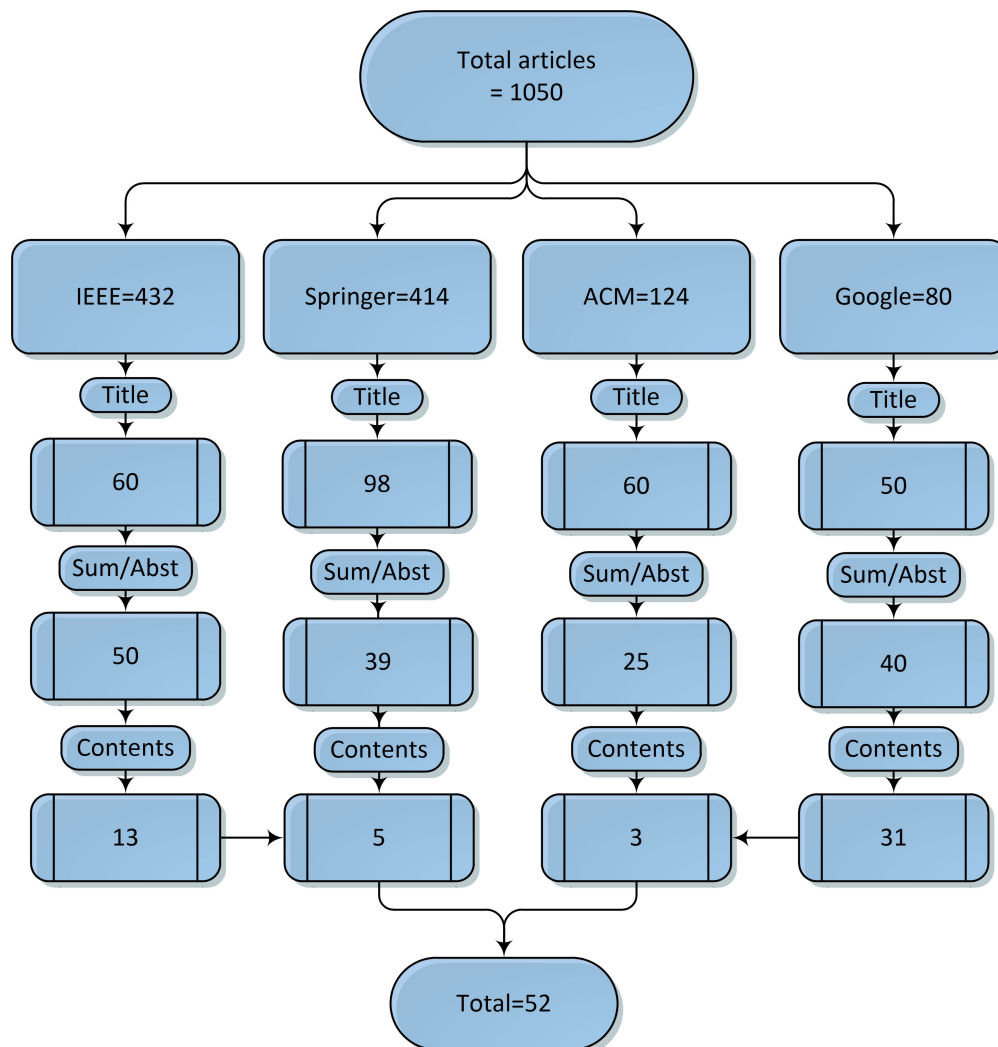| S.No	Digital Libraries	URL	Period(2000-2020)	Total publications
1	ACM	http://dl.acm.org/	Cover all years	124
2	IEEE Xplore	http://ieeexplore.ieee.org/	Cover all years	432
3	Springer Link	http://link.springer.com/	Cover all years	414
4	Google	https://www.google.com/	Cover all years	80
	Total			1050

FIGURE 2. Primary study selection based on inclusion and exclusion criteria.

to a secondary reviewer to review the selection process and address any uncertainty that exists in the process of inclusion, exclusion and primary studies selection.

E. INCLUSION CRITERIA

This section discusses which part of the materials, i.e. article, book, conference paper, workshop and technical report identified through the search strings, will be included in the data extraction process. The material that contains any of the point or points of the following inclusion criteria will be included in the current study.

- Studies that contains application maintenance outsourcing;

- Studies that discusses software offshore outsourcing decision;
- Studies that shows the challenges of global delivery;
- Studies that shows the challenges of global delivery;
- Studies conducted on critical parameters of the offshore decision of application maintenance;
- Studies that discusses critical barriers of outsourcing decisions.

