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Empirical Investigation of Influencing Factors Regarding Offshore Outsourcing Decision of Application Maintenance

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ABSTRACT Global Software Development (GSD) has been an emerging trend in the development of software globally, for the last two decades. Information Technology (IT) outsourcing includes application development, application maintenance, infrastructure management and business process outsourcing. Software maintenance aims to keep the IT system operational and to fulfill the client requirements. The maintenance is considered the longest phase of software life cycle that consumes about 60-70% of the total software budget. Maintenance of software is not only time consuming but also requires a significant human resources' ratio. Mostly, software acquisition and maintenance consume a big portion of the total IT budget. The current study aims to evaluate the findings of the systematic literature review and to derive a list of critical success factors regarding offshore outsourcing decision of application maintenance. Thus, an empirical study is performed to validate the influencing factors that were identified by using systematic literature review. These factors are further validated by 93 outsourcing experts from 30 different countries. The collected data through online survey is analyzed based on variables such as respondents experience level, respondents' locations (continents), experts' positions. Similarly, the data is analysed based on Chi square test (linear by linear association) and Spearman Rank Correlation. Additionally, the identified factors through survey and systematic literature review are ranked by two different methods. Consequently, a project assessment model is proposed, based on the critical success factors for the sourcing decision of application maintenance.

INDEX TERMS Application maintenance, critical success factors, influencing factors, offshoring, ranking, sourcing decision, sourcing model.

I. INTRODUCTION

Globalization, strongly influences the business models for those organizations that access global market and to seek for increase productivity at lower cost. For the last two decades, Global Software Development (GSD) has been an emerging trend in the development of software globally. In this case, the vendors and consumers are located in various geographic areas with variations in cultural diversity and time zone. The software development team itself may disperse at various locations and countries. GSD provides the opportunity to reduce the cost significantly of software development by utilizing the resources of low-wage countries as well to quickly accomplish the tasks by following the sun. Similarly, this strategy benefits the organizations by accessing the cheaper resources of low cost countries, utilizing the employees with IT capabilities and high skill set, gaining global expertise and international market shares; and achieving product with high quality [1]–[4].

Outsourcing is one of the consequences of globalization, where companies rent out, one or more of their services. In outsourcing, vendors are usually involved from developing countries to make software at low cost. Outsourcing is a bond that involves subcontractors for software development and maintenance. Likewise, in the global outsourcing a company engages vendor which is geographically distant. It is

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an agreement in which high quality software is developed across the national borders. The terms Global outsourcing, offshore outsourcing and offshoring are used interchangeably [3], [5]. By adopting offshoring strategy, organizations achieve around 20-50% of cost saving in software development and maintenance. Outsourcing encompasses a variety of business functions, such as Information Technology (IT), logistics, human resources management and financial services. IT outsourcing includes application development, application maintenance, infrastructure management and business process outsourcing [2], [6].

Software maintenance aims to keep the IT system operational and to fulfill the client requirements. The major categories of maintenance are preventive, adoptive, perfective and corrective. The maintenance is considered the longest phase of software life cycle that consumes about 60-70% of the total software budget. Maintenance of software is not only time consuming but also requires a significant human's resources ratio. Mostly, software acquisition and maintenance consume a big portion of the total IT budget. Therefore, organizations outsource the maintenance of application to cut down the maintenance cost, free up their resources and to focus on their core activities in order to get the competitiveness [7], [8].

A. RESEARCH OBJECTIVE AND RESEARCH QUESTIONS

The aim of this study is to bridge the gap between the outsourcing experts and the existing literature regarding the influence level of factors which are used in making the sourcing decision of application maintenance. As a result, an empirical investigation is undertaken to evaluate the findings of the systematic literature review and to get the perceptions of outsourcing experts about these factors. It will lead us to the identification of a list of influencing factors that will be used to assess and evaluate a project prior to make sourcing decision. Similarly, the development of project assessment model for the sourcing decision is the second objective of the current study.

The collected data through the online survey is analyzed based on variables such as respondents experience level, respondents' locations (continents), experts' positions/roles. In addition to this, the ranking of survey data is calculated by two different methods which is followed by the calculation of average ranking of influencing factors. The average ranking will lead us to identify a list of critical success factors. The Spearman Rank Correlation is performed to find the association between the ranks of the two data sets, i.e. systematic literature review and empirical study. The following research questions are defined to address the objectives of the current study:

- RQ1: Is it possible to evaluate the identified factors of systematic literature review from outsourcing experts through empirical investigation?
- RQ2: Is it possible to summarize the experts' perceptions based on their level of experience regarding the factors affecting the maintenance of the application?
- RQ3: Do the experts' views concerning the factors' impact on application maintenance offshoring vary across the continents?
- RQ4: Is it possible to present the experts' views based on their positions/roles about the influencing factors of application maintenance?
- RQ5: Is it possible to derive common critical success factors by taking into account the identified factors of systematic literature review and empirical study?
- RQ6: Is it possible to develop a project assessment model that helps IT experts in making appropriate sourcing decisions?

The rest of paper is organized as follows: The research background and the proposed research method is explained in section II and III, respectively. The findings of the study are summarized in section IV, i.e. the identification of influencing factors based on survey responses, as well as analysis of factors on the basis of various variables, i.e. respondents' experience level, respondents' locations, respondents' roles and analysis of data by using Chi square test (linear by linear association). While section V includes calculation of average ranking and section VI consists of critical success factors, performing a Spearman Rank Correlation and the proposed project assessment model for application maintenance offshoring. Similarly, study limitation and conclusion are presented in sections VII and VIII.

II. RESEARCH BACKGROUND

Offshore outsourcing strategy is used to develop high quality software in low-wage countries by utilizing their cheaper resources, global expertise and highly skilled workers. By adopting this strategy, organizations not only reduce the production cost significantly but also improve their performance. Clients in the outsourcing situations are generally from industrialized countries such as the United States, the United Kingdom, Japan, and Australia, while services are provided from the low-cost countries such as China, India, Ireland, and Russia. Likewise, the major reasons for outsourcing are [4], [9]

- To cut down the development and maintenance cost;
- To improve the productivity;
- To free up resources;
- It enables the organizations to focus on their core activities and products;
- It provides the opportunity to access to the international market;
- By adopting this strategy, organizations gain global experience;
- As vendors are involved across the globe, so business innovation is achieved;
- Employees with IT capabilities as well as high skill set are accessed;
- It enables the development team to work round the clock from various countries.

Khan *et al.* [4] performed a systematic literature review that identified a set of 18 challenges faced by vendors.

In order to validate the findings of the literature review an empirical study was conducted in six countries by collecting data from 42 experts. The study presented six challenges as critical amongst the total. Based on the identified challenges an evaluation framework was proposed and implemented. Ali *et al.* [9] developed a framework that models structural associations among the barriers for the partnership of software outsourcing by using a hybrid methodology that consists of systematic literature review and empirical study. Firstly, a set of 27 barriers were identified through systematic literature review. Secondly, an empirical investigation was performed by questionnaire survey from 50 experts in 20 countries which show the interrelationships amongst the barriers. Salam and khan [10] conducted a systematic literature review and industrial survey that identified challenges faced by vendors in multi-sourcing environment. Both the literature review that consists of 54 papers and survey with 108 responses presented 14 challenges. Out of these challenges only 8 were tagged as critical factors.

Khan *et al.* [11] performed a questionnaire based survey to identify success factors for vendors in GSD. A total of 53 experts participated in the survey from 20 countries and the identified factors of systematic literature review have been ranked. All the categories of the respondents, ranked the cost saving, infrastructure and project management as critical. The result shows that these factors should be considered to compete in the outsourcing business. Rehman *et al.* [8] identified a list of parameters that impact the sourcing decisions through literature review. The identified parameters were validated in industry with outsourcing experts that resulted into 5 influencing factors. A sourcing model was developed by using Analytic Hierarchical Process (AHP) technique based on the identified factors. The developed model was implemented in the outsourcing industry with the values taken from the experts. Hamzah *et al.* [12] proposed an outsourcing model for Malaysian e-business adoption. The model includes three dimensions which are relationship dimension, contract dimension and capability dimension that provide better solutions of information technology outsourcing for the small and medium enterprises of Malaysia. Lacity and Rottman [13] conducted 67 interviews with managers of the clients' organizations. The interviews resulted into a total of 27 effects on their roles that can be categorized into two types i.e. 21 negative and six positive effects. They presented a framework that shows the impact of outsourcing on the projects managers of clients. The areas of concerns addressed by the proposed framework are planning of project, standard processes, the transfer of knowledge, the support of organization, work management and the management of people.

A. STUDY MOTIVATION

The literature review highlights that most studies discussed the problems, obstacles and barriers of GSD, as well as the influencing factors and critical success factors of information system outsourcing and IT outsourcing [14]–[24]. Similarly, a number of researchers have focused on software maintenance outsourcing such as [25]–[31].

A little research, however, has focused on the offshore outsourcing of application maintenance [8], [32], [33]. Furthermore, we could not find a thoroughly investigated study in the literature that looked at the factors that affect application maintenance offshoring by adopting a hybrid approach, i.e. first, a systematic literature review is carried out which is followed by an empirical study to validate the results of systematic literature review.

Therefore, the current study seeks to fill the research gap by conducting a systematic literature review followed by an empirical study to evaluate the findings of the SLR. We believe that performing a systematic literature review as well as an empirical investigation would provide sufficient knowledge for making the sourcing decisions. Our findings would contribute to previous studies in the field of offshore outsourcing of application maintenance. The study will inform the research community about the common reported challenges of application maintenance as well as the views of outsourcing experts regarding the influence of these challenges on outsourcing. Moreover, the study presents a list of critical success factors and a project assessment model for making the sourcing decisions. IT experts and decision makers would use the results of the study to get a deeper understanding of the major challenges which will enable them to make effective sourcing decisions.