F. EXCLUSION CRITERIA

The following criteria describe which part of the literature will be excluded from the current study.

TABLE 2. Quality evaluation of selected papers.

Quality Evaluation	Checklist
Quality evaluation 1	Does the used method address the questions of research study?
Quality evaluation 2	Does primary study discuss offshore outsourcing decisions?
Quality evaluation 3	Does primary study discuss application maintenance outsourcing?
Quality evaluation 4	Does primary study presents influencing factors of outsourcing?
Quality evaluation 5	Does primary study contains challenges of global delivery?
Quality Evaluation Score	**Description**
Quality evaluation score-1	The papers were assigned "1" score that fully addressed the developed checklist
Quality evaluation score-2	The papers were assigned "0.5" score that partially addressed the developed checklist

- Studies that discusses critical barriers of outsourcing decisions;
- Studies with no influencing factors of outsourcing decision of maintenance;
- Studies that lack of offshore outsourcing decisions;
- Studies with no significant details of software outsourcing and offshoring;
- Studies that do not address the defined research questions;
- Studies that do not present critical success factors for application offshoring.

G. QUALITY ASSESSMENT

The process of quality assessment and the deigned quality checklist is given in Table 2.

The selected primary studies (52 papers) were assessed by using a checklist that is based on the instructions provided by Khan and Keung [16] and Kitchman and Charters [21]. It can be seen from the Fig 3, that of 52 papers, 13 were assigned scores '0.5' whereas 39 papers were assigned scores '1'. Moreover, Fig 3, also indicates the data sources of the primary studies (digital libraries and Google scholar), type of papers (conference, articles, books and reports) collected for the current study and all years of publication (2002-2020). Likewise, Fig 4, shows the year-wise distribution of papers as well as the type of primary studies (conference, article, book and report). It shows that all the selected papers were published in the year 2002 to 2020. The publication years and respective published papers are as 2020(1 paper), 2019(5 papers), 2018(1 paper), 2017(5 papers), 2016(3 papers), 2013(3 papers), 2012 (4papers), 2011(3 papers), 2010(6 papers), 2009(2 papers), 2008(3 papers), 2007(5 papers), 2006(6 papers), 2005 (2 papers), 2003(2 papers) and 2002(1 paper).

H. DATA EXTRACTION

In the current study, all the data is extracted by a single author; however, other authors helped in finalizing the influencing factors of application maintenance, identification of critical success factors amongst the identified list of factors and helped in proposing the sourcing model for application maintenance. The extracted data, i.e. 15 influencing factors of offshore outsourcing are shown in Table 3. In the current study inter ratter reliability test was conducted in order to validate the extracted data. The secondary reviewer randomly selected five papers from the sample size and then extracted data from the five chosen publications. The primary and secondary reviewer's results were compared and both the results matched.

I. DATA SYNTHESIS

In order to obtain the results against the research questions, all the extracted data were arranged by rephrasing factors according to the study questions, combined subfactors and the various factors with similar impact on sourcing decisions were merged together. The study research questions were evaluated against the obtained results.

IV. RESULTS AND ANALYSIS

The results obtained against the defined research questions i.e. RQ1, RQ2, RQ3, RQ4, RQ5 and RQ6 through SLR are presented in this section. The detailed discussion and analysis of the findings such as influencing factors of application maintenance, decade-wise influencing factors, factors identified based on study strategies, critical success factors amongst the identified factors, the impact of critical success factors on outsourcing decisions and the proposed sourcing model are given in subsections A to E.

A. INFLUENCING FACTORS IDENTIFIED THROUGH SLR

Using the SLR, a list of 15 influencing factors was obtained from 52 selected papers. The various factors found in literature review were merged together as well as rephrased by authors in order to describe the influencing factors for the offshore outsourcing of application maintenance. The identified influencing factors, as well as the factors' frequencies and their respective percentages are presented in Table 3.

The findings show that employees skills including employees' knowledge, expertise and IT capabilities is highly rated factor, concerning the outsourcing decision of application maintenance. It stands on the top (77%) amongst all the identified factors. The second highest factors of the current study are cost, legal requirements and communication that are stand on the same level of priority of 69% regarding the impact on global sourcing. The high number of occurrences in the selected literature indicate their strong impact on outsourcing decisions of application maintenance.

Three factors, i.e. infrastructure, maturity level and frequent requirements changes have slightly lower values with each of 61% of occurrences. Other factors that got scores greater than 50% and less than 60% are language barrier,
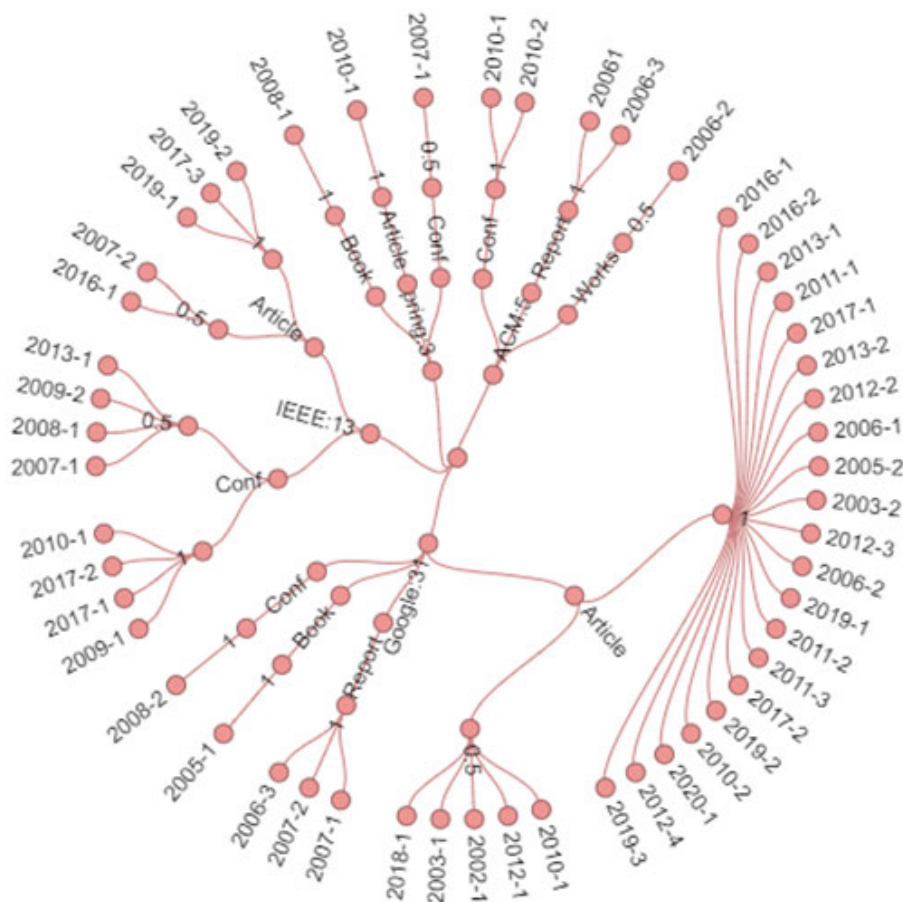
FIGURE 3. Quality scores of all selected papers, along with their publication dates.

project management and knowledge transfer with the values of 59%, 56% and 56% respectively. This statistic shows that after the language barrier, both the project management and knowledge transfer are equally important with 56% of preferences.

The literature review revealed that 5 factors did not get enough scores in the context of outsourcing decisions and remained below the 50%. The factors are cultural diversity, time zone difference, domain knowledge, service scope and size of engagement with the score of 49%, 41%, 31%, 13% and 13% respectively.

The study result shows that out of 15 factors only 10 received scores greater than 50%, i.e. employees skills, cost, legal requirements, communication, infrastructure, frequent requirements changes, maturity level, language barrier, project management and knowledge transfer.

B. INFLUENCING FACTORS DECADE-WISE
Table 4 shows analysis of the influencing factors based on two decades, whereas Table 5 contains the derived critical success factors from the decade1 and decade2. The selected primary studies have been grouped into two periods, i.e. decade1 (2000-2010) and decade2 (2011-2020).