III. PROPOSED METHODOLOGY

In this research, a hybrid research methodology is adopted that comprised of systematic literature review and empirical study. The adoption of hybrid methodology aims to thoroughly investigate the research domain. We have already performed a systematic literature review [1] that identified a list of influencing factors concerning the offshore outsourcing decisions of application maintenance. The current study, evaluates the findings of the systematic literature review in the outsourcing industry. The literature highlights that similar approach was used by other researchers [3], [10], [34]–[36]. Fig 1, shows the proposed research method for the identification of influencing factors and their evaluation from the experts in the outsourcing industry. The detailed discussion of the proposed research method is given in the following sub sections.

A. SYSTEMATIC LITERATURE REVIEW

Systematic literature review is a commonly known approach used to examine a research problem and thoroughly assess it. By using this approach, the selected published work is filtered, evaluated and analyzed against the defined questions. Since, it follows a pre-defined research review protocol, it therefore, differs from an ordinary review [37]. A new study protocol was developed and followed for the identification of influencing factors concerning offshore outsourcing decision of application maintenance that was published in [1], [2]. The systematic literature reviews were carried out

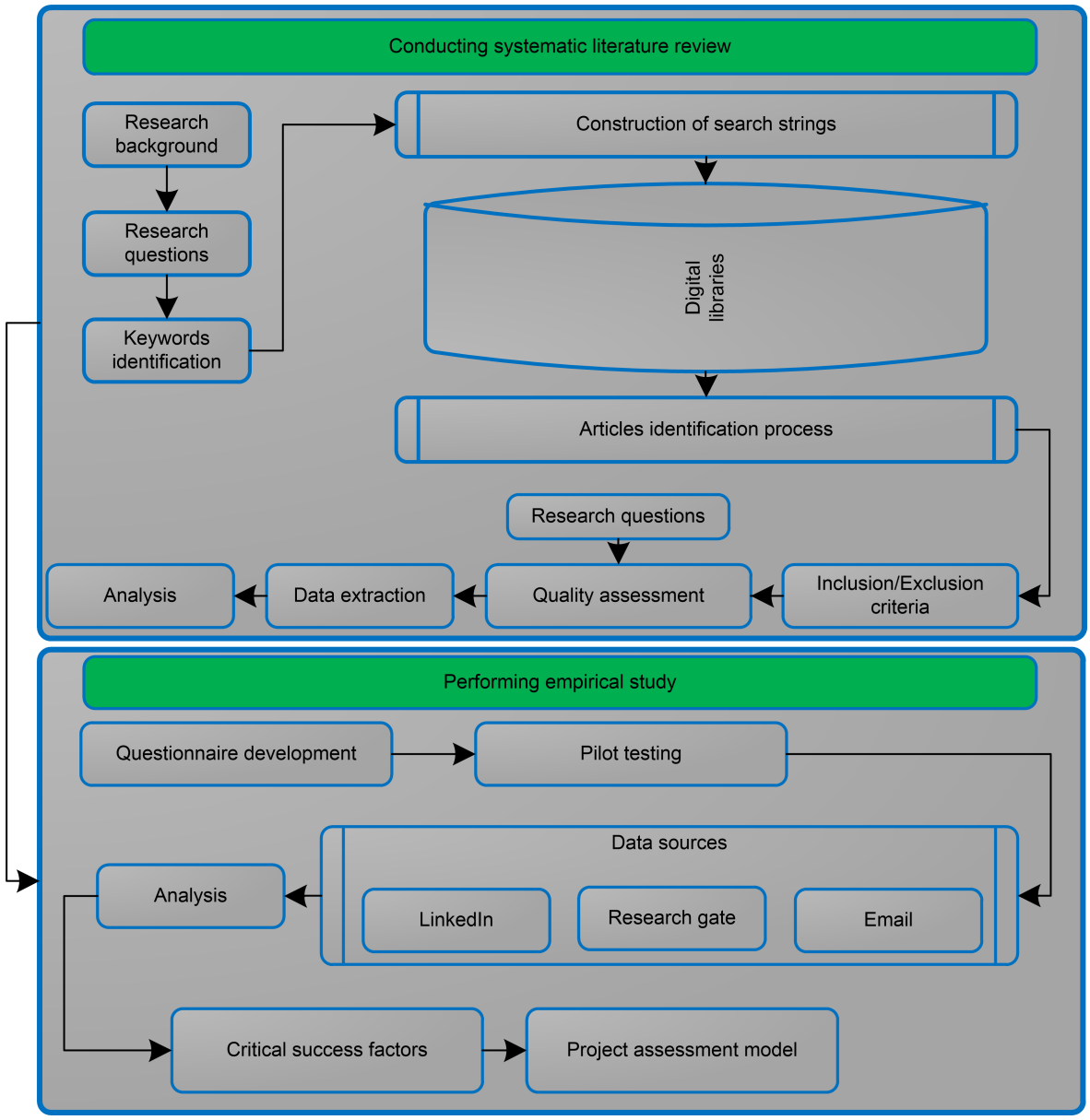

FIGURE 1. Proposed study method.

by adopting the guidelines of Kitchenham and Charters [37]. The basic steps that were followed are defining questions, identifying keywords, construction of strings, search period, inclusion/exclusion criteria, quality assessment, data synthesis and analysis. The detailed discussions of these steps have been given in previous published studies [1], [2].

B. EMPIRICAL STUDY

An online survey is performed in the outsourcing sector by using an online survey tool to empirically evaluate the results of a systematic literature review, i.e. Google Form (https://docs.google.com/forms/u/0/). In the current research, the online survey approach is used for data collection, as the following benefits are provided by this method [38]:

- Data can easily be obtained from experts who are located in various continents by using the online questionnaire survey;
- The survey is easily handled and the data is collected quickly by using online resources such as Google Online Form;
- It is cost-effective method and can be completed in a short time;
- To obtain experts opinions, the researchers do not need to take appointment.

In general, the questionnaire survey consists of the design phase and the sampling phase. Similarly, the design phase involves questions that the sample can address. Sampling may be carried out by both methodical and non-methodical

methods. Data is directly collected from the population in a methodical approach [3], [39]. It was not possible to collect data directly from experts from different countries for the present analysis. Therefore, we adopted non methodical approach, i.e. online survey for data collection. Other researchers have also used this approach for data collection [40]–[42].

1) QUESTIONNAIRE

The questionnaire technique is more effective than other observational methods because it provides the opportunity to target a larger population for data collection [43], [44]. In the current study online questionnaire survey is used for data collection. The questionnaire is based on the identified factors that were reported in the previous studies [1], [2]. The questionnaire comprises of both open ended and close ended questions. The purpose of close ended questions is to collect the respondents' rating about the included factors whereas the open ended questions enable outsourcing experts to highlight additional factors apart from the included one. The format of the designed questionnaire is as follows:

In the beginning of questionnaire, we briefly explained the purpose of survey, included a data privacy statement and also provided instructions to fill out the questionnaire. It is followed by section 1, that contains demographics of respondents while section 2, contains a list of 15 influencing factors to be evaluated by the experts. Section 2, also has open ended questions in order to allow the respondents to mention new factors. The sample of questionnaire used in this survey is given in Appendix A. We have adopted five point Likert scale to evaluate the influencing factors regarding the offshore outsourcing decision of application maintenance. In order to evaluate the influencing factors the respondents were asked to rate the factors based on the defined criteria such as 'VHI' = Very High Influence, 'HI' = High Influence, 'MI' = Moderate Influence, 'LI' = Low Influence and 'NI' = No Influence. The literature shows that five point Likert scale is comparatively simple and less confusing than 7 point scale. Therefore, it increases the response ratio and quality. Another reason for the adoption of five points Likert scale is to minimize the researchers' biasness [38], [45]–[48]. The five point Likert scale has also been adopted by previous studies [11], [15], [49].

2) QUESTIONNAIRE PILOT TESTING

The aim of the pilot test is to review the survey instructions for readability, to check the understandability of the included factors in order to overcome uncertainty, and to estimate the time taken to complete the questionnaire. Furthermore, the previous studies [10], [11], [15], [49] have shown that pilot testing with experts guarantees that the questionnaire is reliable, precise, and easy to understand.

The questionnaire was tested in the current research by outsourcing experts from academia and industry. The pilot test was carried out by two academicians from the Abdul Wali Khan University Mardan, Pakistan, and the University of Swabi, Pakistan. Similarly, the questionnaire was evaluated by three practitioners including a global application maintenance expert (Associate Partner Global Business Services) at IBM Stockholm, Sweden, a Global Delivery expert at Vattenfall AB, Stockholm, Sweden; and an Administrator and Systematic Information Security at MSB (Agency for Civil Protection and Emergency Planning), Stockholm Sweden. The experts suggested to include the details of the influencing factors as well as to change the structure of the questionnaire. The questionnaire was revised and improved according to the received feedback and recommendations of the experts.

IV. FINDINGS OF THE STUDY

This section presents the detailed description and analysis of the findings of empirical study and comparison with the findings of systematic literature review. Section A, shows the factors identified through systematic literature review. Section B, on the other hand, discusses analysis of the influencing factors identified via empirical study.

A. FACTORS IDENTIFIED THROUGH SYSTEMATIC LITERATURE REVIEW

Table 1, shows a list of 15 influencing factors of application maintenance offshoring that were identified by systematic literature reviews and reported in the previous studies [1], [2]. The present research performing an empirical study in the outsourcing industry to evaluate the findings of the systematic literature reviews.

TABLE 1. Identified list of factors by using systematic literature review.