The results show that 15 factors were identified in decade1. Amongst them, only 10 factors were ranked as critical success factors as these were cited >=50%. The critical success factors are employees skills (71%); cost (71%); legal requirements (66.6%); poor communication (66%); infrastructure (80.9%); maturity level (52%); language barrier (52%); frequent requirements changes (52%); cultural diversity (57%) and sharing information or knowledge transfer (52%). In the decade1, the factor infrastructure got the highest ratio, i.e. 80.9%. It means that infrastructure has been the most important factor in decade1. However, infrastructure shows a remarkable decrease in the decade2 and achieved only 33.3% of preferences. Likewise, the decade2 presented a list of 15 factors, whereas 8 factors were tagged as critical which are employees skill (72%); cost (61%); legal requirements (61%); poor communication (61%); maturity level (61%); language barrier (55.5%); frequent requirements changes (55.5%) and project management (66%). The factor with the highest score in the decade2 is Employees skill which shows that high skill set of employees has high impact on the offshore outsourcing decision of application maintenance. Other factors which got a remarkable increase in the second period are project management and maturity level. On the
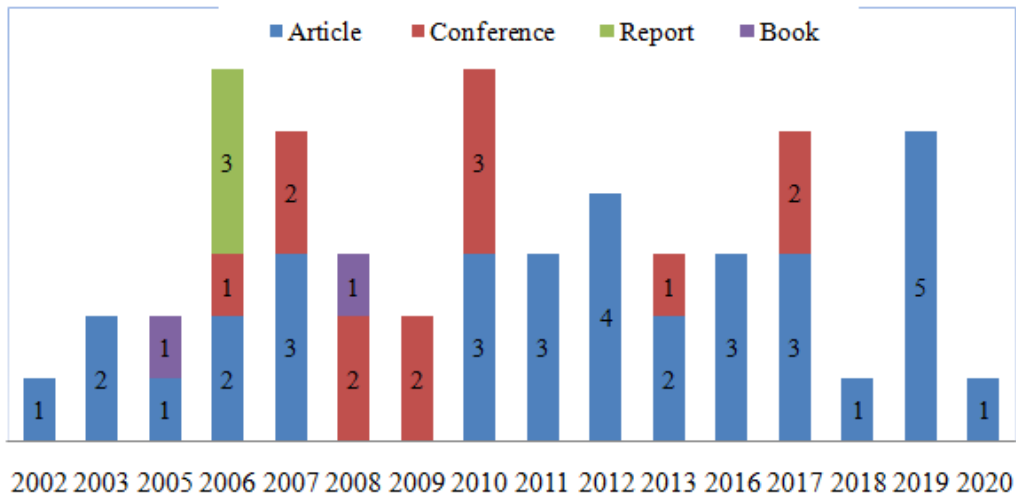
FIGURE 4. The total number of articles, conference papers, books, reports, their citations and sources.

TABLE 3. Influencing factors of application maintenance offshoring.

S.No	Influencing factors	Total selected papers for RQ3 (N=39)		
		References	Fr	%
01	Employees skills	[1], [2], [12], [14], [16], [8], [9], [46], [51], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [41], [42], [50], [20]	30	77
02	Cost	[1], [2], [4], [12], [17], [8], [9], [46], [51], [24], [25], [26], [27], [28], [29], [30], [31], [33], [34], [39], [43], [44], [45], [19], [47], [48], [49]	27	69
03	Legal requirements	[1], [2], [4], [12], [9], [46], [51], [24], [25], [26], [27], [28], [29], [30], [31], [32], [33], [34], [36], [37], [39], [40], [42], [43], [47], [48], [49]	27	69
04	Communication	[1], [12], [14], [17], [46], [51], [24], [26], [28], [29], [31], [32], [33], [35], [36], [37], [38], [39], [40], [41], [42], [43], [19], [47], [48], [50], [20]	27	69
05	Infrastructure	[2], [12], [14], [8], [46], [24], [25], [26], [27], [28], [29], [31], [32], [33], [34], [38], [40], [41], [42], [43], [45], [19], [47], [20]	24	61
06	Maturity level	[1], [2], [4], [12], [16], [46], [51], [24], [28], [29], [30], [31], [32], [34], [35], [37], [38], [41], [42], [44], [45], [48], [49], [50]	24	61
07	Language barrier	[1], [4], [12], [9], [46], [24], [26], [27], [28], [29], [30], [31], [33] [34], [36], [38], [40], [42], [43], [44], [45], [19], [20]	23	59
08	Requirements changes	[1], [4], [12], [9], [46], [51], [28], [30], [31], [32], [35], [36], [37], [38], [40], [41], [43], [44], [45], [19], [47], [48], [49], [50]	24	61
09	Cultural diversity	[1], [12], [14] [8], [9], [46], [51], [24], [25], [26], [28], [31], [33], [36] [38], [39], [40], [43], [49]	19	49
10	Project management	[2], [12], [14], [16], [17], [9], [46], [51], [24], [27], [28], [29], [30], [31], [32], [33], [34], [37], [43], [48], [49], [50]	22	56
11	Knowledge transfer	[1], [2], [14], [16], [17], [46], [26], [28], [29], [31], [32], [34], [39], [40], [41], [42], [44], [45], [[47], [48], [50], [20]	22	56
12	Time zone difference	[1], [46], [51], [26][, [27], [31], [36], [38], [40], [41], [42], [44], [47], [48], [50], [20]	16	41
13	Domain knowledge	[46], [25], [28], [31], [32], [38], [39], [41], [19], [47], [50], [20]	12	31
14	Service scope	[4], [46], [26], [31], [48]	5	13
15	Size of engagement	[14], [46], [26], [31], [39]	5	13