S.No	Influencing factors	Frequency	Percentage
01	Cost	27	69
02	Legal requirements	27	69
03	Language barrier	23	59
04	Maturity level	24	61
05	Frequent requirements changes	24	61
06	Service scope	5	13
07	Cultural diversity	19	49
08	Time zone difference	16	41
09	Knowledge transfer	22	56
10	Project management	22	56
11	Domain knowledge	12	31
12	Employees skills	30	77
13	Infrastructure	24	61
14	Poor communication	27	69
15	Size of engagement	5	13

B. EMPIRICAL INVESTIGATION (Online Survey)

Since, the primary aim of the current study is gaining in-depth understanding of the outsourcing experts' perceptions concerning the factors that influence the offshore outsourcing decision of application maintenance. We need a thorough investigation in order to collect data from practitioners across the world in outsourcing industry. The traditional method of addressing the target population was not suitable, as the contacts of these practitioners were not available to us as well as we could not find any website that had such information. Therefore, the suitable population was targeted through

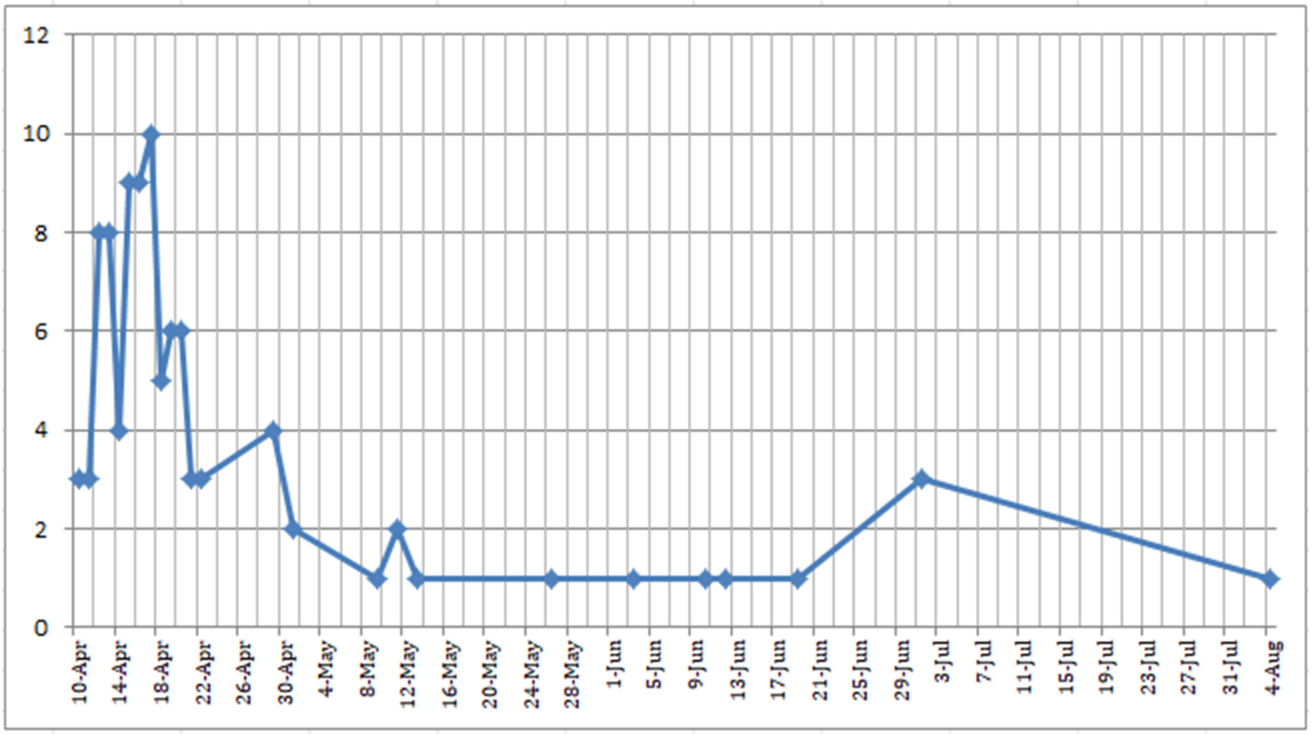

FIGURE 2. Survey responses date-wise.

online survey by using various applications such as LinkedIn, Research gate and Google Scholar. We decided to join different outsourcing groups on LinkedIn in order to reach the target population. The online outsourcing groups that were used for targeting appropriate population are given in Table 13, appendix B. Outsourcing experts and researchers around the globe were carefully selected by checking their profiles. After that, survey links were shared with the selected profiles and the follow up process was adopted to get the experts' responses by sending emails; and messages through LinkedIn and Research gate. Consequently, we received a total of 96 responses from 30 countries. All the countries along with the received responses are shown in Fig 7, Appendix C, whereas the complete information about the participants are given in Table 14 and 15 in Appendix D. The process for collecting data was initiated on 4th April, 2020 and completed on 4th August, 2020. After reviewing all the received responses, only 3 responses were found incomplete which were discarded. Thus, 93 responses were finalized as the survey sample size. The time span of the survey responses is shown in Fig 2.

The bibliographic data of participants such as their designations and levels of experience are shown in Fig 3. The main purpose of the collection of bibliographic data is to analyze the appropriateness of the respondents for the research objectives of the current study.

Fig 3, shows that majority of participants are project managers (61), 12 are consultants, 6 are each researchers and professors; and 5 are developers/programmers. It depicts that collected data has the depth to address the identified research gap. The range of participants' experience is junior level (1-5) years, middle level (6-10) years and senior level (+11) years. Among the 93 respondents, 62 belong to senior level, 22 middle level and 9 lower/junior level. It shows that most of the survey respondents are experienced in the research domain.

C. IDENTIFIED INFLUENCING FACTORS THROUGH SURVEY

Table 2, shows a list of influencing factors identified through the survey. The table is mainly consisted of two columns, namely ''influencing factors'' that contains the list of identified factors and ''experts' responses'' that are categorized as strong influence, weak influence and no influence. Each category contains sub parts such as 'strong influence' includes VHI and HI; 'weak influence' includes MI and LI whereas 'no influence' contains only NI. Strong influence shows the participants who marked the level of influence as very high and high regarding the offshore outsourcing of application maintenance. While, weak influence includes responses (moderate and weak) that have a low influence on offshore outsourcing. The third category contains the responses where the respondents thought that the factors do not have influence on offshoring decision.

We did not notice any new factors related to application maintenance offshoring in the empirical study. Interestingly, all the identified factors through systematic literature review were evaluated and found related to offshoring decisions.

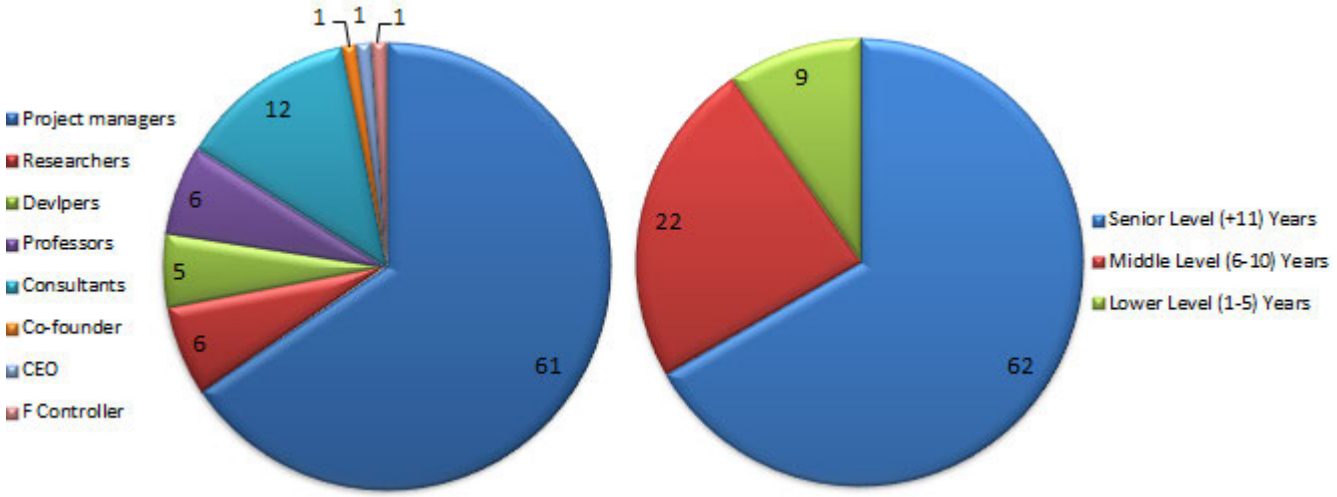

FIGURE 3. Respondents designations and experience levels.

TABLE 2. Factors identified through industrial survey.

S.No	Influencing factors	Experts responses (N=93)									
		Strong influence				Weak influence				No influence	
		VHI	HI	VHI+HI	%	MI	LI	MI+LI	%	NI	%
1	Cost	30	42	72	77	19	1	20	21	1	1
2	Legal requirements	33	40	73	78	13	4	17	18	3	3
3	Language barrier	12	43	55	59	22	14	36	39	2	2
4	Maturity level	14	58	72	77	18	2	20	21	1	1
5	Frequent requirements changes	21	33	54	58	24	11	35	38	4	4
6	Service scope	13	42	55	59	27	10	37	40	1	1
7	Cultural diversity	8	21	29	31	32	27	59	63	5	5
8	Time zone difference	7	17	24	26	42	22	64	69	5	5
9	Knowledge transfer	9	40	49	53	26	16	42	45	2	2
10	Project management	11	39	50	54	28	15	43	46	0	0
11	Domain knowledge	22	38	60	64	28	5	33	35	0	0
12	Employees skills	23	57	80	86	12	1	13	14	0	0
13	Infrastructure	24	42	66	71	23	3	26	28	1	1
14	Poor communication	39	34	73	78	13	6	19	20	1	1
15	Size of engagement	7	41	48	52	31	13	44	47	1	1

We selected only 'strong influence' column for the analysis purposes, this method was also used by other researchers to analyze the survey results [11], [15], [36].

The result shows that only 6 factors received scores more than 70% in the experts' responses. The most common factor in all responses is the 'employees skills' with value of 86%. The second most common factors are 'legal requirements' and 'poor communication' with equal preferences of 78%. The third position is hold by both 'cost' and 'maturity level' which got 77% in experts' responses. 'Infrastructure' was also placed in strong influencing category by receiving responses of 71%.

Only 1 factor, i.e. 'domain knowledge' got preference more than 60%. Other high rated factors that received scores more than 50% are 'language barrier', 'service scope', 'frequent requirements changes', 'project management' and 'size of engagement' which received 59%, 59%, 58%, 54%, 53% and 52% respectively. The remaining factors did not get high scores and were below the 50%.

1) FACTORS SUMMARY BASED ON RESPONDENTS' EXPERIENCE

In order to analyze the respondents' perceptions regarding application maintenance offshoring, the respondents are grouped into three categories on the bases of their experience levels such as lower (1-5 years), middle (6-10 years) and senior (+11 years) as shown in Table 3. We received a total of 93 responses, among them the lower level responses are 9, middle level (21) and senior level (63). 'Frequent requirements changes' is the most highly rated factor (100%) in lower level while it is just above 50% in both middle and senior level. Similarly, the factor 'maturity level' is the second highest factor (89%) in lower level. However, this factors was perceived comparatively less important in both middle and

TABLE 3. Factors summary based on the experience level of respondents.

Influencing factors	Respondents' categories by experience					
	Lower level (1-5 Years) N=9		Middle level (6-11 Years) N=21		Senior level (+11 Years) N=63	
	Freq	%	Freq	%	Freq	%
Cost	7	78	17	81	48	76
Legal requirements	6	67	13	62	54	59
Language barrier	5	55	15	71	35	55
Maturity level	8	89	16	76	48	76
Frequent requirements changes	9	100	12	57	33	52
Service scope	5	55	11	52	39	62
Cultural diversity	2	22	6	29	21	33
Time zone difference	1	11	7	33	16	25
Knowledge transfer	3	33	12	57	34	54
Project management	3	33	10	48	37	59
Domain knowledge	1	11	11	52	43	68
Employees skills	7	78	18	86	55	87
Infrastructure	6	67	14	67	46	73
Poor communication	7	78	17	81	49	78
Size of engagement	2	22	11	52	35	55

TABLE 4. The table of significant difference regarding the respondents' categories based on experience.

Factors	Managers N= 64	Consultants N=12	linear by linear association a=0.05		Managers N= 64	Professors /Researchers N=12	linear by linear association a=0.05		Consultants N=12	Professors /Researchers N=12	linear by linear association a=0.05	
	Freq	Freq	X2	P	Freq	Freq	X2	P	Freq	Freq	X2	P
Cost	45	11	2.37641	0.1232	45	12	4.75	0.0293	11	12	1.04348	0.307
LR	46	12	4.42241	0.03547	46	10	0.684226	0.4081	12	10	2.18182	0.1396
LB	37	7	0.0011245	0.9732	37	8	0.328017	0.5668	7	8	0.177778	0.6733
ML	51	6	4.75	0.0293	51	10	0.0847905	0.7709	6	10	1.49722	0.2211
FRC	36	7	0.017852	0.8937	36	6	0.159664	0.6895	7	6	0.167832	0.682
SS	38	8	0.224879	0.6353	38	7	0.00454002	0.9463	8	7	0.177778	0.6733
CD	21	4	0.001241	0.9719	21	3	0.285457	0.5931	4	3	0.201681	0.6534
TZD	18	2	0.684226	0.4081	18	4	0.133277	0.7151	2	4	0.888889	0.3458
KT	30	9	3.19958	0.07366	30	7	0.53107	0.4662	9	7	0.75	0.3865
PM	33	9	2.24527	0.134	33	6	0.009875	0.9208	9	6	1.6	0.2059
DK	41	7	0.142547	0.7058	41	9	0.537115	0.4636	7	9	0.75	0.3865
ES	57	8	4.09452	0.04302	57	12	1.44565	0.2292	8	12	4.8	0.02846
Infra	47	7	1.12086	0.2897	47	8	0.231674	0.6303	7	8	0.177778	0.6733
PC	48	9	0	1	48	11	1.61648	0.2036	9	11	1.2	0.2733
SOE	33	9	2.24527	0.134	33	3	2.8599	0.09081	9	3	6	0.01431

senior level with respondents' value of 76%. According to the respondents' views the factor 'cost' has almost the same importance in all the three level with influence of 78%, 81% and 76%. Similarly, the lower level assigned weight (78%) to both 'employees skills' and 'cost' but surprisingly, the middle level and senior level ranked it as the most highest factor (86%, 87%) among the factors. Other notable factors which got weight more than 60% in all the three levels are 'poor communication' (78%, 81%, 78%) and 'infrastructure' (67%, 67%, 73%). All the three levels ranked these factors as crucial factors for offshore outsourcing decision of application maintenance. Other factors which received importance more than 50% in all the levels are 'legal requirements', 'language barrier' and 'service scope'. All the respondents of three levels believed that the aforementioned factors are critical for application maintenance offshoring. The rest of 6 factors did not receive high importance which got the value less than 50% in all the experience levels.

We performed the linear by linear association (Chi square test) of the three groups as given in Table 4. The result shows that 'frequent requirements changes' and 'domain knowledge' has significant differences in groups, namely lower and middle; and lower and senior. Similarly, the significant difference was observed only in 'legal requirements' in middle and senor group.

2) FACTORS SUMMARY BASED ON RESPONDENTS' LOCATIONS (Continents)

The current sub section addresses RQ3, which identifies a list of influencing factors in various continents as shown in Table 5. The analysis of the influencing factors based on continents such as Asia, Europe and Mixed (Other mentioned continents). This analysis will determine variations in the identified factors with respect to continents. The identification of similarities and differences amongst the factors will add value to the existing understanding of the influencing factors regarding the offshore outsourcing decision.

The collected data through online questionnaire is analyzed based on two continents, i.e. Asia and Europe. Table 5,

TABLE 5. Factors' rating by experts based on continents.

Influencing factors	Respondents' categories by experience						Chi square test (linear by linear association) a=0.05		
	Europe N= 50		Asia N=26		Mixed (All other continents) N=17				
	Freq	%	Freq	%	Freq	%	X2	df	P
Cost	40	80	19	73	13	76	0.472122	1	0.492
Legal requirements	40	80	18	69	15	88	1.09755	1	0.2948
Language barrier	27	54	16	61	12	71	0.395676	1	.5293
Maturity level	34	68	24	92	14	82	5.5917	1	0.01805
Frequent requirements changes	26	52	17	65	11	65	0.332088	1	0.5644
Service scope	27	54	16	61	12	71	0.395676	1	0.5293
Cultural diversity	14	28	10	38	5	29	0.86643	1	0.3519
Time zone difference	9	18	6	23	7	41	0.278315	1	0.5978
Knowledge transfer	28	56	12	46	9	53	0.665162	1	0.4147
Project management	23	46	15	58	12	71	0.935385	1	0.3335
Domain knowledge	32	64	16	61	12	71	0.0445421	1	0.8328
Employees skills	39	78	26	100	15	88	6.688	1	0.009706
Infrastructure	38	76	20	77	8	47	0.00806366	1	0.9284
Poor communication	37	74	21	81	15	88	0.433646	1	0.5102
Size of engagement	27	54	9	35	12	71	2.57815	1	0.1083

TABLE 6. Factors rating by experts based on their positions/roles.

Influencing factors	Outsourcing experts groups/categories							
	Mangers N=64		Consultants N=12		Professors/Researchers N=12		Programmers/Developers N=5	
	Freq	%	Freq	%	Freq	%	Freq	%
Cost	45	70	11	92	12	100	4	80
Legal requirements	46	72	12	100	10	83	5	100
Language barrier	37	58	7	58	8	67	3	60
Maturity level	51	80	6	50	10	83	5	100
Frequent requirements changes	36	56	7	58	6	50	5	100
Service scope	38	59	8	67	7	58	2	40
Cultural diversity	21	33	4	33	3	25	1	20
Time zone difference	18	28	2	17	4	33	0	0
Knowledge transfer	30	47	9	75	7	58	3	60
Project management	33	52	9	75	6	50	2	40
Domain knowledge	41	64	7	58	9	75	3	60
Employees skills	57	89	8	67	12	100	3	60
Infrastructure	47	73	7	58	8	67	4	80
Poor communication	48	75	9	75	11	92	3	80
Size of engagement	33	52	9	75	3	33	3	60

indicates that among the total received responses (93), the majority of respondents belong to Europe (50), 26 from Asia and only 17 responses from other continents. In order to identify the significant difference between the factors identified in Europe and Asia, we performed the Chi square test. The test produced significant difference among the factors, i.e. 'language barrier', 'maturity level' and 'employees skills'.

Similarly, the result shows that both 'cost' and 'legal requirements' stand on the top in Europe with value of 80%. Whereas both factors, show a decline in Asia with 73% and 69% respectively. The factor 'employees skills' appeared on the top in Asia with 100% and also got third position in Europe (78%). Similarly, the second highest rated factor in Asia is 'maturity level' (92%), however, it is considered comparatively less important in Asia (68%). The third high rated factor in Asia is 'poor communication' (81%) while it shows a decrease in its value (74%) with the experts' perspective belong to Europe. The factors which are considered important and got values more than 50% in both continents, i.e. Europe and Asia are 'frequent requirements changes', 'service scope', 'domain knowledge' and 'infrastructure'.

3) FACTORS SUMMARY BASED ON OUTSOURCING EXPERTS' POSITIONS

The survey respondents were categorized into four groups based on their positions, including managers, consultants, professors/researchers and programmers/developers. The primary aim of the position's based summary of factors is to highlight the perception of various groups of experts about the influencing factors regarding offshore outsourcing decision of application maintenance. The experts rated the factors according to their knowledge, understanding and expertise in the global software development and IT outsourcing. Previous research studies [41], [49] also performed the same categorization. Table 6, indicates that out of 15 factors, 11 factors were rated as high influential by the managers group. The factors are 'cost' (70%), 'legal requirements' (72%), 'language barrier' (58%), 'maturity level' (80%), 'frequent requirement changes' (56%), 'service scope' (59%), 'project

TABLE 7. The table of significant difference regarding the experts' groups/categories.