other hand the factor that showed a drastic decline from 80.9% to 33.3% is the infrastructure factor.

Additionally, the chi square test (Linear by linear association) was performed in order to determine the significant difference between the influencing factors. We compared the factors identified based on the two decades, which indicates that there are only two factors, i.e. infrastructure and project management that vary significantly which p value are less than 0.05. The reason for the significant difference is that infrastructure appeared 80.9% in decade1 and only 30% in decade2. Similarly, project management has 38% preferences in decade1 whereas 66.6% preferences in decade2.

C. INFLUENCING FACTORS BASED ON STUDY STRATEGIES
The total selected publications for the current study were grouped into four categories based on study strategies. Table 6 shows the categories of study strategies which are SLR, empirical studies, case studies and others. The study strategies were initially identified by the primary author during the data extraction process. Table 3 shows that 38% papers represent empirical studies, 28% SLR, 25.6% others and only 7.6% case studies.

Amongst the included papers, empirical studies have the highest ratio (38%) and 15 influencing factors were derived from the empirical studies. The factors, both Legal

TABLE 4. Decade-wise identification of influencing factors.

| Influencing factors | Total selected papers for factors identification (N=39) | | | | | |
| | Decade1: 2000-2010 (N=21) | | Decade2: 2011-2020 (N=18) | | Linear by linear association Chi square test a=0.05 | |
	Freq	%	Freq	%	X2	P
Employees skills	15	71	13	72	0.123169	0.7256
Cost	15	71	11	61.1	0.196509	0.6575
Legal requirements	14	66.6	11	61.1	0.0160483	0.8991
Poor communication	14	66.6	11	61.1	0.0160483	0.8991
Infrastructure	17	80.9	6	33.33	8.19731	0.00419
Maturity level	11	52	11	61.1	0.585434	0.4441
Language barrier	11	52	10	55.55	0.157726	0.6912
Frequent requirements changes	11	52	10	55.55	0.157726	0.6912
Cultural diversity	12	57	8	44.44	0.691259	0.5358
Project management	8	38	12	66.66	3.97859	0.0460
Knowledge transfer	11	52	7	38.88	0.473078	0.4915
Time zone difference	8	38	4	22.22	0.922502	0.3368
Domain knowledge	7	33	2	11.11	2.418	0.1199
Service scope	2	9.52	3	16.66	0.542535	0.4613
Size of engagement	3	14	2	11.11	0.0522536	0.8191

TABLE 5. Critical success factors identified in decades.

| Decade-wise critical success factors Factors>=50%) | |
Decade1(2000-2010)	Decade2(2011-2020
1.Employees skills: application knowledge, IT capabilities 2.Cost 3.Legal requirements: data protection, IP rights 4.Poor Communication 5.Infrastructure: internet connectivity, data centers 6.Maturity level: prior global experience, client/vendor maturity 7.Language barrier 8.Requirements changes: unclear and volatile requirements 9.Cultural diversity 10.Knowledge transfer/sharing	1.Employees skills: employees knowledge, IT capabilities 2.Cost 3.Legal requirements: data protection, IP rights 4.Poor communication 5.Maturity level: prior global experience, client/vendor maturity 6.Language barrier 7.Requirements changes: unclear and volatile requirements 8.Project management

requirements and poor communication got 80% occurrences in empirical studies. Employee skill occurrences were 73% in the literature that achieved the second position. The factors infrastructure and language barrier both were ranked third with 66.6% of occurrences. Other notable factors are cost and cultural diversity that each of them got 60% occurrences in empirical studies. similarly, the complete list of identified influencing factors (14) were found in the primary selected studies based on systematic literature reviews. Employee skill is the most commonly cited factor in SLR that got 72.7% of occurrences. Other factors that got notable occurrences are cost, project management and knowledge transfer with each about 62% of occurrences. The remaining factors except the legal requirements and maturity level received less than 50% of occurrences.