Factors	Managers N= 64	Consultants N=12	linear by linear association a=0.05		Managers N= 64	Professors /Researchers N=12	linear by linear association a=0.05		Consultants N=12	Professors /Researchers N=12	linear by linear association a=0.05	
	Freq	Freq	X2	P	Freq	Freq	X2	P	Freq	Freq	X2	P
Cost	45	11	2.37641	0.1232	45	12	4.75	0.0293	11	12	1.04348	0.307
LR	46	12	4.42241	0.03547	46	10	0.684226	0.4081	12	10	2.18182	0.1396
LB	37	7	0.0011245	0.9732	37	8	0.328017	0.5668	7	8	0.177778	0.6733
ML	51	6	4.75	0.0293	51	10	0.0847905	0.7709	6	10	1.49722	0.2211
FRC	36	7	0.017852	0.8937	36	6	0.159664	0.6895	7	6	0.167832	0.682
SS	38	8	0.224879	0.6353	38	7	0.00454002	0.9463	8	7	0.177778	0.6733
CD	21	4	0.001241	0.9719	21	3	0.285457	0.5931	4	3	0.201681	0.6534
TZD	18	2	0.684226	0.4081	18	4	0.133277	0.7151	2	4	0.888889	0.3458
KT	30	9	3.19958	0.07366	30	7	0.53107	0.4662	9	7	0.75	0.3865
PM	33	9	2.24527	0.134	33	6	0.009875	0.9208	9	6	1.6	0.2059
DK	41	7	0.142547	0.7058	41	9	0.537115	0.4636	7	9	0.75	0.3865
ES	57	8	4.09452	0.04302	57	12	1.44565	0.2292	8	12	4.8	0.02846
Infra	47	7	1.12086	0.2897	47	8	0.231674	0.6303	7	8	0.177778	0.6733
PC	48	9	0	1	48	11	1.61648	0.2036	9	11	1.2	0.2733
SOE	33	9	2.24527	0.134	33	3	2.8599	0.09081	9	3	6	0.01431

management' (52%), 'employees skills' (89%), 'infrastructure' (73%) and 'poor communication' (75%). Similarly, the programmers/developers considered 10 factors as influencing, out of 15 factors. There is a slight difference between in the perception of managers group and programmers group. The factors 'service scope' and 'project management' are important only with managers group perspective whereas programmers ranked 'knowledge transfer' is an important factor. However, the managers group thought that 'knowledge transfer' can be managed in the offshore outsourced project and did not rank it as an influential factor.

The consultant group ranked most of the factors high influential except the cultural diversity (33%) and time zone difference (28%). We got exactly the same result from the researchers/professors group by rating only two factors less important, i.e. 'cultural diversity' and 'time zone difference'. Therefore, outcome indicates that both the researchers/professors and consultants groups considered, 13 factors as important for making the sourcing decision of application maintenance. Whereas, managers group believe that only 11 factors are important for making offshore outsourcing decision.

Table 7, shows the linear by linear association (Chi square test) of the factors between the outsourcing experts groups. Three factors, i.e. 'legal requirements', 'maturity level' and 'employees skills' showed significant difference between the mangers and consultants group. Whereas, the significant difference was found only in the factor of ''cost'' between the groups of managers and professors. Similarly, in the group of professors/researchers and consultants, two factors have significant difference which are 'employees skills' and 'size of engagement'.

V. AVERAGE RANKING OF FACTORS IDENTIFIED THROUGH INDUSTRIAL SURVEY AND SLR

The current section explains the average ranking of both data sets as well as the ranking of influencing factors found by systematic literature review and empirical study. The average ranking is determined using two different methods, as described in sub sections A and B.

A. METHOD 1

This method consists of the following two steps:

Step 1: Calculate the ranking of the factors identified by systematic literature review and empirical study;

The factors found by using a systematic literature review were ranked and reported in the previous study [1]. Similarly, Table 8, illustrates the ranking of factors identified through an online survey. The factors were ranked on the basis of their frequencies in the received responses. Among the identified factors, the top 10 factors are 'employees skills', 'legal requirements', 'poor communication', 'cost', 'maturity level', 'infrastructure', 'domain knowledge', 'language barrier', 'service scope' and 'frequent requirements changes'.

Step 2: Calculate average ranking of systematic literature review and empirical study:

The calculated average ranking of the influencing factors found by SLR and empirical study is shown in Table 9. The ranking shows that 'legal requirements' (2.75) and 'poor communication' (2.75) gained the same level of priority whereas other factors such as 'project management' (10.25) and 'knowledge transfer' (10.75); as well as 'time zone difference' (13.5) and 'size of engagement' (13.75) were found close to each other. The top 10 factors of both data sets are 'employees skills', 'legal requirements' and 'poor communication'; 'cost', 'maturity level', 'infrastructure', 'frequent requirements changes', 'language barrier', 'domain knowledge' and 'project management'.

B. METHOD 2

This method also follows the same steps as of method 1 for the derivation of average ranking, i.e. step 1: ranking of factors identified through SLR and empirical study. Firstly, the factors identified through SLR and empirical study are ranked.

TABLE 8. Factors ranking identified through empirical study.

Experts responses (N=93)						
S.No	Influencing factors	Strong influence				
		VHI	HI	Sum=VHI+HI	Percentage	Ranking
1	Cost	30	42	72	77	4.5
2	Legal requirements	33	40	73	78	2.5
3	Language barrier	12	43	55	59	8.5
4	Maturity level	14	58	72	77	4.5
5	Frequent requirement changes	21	33	54	58	10
6	Service scope	13	42	55	59	8.5
7	Cultural diversity	8	21	29	31	14
8	Time zone difference	7	17	24	26	15
9	Knowledge transfer	9	40	49	53	12
10	Project management	11	39	50	54	11
11	Domain knowledge	22	38	60	64	7
12	Employees skills	23	57	80	86	1
13	Infrastructure	24	42	66	71	6
14	Poor communication	39	34	73	78	2.5
15	Size of engagement	7	41	48	52	13

TABLE 9. Average ranking of influencing factors based on method 1.

S.No	Influencing factors	Experts responses (N=93)			Selected articles for SLR (N=38)			Average
		Freq	%	Ranking	Freq	%	Ranking	ranking
1	Employees skills	80	86	1	30	77	1	1
2	Legal requirements	73	78	2.5	27	69	3	2.75
3	Poor communication	73	78	2.5	27	69	3	2.75
4	Cost	72	77	4.5	27	69	3	3.75
5	Maturity level	72	77	4.5	24	61	6	5.25
6	Infrastructure	66	71	6	24	61	6	6
7	Frequent requirements changes	54	58	10	24	61	6	8
8	Language barrier	55	59	8.5	23	59	8	8.25
9	Domain knowledge	60	64	7	12	31	13	10
10	Project management	50	54	11	22	56	9.5	10.25
11	Knowledge transfer	49	53	12	22	56	9.5	10.75
12	Service scope	55	59	8.5	5	13	14.5	11.5
13	Cultural diversity	29	31	14	19	49	11	12.5
14	Time zone difference	24	26	15	16	41	12	13.5
15	Size of engagement	48	52	13	5	13	14.5	13.75

The identified factors of SLR were ranked and already published in the previous study [1]. In order to rank the survey factors, we need to calculate the mean of responses against each factor and step 2: Identifying the average ranking of both ranks of SLR and survey.

However, in this method the survey factors are ranked on the basis of their 'mean' values. The factor with high 'mean' value would be high in ranking. The details of calculating the 'mean' of each factor from the received responses are as follows [50]:

Table 10, shows the mean calculation by adopting the following steps:

a. By multiplying the responses received for each factors with their corresponding weights;

b. Sum of total weights (W1+W2+W3+W4+W5) will be divided by total survey responses (93).

Secondly, the average ranking of both data sets are determined by putting together the survey and SLR data as shown in Table 11. Thus, by taking the average of SLR ranking and survey ranking, we get the final ranking of influence factors. The current approach provides a clear and single valued ranking for each influencing factor, as illustrated in Table 11, whereas in the previous method, two factors, i.e. 'poor communication and 'legal requirements' were ranked equally (Table 9).

The Spearman Rank Correlation was performed to find the correlation between the factors ranking of the two data sets [10], [34] as given in Table 12. The value of coefficient is 0.769187 that shows a positive correlation between the two data sets' ranking as shown in Fig 4.

Besides that, we calculated a P value (0.000802) that is less than 0.005. It means that there is a significant positive correlation between the ranks of SLR and survey factors.

VI. PROPOSED PROJECT ASSESSMENT MODEL BASED ON THE IDENTIFIED CRITICAL SUCCESS FACTORS

This section addresses RQ.5 and RQ.6 by identifying a list of 10 critical success factors as shown in Fig 5, and proposing a project assessment model for application maintenance offshoring. We calculated the average ranking of factors by two different methods. Surprisingly, we came up with almost identical rankings for the top 10 factors, with the exception of a small variation in the order of factors. Out of a total of 15 factors only 10 were ranked as critical success factors.

TABLE 10. Ranking of survey factors based on mean calculation.

	Experts's responses (N=93)							
Influencing Factors	VHI(W=5)	HI(W=4)	MI(W=3)	LI(W=2)	NI(W=1)	Wt= VHI+HI+MI+LI+NI	Mean=Wt/93	Ranking
Poor communication	39*5=195	34*4 =136	13*3 =39	6*2 =12	1*1 =1	383	4.11	1
Employees skills	23*5=115	57*4=228	12*3=36	1*2=2	0*1=0	381	4.09	2
Cost	30*5=150	42*4=168	19*3=57	1*2=2	1*1=1	378	4.06	3
Legal requirements	33*5=165	40*4=160	13*3=39	4*2=8	3*1=3	375	4.03	4
Infrastructure	24*5=120	42*4=168	23*3=69	3*2=6	1*1=1	364	3.91	5
Maturity level	14*5=70	58*4=232	18*3=54	2*2=4	1*1=1	361	3.88	6
Domain knowledge	22*5=110	38*4=152	28*3=84	5*2=10	0*=0	356	3.82	7
Frequent requirements changes	21*5=105	33*4=132	24*3=72	11*2=22	4*1=4	335	3.60	8.5
Service scope	13*5=65	42*4=168	27*3=81	10*2=20	1*1=1	335	3.60	8.5
Language barrier	12*5=60	43*4=172	22*3=66	14*2=28	2*1=2	328	3.52	10
Project management	11*5=55	39*4=156	28*3=84	15*2=30	0*1=2	325	3.49	11
Size of engagement	7*5=35	41*4=164	31*3=93	13*2=26	1*1=1	319	3.43	12
Knowledge transfer	9*5=45	40*4=160	26*3=78	16*2=32	2*1=2	317	3.40	13
Cultural diversity	8*5=40	21*4=84	32*3=96	27*2=54	5*1=5	279	3	14
Time zone difference	7*5=35	17*4=68	42*3=126	22*2=44	5*1=5	278	2.98	15

TABLE 11. Average ranking of influencing factors based on method 2.

Influencing factors	Survey identified factors ranking	SLR identified factors ranking	Average ranking
Employees skills	2	1	1.5
Poor communication	1	3	2
Cost	3	3	3
Legal requirements	4	3	3.5
Infrastructure	5	6	5.5
Maturity level	6	6	6
Frequent requirements changes	8.5	6	7.25
Language barrier	10	8	9
Domain knowledge	7	13	10
Project management	11	9.5	10.25
Service scope	8.5	14.5	11.5
Size of engagement	12	14.5	13.25
Knowledge transfer	13	9.5	11.25
Cultural diversity	14	11	12.5
Time zone difference	15	12	13.5

TABLE 12. Spearman rank correlation.

Performing Spearman correlation and P value		
Coefficient (rs)	=CORRE(array1,array2)	0.769187
N	Size of data set	15
T statistic	T= rs$\times\sqrt{n-2}/\sqrt{1-rs2}$	4.33996
Df	N-2	13
P value	=TDIST(T statistic*DF*2)	0.00080

The same criteria was also followed by previous research studies [10], [34]. The critical success factors are briefly discussed in the following paragraphs.

1. Employees Skills: The most influential factor among all the identified factors is the 'employees skills'. It has been ranked at the top by securing first place among the critical success factors. The sub factors are employees knowledge, employees skills, employees expertise and IT skills. The inexperienced employees may cause the increase of failure ratio in the outsourced projects as well as they are unable to solve the problems quickly without the proper support.

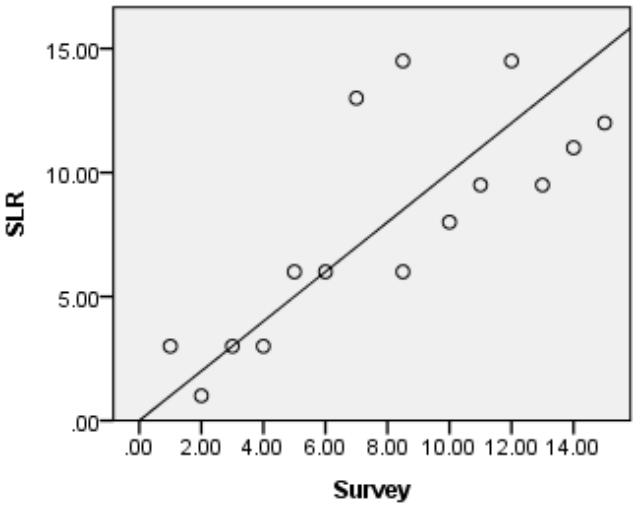

FIGURE 4. Scattered graph of two data sets ranking.

Whereas, the experienced employees with high skill set, enable the vendors to provide on time services as well as quality products. Similarly, the resources that work on client

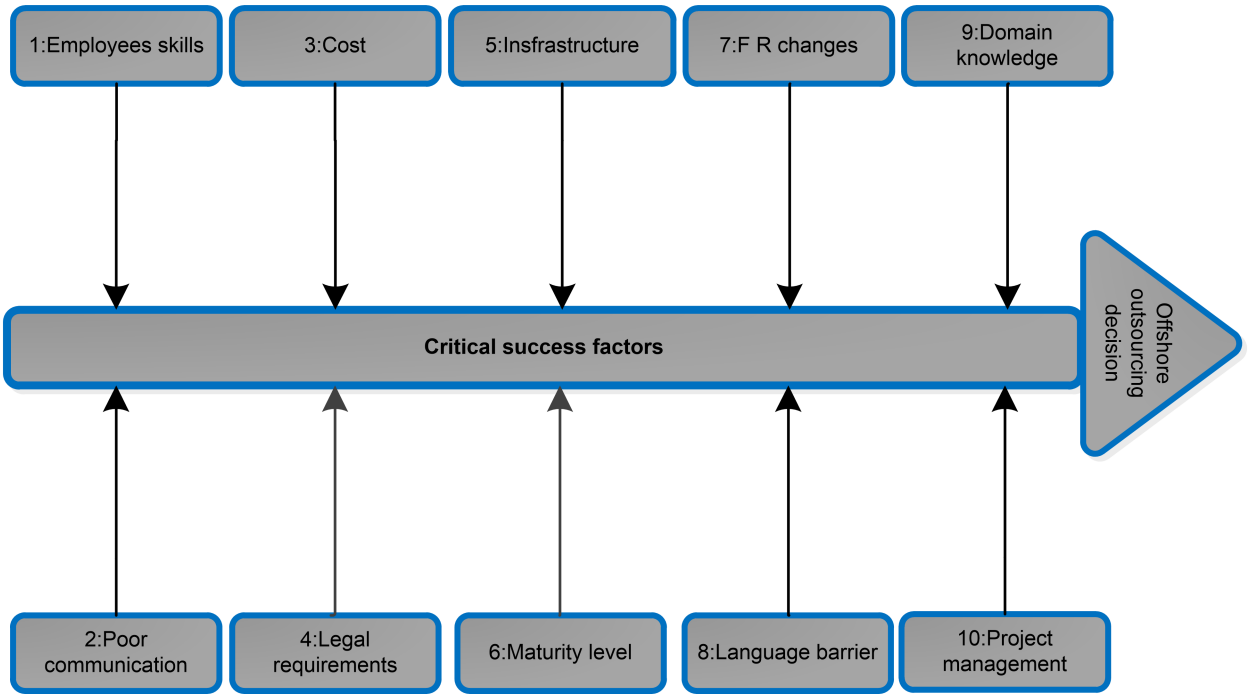

FIGURE 5. Identified critical success factors in both data sets.

side with sufficient business process knowledge and of IT knowledge enable them to receive the services smoothly. The customer assesses the vendor, prior to an outsourcing decision by determining the potential of the vendor in terms of expertise, global experience and outsourcing experience [1], [51]–[53].

2. Poor Communication: The factor 'poor communication' was ranked as the second highest important factor among the identified list. The challenges of global software engineering such as cultural diversity, distance, time zone and language barrier hinder the communication across the various dispersed working units. Therefore, often the questions of offshore team are not adequately addressed in the global software development, and the situation gets worse when the offshore resources make wrong assumptions [3], [54]–[57]. Thus, poor communication results low productivity and high volume of issues in the distributed project.

3. Cost: it is the third high weighted CSF for offshore outsourcing of application maintenance. It is one of the main factors that drives offshore outsourcing and enables the organizations to bring down the overall cost of their projects. By adopting the offshoring strategy, organizations get around 30-50% of cost savings [8]. On the other hand, onsite employees consume a high amount of resources which increase the production cost as well as the transaction cost [30], [58].

4. Legal Requirements: 'Legal requirements' is another factor which has been place on fourth position amongst the CSFs. It includes data security, data confidentiality, Intellectual Property (IP) rights, import issues, export issues and data privacy etc. The most challenging issue is the IP rights in the global software development because it is difficult to effectively protect individual work worldwide [1], [2], [59].

5. Infrastructure: The factor 'infrastructure' could be a serious challenge in some countries. It strongly affects the service quality in distributed projects. It includes internet connectivity, network, servers and data centers etc. The reliable infrastructure and standardized processes make it appropriate for an organization to engage in an offshore outsourcing project [2], [52], [59], [60].

6. Maturity Level: Another critical success factor of application maintenance offshoring is 'maturity level' that includes maturity of client, prior global experience, vendor maturity and processes maturity. In global outsourcing, both the consumer and the provider must have expertise. The provider can contribute to project failure without global expertise, skills and application knowledge [1], [2].

7. Frequent Requirements Changes: It includes volatile requirements, instability in the requirements, changes in application portfolio and the ambiguous requirements. One of the global constraints that lead to the project failure is the 'frequent requirements changes' [16], [61].

8. Language Barrier: The 'language barrier' factor is a major challenge for the team members distributed across the countries. When offshore team members are approached by using landlines that have connectivity problems such as noise and echoes the 'language barrier' arises strongly [20], [30].