Out of 15 influencing factors, 14 were identified in other studies. Frequent requirement changes got 80% occurrences in other studies. The factors such as cost, poor communication, infrastructure, project management and domain knowledge got 60% each of them, whereas, except the legal requirements and cultural diversity, all others remained below the 50%. Out of 15 influencing factors only 12 factors were identified in the case studies. The infrastructure stands on the top with 100% of occurrences. Whereas 4 factors such as employee skill, poor communication, language barrier and knowledge transfer got 66.6% of occurrences. All the remaining factors got below 50% of occurrences.

Chi square test (Linear by linear association) was performed to find the significant difference between the influencing factors identified through the various study strategies. The comparison of identified factors based on study strategies, show more similarities than the differences. As we have determined the significant differences only in two factors such as employees skills and domain knowledge.

D. CRITICAL SUCCESS FACTORS DERIVED FROM INFLUENCING FACTORS

This section intends to answer RQ5 of the current study. The following rules are adopted to determine the critical success factors amongst the 15 identified influencing factors through SLR. If an influencing factor appeared in literature with a percentage of >=50% then it will be considered a Critical Success Factor (CSF). This criterion for the identification of critical success factors was also used by other researchers [14], [29], [33], [34]. According to this rule, 10 factors ranked as CSFs for offshore outsourcing decision of application maintenance, as shown in the following Table 7.

The detailed discussion of the identified critical success factors i.e. how the CSFs impact the outsourcing decisions of application maintenance are given in the following sub paragraphs.

Employees' skills are the most commonly cited factor amongst all the identified factors. It includes employees' knowledge about project/application, skills, expertise and IT capability. It is the most influential critical success factor as

TABLE 6. Influencing factors identification through study strategies.

Influencing factors	Total selected papers for factors identification (N=39)									
	SLR (N=11) 28%		Empirical studies (N=15) 38%		Others (N=10) 25.6%		Case studies (N=3) 7.6%		Linear by linear association Chi square test a=0.05	
	Freq	%	Freq	%	Freq	%	Freq	%	X2	P
Employees skills	8	72.7	11	73.3	7	70	2	66.6	4.22	0.039
Cost	7	63.6	9	60	6	60	1	33.3	0.46	0.496
Legal requirements	6	54.54	12	80	5	50	1	33.3	0.683	0.408
Communication	5	45	12	80	6	60	2	66.6	0.670	0.41
Infrastructure	4	36	10	66.6	6	60	3	100	2.055	0.15
Maturity level	6	54.54	8	53.3	7	70	1	33	0.508	0.476
Language barrier	5	45	10	66.6	4	40	2	66.6	0.922	0.342
Requirements changes	5	45	8	53	8	80	0	0	2.4	0.121
Cultural diversity	5	45	9	60	5	50	1	33	0.155	0.693
Project management	7	63.6	7	46.6	6	60	0	0	0.830	0.176
Knowledge transfer	7	63.6	5	33	4	40	2	66.6	2.958	0.125
Time zone difference	2	18	6	40	3	30	1	33	8.26	0.432
Domain knowledge	0	0	3	20	6	60	0	0	8.26	0.0040
Service scope	1	9	2	13	1	10	1	33	1.577	.2092
Size of engagement	1	9	2	13	0	0	1	33	3.25	0.071

TABLE 7. Critical success factor derived from the influencing factors.

S.No	Critical success factors	Percentage
1	Employees skills: application knowledge, expertise and IT capabilities	77
2	Cost	69
3	Legal requirements: data protection, confidentiality, intellectual property protection, labor rights, exports and imports restrictions, privacy and data transfer restrictions, taxes and currency exchange	69
4	Infrastructure: data communication, internet connectivity, network, data centers and servers	61
5	Communication or communication gap	69
6	Sharing information or knowledge transfer	56
7	Maturity level: prior global experience, client maturity, vendor maturity, process maturity	61
8	Project Management: relationship management, contract management	56
9	Language barrier or language difference	59
10	Frequent requirement Changes: volatile customer requirements, instability in requirements, rate of change in application portfolio, ambiguous requirements	61

identified in our study that highly influences the outsourcing decision of both client and vendor. Vendors having resources with high skills set and expertise enable to provide quality products as well as adequate services to their clients. Similarly, the client's resources that possess business and IT knowledge enable them to work smoothly with vendors. Therefore, high skilled resources along with IT capability are considered as the backbone of IT industry. The client usually evaluates the service provider's capability in term of skills and expertise, prior to outsourcing decision [2], [15], [17], [52].

The SLR suggests that cost is the second highly significant factor regarding offshore outsourcing decision. Low cost of software maintenance motivates clients for offshore outsourcing decision. Offshoring is a common strategy that is used by companies to achieve cost savings about 20-50%. The companies of leading countries like the United States, United Kingdom, Japan and Australia are adopting outsourcing strategy whereas the companies based in low cost countries, i.e. China, India, Ireland and Russia are providing services [2], [4].

The factor legal requirements is one of the top challenges presented by the offshore outsourcing. It is the most reported factor in literature review after the employees' skills and cost. The sub factors of legal requirements are Intellectual Property (IP) rights, data confidentiality, data transfer/ security, labor laws, rules regarding import and export, data privacy and security, the exchange of currency and taxes [46]. IP rights create issues for outsourcing clients because there are no international laws that effectively secure

the individual's work worldwide. Although some national laws exist to protect the individual's work against the illegal use or access but IP protecting laws vary from country to country and also difficult to implement. These make very hard to avoid misuse of IP rights in offshore outsourced projects. Likewise, the countries such as Russia, India and China do not recognize the patents of software method. Some countries do not have the laws for protecting trade secrets whereas US has laws to protect trade secrets. Some countries such as US and Europe has labor laws as well as the employments laws that complicate the outsourcing process that affect both the customer and vendor [33], [46].

The factor communication is one of the influencing factors that tagged as critical success factor in our study. Communication between the developers and other resources on the different levels of software development and maintenance process plays a key role in the project quality and delivery. Global sourcing, however, posed challenges such as cultural diversity, language barrier and time zone difference that hinder the process of communication between members of the dispersed units. Due to lack of communication or poor communication, many asked questions are not answered and the developers on other sites make wrong assumptions. Similarly, the changes are not communicated to other team on time that creates challenges in global software development [11], [12], [14], [33].

Infrastructure is the fifth highest quoted factor in our study. It is one of the critical success factors in application

maintenance that is known as a potential hurdle in globally distributed projects. It includes data communication, internet connectivity, network, data centers, servers and application management. The appropriate infrastructure has a positive impact on sourcing decisions as well as on the level of quality and service delivery. On the other hand, the poor infrastructure will badly affect the outsourced activity. Therefore, the vendors should thoroughly evaluate the infrastructure prior to make outsourcing decision [2], [12], [46].

Maturity level is another critical success factor that includes prior global experience, client maturity, vendor maturity and processes maturity. Global outsourcing experience is crucial for both the client and vendor. Especially, vendor lacking of prior global experience, expertise and application knowledge may lead to project failure [1], [12]. Similarly, in offshore arrangements the process maturity is important for client and vendor. This issue appeared between the Indian company that achieved high level of maturity (Capability Maturity Model) and its client that had low processes or lacking in maturity. In order to operate the offshore engagement smoothly and effectively the client team must acquire knowledge and update their skills. Ideally, the client needs to achieve Capability Maturity Model (CMM) level 3 for its software practices [46].

The factor language barrier could be a big challenge for the team members between the offshore and onshore sites. This problem strongly arises when talking to offshore team members of heavy accents such as Indians, Russians and Chinese on landlines that have various communication problems i.e. noise, delay and echoes while trying to exchange critical information about the project [20].

The factor frequent requirements changes is another factor in our study that qualifies the criteria to be critical for offshore outsourced arrangements. It includes volatile customer requirements, instability in requirements, rate of change in application portfolio and ambiguous requirements. Certain project got failed due unspecified and unclear requirements changes along with other global constraints [1]. Requirements uncertainty mean a company does not have clear idea that what it needs from a specific business process. If an organization has such process then it is better to be kept in house rather to be outsourced [10].

The knowledge transfer is another critical success factors that must be taken into account while making outsourcing decision. Knowledge sharing is an activity of transferring the knowledge from one person, group to another person, group or organization. Strong organizational relationship and quality partnership play a key role in the knowledge transfer. Whereas a weak relationship between the partners would reduce the flow of information. Vendors can transfer and share their expertise and knowledge to clients in order to improve the clients' IT functions. On the other hand, clients share their business knowledge and information with vendors that will enable the vendors to clearly understand the business requirements. Distributed projects are knowledge exhaustive and having tasks dependency that require the integration

of knowledge of both the client and vendor. The intensive communication that takes place between service providers and receivers will consume much of the software engineers time and efforts. Hence, the proper management of knowledge sharing and transfer is important for both the client and vendor [12], [15].