9. Domain Knowledge: It is the second last critical success factor of application maintenance offshore outsourcing. Client believes that sometime vendor does not have enough knowledge about the client business and application. The

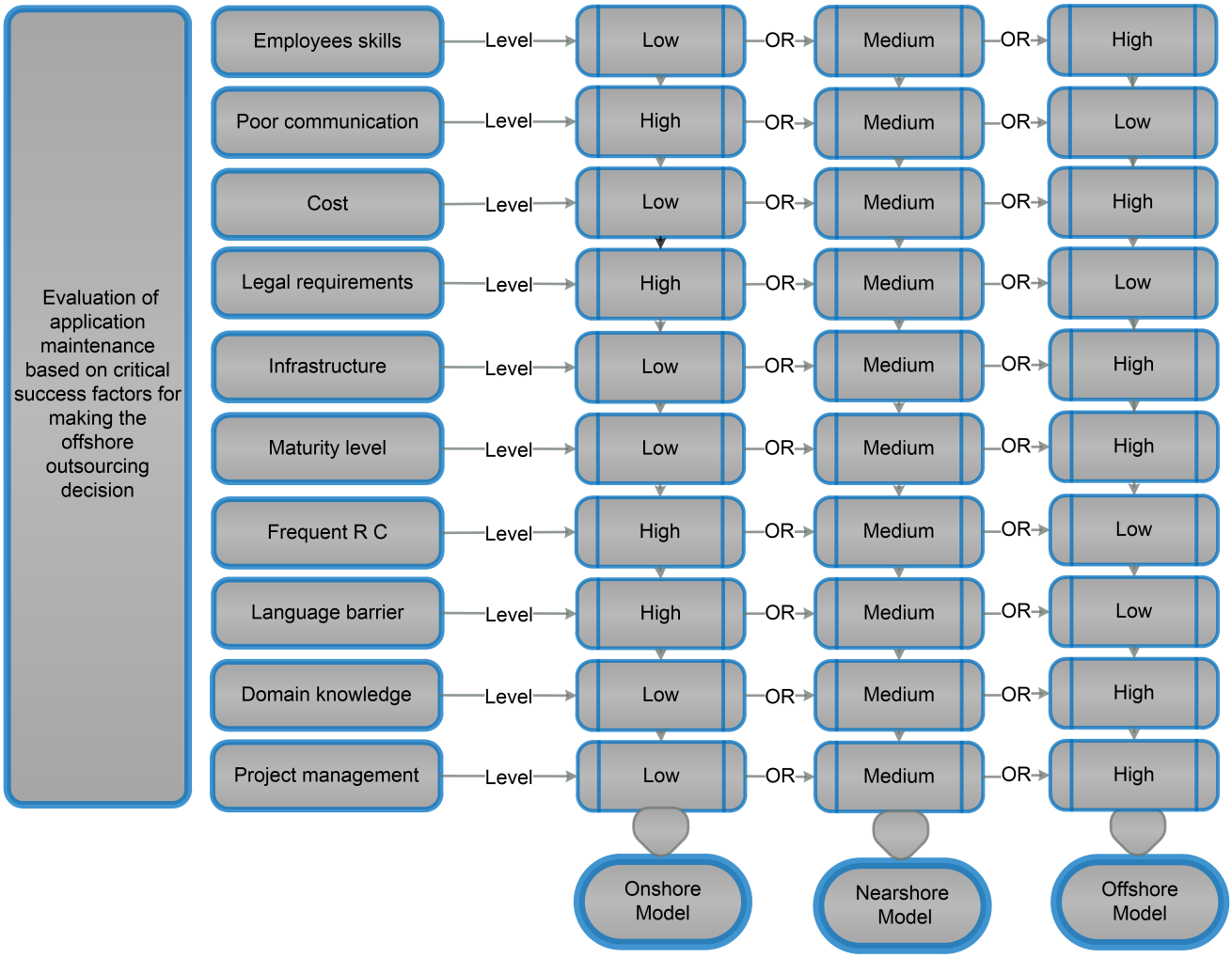

FIGURE 6. Project assessment model for sourcing decision.

client believes that often the vendor does not have adequate customer business and application knowledge. Therefore, the lack of knowledge and expertise about the client application causes a variety of problems, such as delay in service delivery and also adversely impacting the quality of the product [62], [63].

10. Project Management: It is the last critical success factor identified in both data sets. The sub factors are contract management and relationship management. In distributed projects the 'project management' plays an important role, since the management of the scattered teams across the globe is a difficult task. The major hurdles of global software development such as frequent requirement changes, poor communication and synchronization make more challenging the tasks assignment and scheduling in the distributed project [60], [64].

The global outsourcing decision of application maintenance is based on several factors such as project nature, client requirements and stakeholders' preferences etc. The IT managers and decision makers need to consider all the factors which significantly affect the outsourcing decision. Therefore, by using the identified list of 10 critical success factors, we proposed a project assessment model as shown in Fig 6. It will be used by IT experts to understand the project nature and stakeholders' preferences in order to make a suitable sourcing decision. The following paragraphs contain the evaluation of project on the basis of critical success factors for an offshore outsourcing decision.

The proposed model indicates that high ''employees skills'' motivates offshore model. In such case it is easy for the vendor to provide global services as well as the client has the capability to smoothly receive the services. On the other hand, client and vendor with low ''employees skills'' motivates the onshore model.

Similarly, communication between the client and vendor plays an important role in the successful project delivery. ''Poor communication'' creates a number of issues in distributed project that leads to low productivity. Therefore, onshore model is preferred to address the poor communication issues whereas offshore model is suitable in case the communication is better or low ''poor communication''.

TABLE 13. The selected outsourcing groups for data collection on LinkedIn.

Outsourcing groups names	Members	Joining dates	Linkes
The European Sourcing Council	353	Apr 2020	https://www.linkedin.com/groups/716897/
Florida Web, Internet, Online Marketing, IT Project Outsourcing Group - Miami, Broward, Palm Beach	684	Feb 2020	https://www.linkedin.com/groups/3038287/
The Advisory KONNECT Global Outsourcing & Offshoring Discussion Group	10450	Feb 2020	https://www.linkedin.com/groups/103710/
The China Sourcing Council	474	Apr 2020	https://www.linkedin.com/groups/710797/
SEE Outsourcing and Nearshoring Association Group	157	Feb 2020	https://www.linkedin.com/groups/3679777/
Outsourcing Strategy Group	1015	Feb 2020	https://www.linkedin.com/groups/1988741/
Nordic Software Outsourcing Managers Group	286	Feb 2020	https://www.linkedin.com/groups/4668213/
Outsourcing Sweden	1829	Apr 2013	https://www.linkedin.com/groups/1644477/
Outsourcing 2 India	11053	Mar 2020	https://www.linkedin.com/groups/157843/
BPO - Business Process Outsourcing	68940	Feb 2020	https://www.linkedin.com/groups/106055/
Shared Services and Outsourcing Network (SSON)	46424	Feb 2020	https://www.linkedin.com/groups/56376/
iOS, Android, IT Development Outsourcing Group	208	Feb 2020	https://www.linkedin.com/groups/5064364/
Outsourcing & Globalization Forum	2058	Aug 2012	https://www.linkedin.com/groups/3063912/
HR Outsourcing Group UK - HR / Employment Law Professionals UK	864	Feb 2020	https://www.linkedin.com/groups/1863974/
Procurement Outsourcing Interest Group	3515	Feb 2020	https://www.linkedin.com/groups/2295288/
Direct outsourcing group B2B	8260	Feb 2020	https://www.linkedin.com/groups/1814997/
Software & Technology Professionals: Managers |HR| Recruiters| Blockchain| Investors (BIG)	2142811	Feb 2020	https://www.linkedin.com/groups/1976445/
Global Software Development Collaboration	4988	Feb 2020	https://www.linkedin.com/groups/1803698/

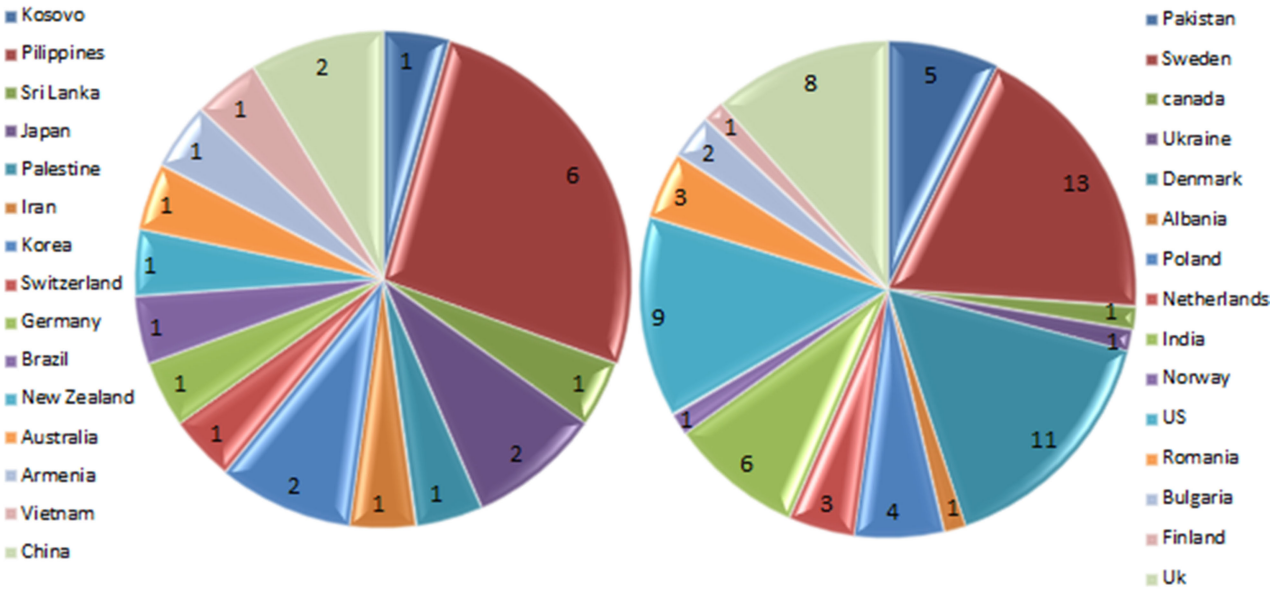

FIGURE 7. The countries from which data has been collected along with received responses.

"Cost" is one of the main factors that drive the offshore outsourcing decisions. For cost sensitive project (High), offshore outsourcing is preferred as companies get around 30-50% cost saving by using offshore model. By using the resources of low-wage nations, vendors significantly minimize project cost. On the other hand, if project cost is not a concern or not sensitive (Low), the onshore model is chosen because it utilizes local employees that consume a high amount of resources compared to the cheaper resources of low cost countries.

Offshore model is not suitable for projects having "legal requirements" (High) such as IP rights, confidentiality, labor laws, import and export etc. For such projects, either a nearshore model is used, or an offshore model is used if the legal conditions are fulfilled, otherwise an onshore model is used to provide services. Offshore model is preferred for the project having minimum (Low) legal requirements because such project can be delivered from any low cost country.