The factor project management includes contract and relationship management as the sub factors. Exactly half of the articles showed the importance of project management in the offshore outsourced engagements. Therefore, lack of project management negatively affects the clients as well as the vendor. The project management plays an important role in distributed projects because the distributed teams' management across the globe is a difficult task and complicated process. Likewise, the lack of project management and planning is a potential hurdle which is considered a great risk to outsourced software [33].

E. PROPOSED MODEL FOR OFFSHORE OUTSOURCING OF APPLICATION MAINTENANCE

This section intends to answer the RQ4 of the current study. Fig 5, shows the proposed model for the application maintenance outsourcing decision based on the identified list of critical success factors. The critical success factors were identified through the current systematic literature review. Two categories of influences, i.e. 'Low' and 'High' were defined for all the factors. Each factor was assigned 'Low' or 'High' level of influence based on its impact on application maintenance in offshore outsourcing context. Consequently, the suitability of onshore model and offshore model is derived based on the influence level of each factor.

It is a conceptual model for evaluating the suitability of onshore and offshore model for the project to be outsourced. The model can be used by the domain experts, IT managers and decision makers to make project evaluation based on the critical success factors prior to outsourcing decision. The proposed model can be used by vendor and client for making appropriate sourcing decision. The limitations of the proposed static model will be addressed in the future research work as briefly discussed in section VI.

V. STUDY LIMITATION

This segment discusses threats to validity of the current study. The SLR was performed by a single person (first author) and the author might have missed some of the relevant publications as well as significant factors. Nevertheless, other authors contributed in addressing threats to validity by solving any observed ambiguity during the identification process of publications and influencing factors.

Similarly, threats exist in the selected primary studies towards the mentioned factors since the authors did not mention the main reasons for the selection of the identified influencing factors and barriers. There is the possibility that certain primary studies have the tendency towards the inclusion of some specific type of factors which is a challenge for us to tackle this threat.

Influencing factors	Alternative selection	
	Impact of factors on sourcing decision of application maintenance	
Employees skills (Level)	Low	High
Cost (Sensitivity)	Low	High
Legal requirements (Sensitivity)	High	Low
Infrastructure (Stability)	Low	High
Communication (Level)	Low	High
Maturity level (Status)	Low	High
Knowledge transfer (Flow)	High	Low
Project management (Influence)	Low	High
Language barrier (Influence)	Low	High
Frequent requirements changes (Influence)	Low	High
	Onshore Model	Offshore Model

FIGURE 5. Proposed model for offshore outsourcing decision of application maintenance.

The sample size of the current study is a set of 52 papers, from which the factors were extracted. However, these papers were selected based on the defined inclusion/exclusion criteria. Most of the authors of the selected papers are academicians. They might not have the expertise in the outsourcing industry. We will conduct an empirical study in the offshore outsourcing industry in order to validate the findings of the current study.

VI. CONCLUSION AND FUTURE RESEARCH WORK

The current study addressed the complex phenomenon of the offshore outsourcing decision of application maintenance. A set of 15 influencing factors were presented concerning application maintenance offshoring by conducting SLR. The influencing factors were analyzed based on variables such as decade-wise and study strategies. Out of 15 factors only 10 were ranked as critical success factors based on the defined criteria. The criteria to be a critical success factor is $>=50\%$ of its occurrences in the literature. The critical success factors are employees' skills, cost, legal requirements, infrastructure, communication, knowledge transfer, maturity level, project management, language barrier and frequent requirements changes. Our study findings show that both the service

provider and client should focus on these critical success factors before making an outsourcing decision. In addition, a model for offshore outsourcing decision of application maintenance was proposed based on the identified critical success factors. The proposed model will help in making appropriate sourcing decisions. The model will be used by IT managers, decision makers and IT experts to evaluate the alternatives based on the assessment criteria that will suggest the most suitable sourcing model among the available options.

The findings of the current study will be used as the foundation for further research work as given below:

- An empirical study will be conducted in the outsourcing industry in order to validate the influencing factors found via the SLR.
- The list of factors identified might be updated by identifying other influencing factors through an industrial survey.
- A comparison will be made of the critical success factors found through SLR and empirical study.
- This will be followed by the development of multi criteria decision support system that will be implemented with various case studies in the outsourcing industry.

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