Infrastructure includes internet connectivity, servers and data centers, which impact largely the service delivery in

TABLE 14. Demographics of respondents.

Responses No	Country	Position	Experience level	Time stamp
1	Pakistan	Researcher	Middle: (6-10 Years)	4/10/2020 10:12:50
2	Sweden	Management	Senior: (+11 Years)	4/10/2020 13:40:03
3	Sweden	Manager	Middle: (6-10 Years)	4/10/2020 21:17:56
4	Canada	Programmers/Developer	Middle: (6-10 Years)	4/11/2020 19:54:26
5	Pakistan	Professor/Lecturer	Middle: (6-10 Years)	4/11/2020 21:53:30
6	Ukraine	Manager	Lower: (1-5 Years)	4/11/2020 23:48:35
7	Denmark	Manager	Middle: (6-10 Years)	4/12/2020 1:06:23
8	Sweden	Programmers/Developer	Senior: (+11 Years)	4/12/2020 2:40:15
9	Denmark	Professor/Lecturer	Senior: (+11 Years)	4/12/2020 10:04:00
10	Albania	Manager	Middle: (6-10 Years)	4/12/2020 14:27:45
11	Denmark	Consultant	Senior: (+11 Years)	4/12/2020 14:31:42
12	Poland	Manager	Senior: (+11 Years)	4/12/2020 15:34:25
13	Sweden	Management	Senior: (+11 Years)	4/12/2020 21:28:28
14	Denmark	Management	Senior: (+11 Years)	4/12/2020 23:11:33
15	Denmark	Management	Senior: (+11 Years)	4/13/2020 1:25:12
16	Netherlands	Professor/Lecturer	Senior: (+11 Years)	4/13/2020 12:40:14
17	India	Management	Senior: (+11 Years)	4/13/2020 16:43:36
18	Norway	Consultant	Senior: (+11 Years)	4/13/2020 17:59:17
19	US	Professor/Lecturer	Senior: (+11 Years)	4/13/2020 18:23:41
20	Romania	Manager	Lower: (1-5 Years)	4/13/2020 19:17:42
21	Bulgaria	Management	Senior: (+11 Years)	4/13/2020 21:24:09
22	Poland	Manager	Senior: (+11 Years)	4/13/2020 21:27:14
23	worldwide	Researcher	Senior: (+11 Years)	4/14/2020 11:55:27
24	Sweden	Consultant	Middle: (6-10 Years)	4/14/2020 15:33:52
25	Netherlands	Programmers/Developer	Middle: (6-10 Years)	4/14/2020 15:53:58
26	Denmark	Consultant	Senior: (+11 Years)	4/14/2020 16:05:08
27	Poland	Manager	Lower: (1-5 Years)	4/15/2020 14:24:42
28	Finland	Programmers/Developer	Middle: (6-10 Years)	4/15/2020 15:17:42
29	UK	Manager	Senior: (+11 Years)	4/15/2020 15:22:12
30	Prishtina, Kosovo	Management	Middle: (6-10 Years)	4/15/2020 15:32:29
31	UK	Manager	Senior: (+11 Years)	4/15/2020 15:40:15
32	US	Consultant	Senior: (+11 Years)	4/15/2020 16:22:56
33	Philippines	Co-Founder	Middle: (6-10 Years)	4/15/2020 16:47:56
34	Sri Lanka	Management	Middle: (6-10 Years)	4/15/2020 18:09:46
35	Philippines	Management	Senior:(+11 Years)	4/15/2020 18:31:02
36	Japan	Management	Senior: (+11 Years)	4/16/2020 10:41:50
37	Denmark	Manager	Senior: (+11 Years)	4/16/2020 12:38:56
38	Sweden	Management	Senior: (+11 Years)	4/16/2020 12:58:53
39	Sweden	Financial Controller	Senior: (+11 Years)	4/16/2020 16:22:44
40	US	Management	Senior: (+11 Years)	4/16/2020 16:37:36
41	Sweden	Solution Manager	Senior: (+11 Years)	4/16/2020 17:09:50
42	UK	Management	Lower: (1-5 Years)	4/16/2020 17:34:02
43	UK	Consultant	Senior: (+11 Years)	4/16/2020 18:03:12
44	US	Management	Senior: (+11 Years)	4/16/2020 20:10:36
45	Sweden	Management	Senior: (+11 Years)	4/17/2020 0:25:37
46	UK	Consultant	Senior: (+11 Years)	4/17/2020 1:40:12
47	Palestine	Manager	Middle: (6-10 Years)	4/17/2020 2:19:57
48	Philippines	Manager	Senior: (+11 Years)	4/17/2020 5:33:44
		Continued on Table 15		

GDS context. The appropriateness of offshore outsourcing decisions is shown by stable infrastructure, while an unreliable infrastructure or one with a poor degree of reliability tends to follow an onshore model.

Maturity includes prior global experience, vendor/client maturity and processes maturity. High maturity of both client and vendor motivates the adoption of offshore model. However, a lack of global expertise or maturity (Low) can play a role in the failure of an outsourced project.

The factors ''frequent requirements changes'' includes volatile requirements, requirements instability and requirements ambiguity. A project with these challenges needs to be kept onshore rather to be offshore outsourced. ''Frequent requirements changes'' (High) demand for onsite resources to handle the occurrence of frequent changes. As a result, either an onshore model is preferred or local resources are employed to handle the changes if an offshore model is used.

Language barrier (High) may lead to communication gap between the offshore and onshore teams. If all teams are not native speakers and are speaking over a landline or other device that is subject to noise, delay, or echoes, the language barrier is exacerbated. The language barrier can now be overcome, and vendors are increasingly opting for the offshore model.

''Domain knowledge'' and ''project management'' both have a huge effect on sourcing decisions. Managing dispersed teams across many countries is a difficult challenge.

TABLE 15. Demographics of respondents.

		Continued from Table 14		
Responses No	Country	Position	Experience level	Time stamp
49	India	CEO	Senior:(+11 Years)	4/17/2020 13:03:39
50	Bulgaria	Manager	Senior: (+11 Years)	4/17/2020 18:50:29
51	India	Manager	Senior: (+11 Years)	4/17/2020 19:22:44
52	Pakistan	Management	Senior: (+11 Years)	4/17/2020 19:29:30
53	UK	Consultant	Senior: (+11 Years)	4/17/2020 21:03:45
54	India	Manager	Lower : (1-5 Years)	4/17/2020 21:13:59
55	Sweden	Manager	Senior: (+11 Years)	4/18/2020 11:46:30
56	Denmark	Manager	Senior: (+11 Years)	4/18/2020 13:06:33
57	Sweden	Manager	Senior: (+11 Years)	4/18/2020 21:21:24
58	Pakistan	Researcher	Middle: (6-10 Years)	4/18/2020 22:34:31
59	Iran	Manager	Senior: (+11 Years)	4/18/2020 23:08:31
60	US	Manager	Senior: (+11 Years)	4/19/2020 1:48:18
61	US	Management	Senior: (+11 Years)	4/19/2020 5:15:01
62	Republic of Korea	Project Manager	Senior: (+11 Years)	4/19/2020 11:31:40
63	US	Manager	Senior: (+11 Years)	4/19/2020 12:21:41
64	Switzerland	Management	Senior: (+11 Years)	4/19/2020 12:36:16
65	Republic of Korea	Project Manager	Senior: (+11 Years)	4/19/2020 13:03:42
66	Moldova and Romania	Management	Senior: (+11 Years)	4/20/2020 0:55:15
67	Germany	Manager	Middle: (6-10 Years)	4/20/2020 1:41:32
68	Brazil	Professor/Lecturer	Senior: (+11 Years)	4/20/2020 5:23:00
69	Sweden	Programmers/Developer	Lower: (1-5 Years)	4/20/2020 11:44:31
70	India	Manager	Middle: (6-10 Years)	4/20/2020 12:20:51
71	New Zealand	Manager	Senior: (+11 Years)	4/20/2020 13:15:22
72	Romania	Manager	Senior: (+11 Years)	4/21/2020 17:29:08
73	US	Manager	Senior: (+11 Years)	4/21/2020 18:55:07
74	India	Manager	Senior: (+11 Years)	4/21/2020 19:40:18
75	Philippines	Management	Senior: (+11 Years)	4/22/2020 12:51:27
76	Poland	Manager	Senior: (+11 Years)	4/22/2020 16:45:42
77	Netherlands	Consultant	Senior: (+11 Years)	4/22/2020 20:06:24
78	-	-	-	4/29/2020 22:40:34
79	-	-	-	4/29/2020 22:40:49
80	Sweden	Professor/Lecturer	Middle: (6-10 Years)	4/29/2020 22:43:17
81	-	-	-	4/29/2020 22:43:18
82	Denmark	Manager	Senior: (+11 Years)	5/1/2020 0:06:32
83	Philippines	Management	Senior: (+11 Years)	5/1/2020 4:55:41
84	Australia	Management	Senior: (+11 Years)	5/9/2020 6:45:06
85	Japan	Management	Senior: (+11 Years)	5/11/2020 12:13:59
86	UK	Manager	Middle: (6-10 Years)	5/11/2020 14:42:14
87	UK	Consultant	Middle: (6-10 Years)	5/13/2020 15:47:51
88	Armenia	Consultant	Lower : (1-5 Years)	5/26/2020 16:02:37
89	US	Consultant	Senior: (+11 Years)	6/3/2020 20:03:34
90	Denmark	Management	Senior: (+11 Years)	6/10/2020 1:53:52
91	Denmark	Researcher	Middle: (6-10 Years)	6/12/2020 3:09:33
92	Vietnam	Management	Senior: (+11 Years)	6/19/2020 21:42:26
93	China	Researcher	Lower: (1-5 Years)	7/1/2020 11:59:13
94	China	Researcher	Lower: (1-5 Years)	7/1/2020 11:59:21
95	Pakistan	Management	Middle: (6-10 Years)	7/1/2020 12:26:30
96	Philippines	Management	Senior: (+11 Years)	8/4/2020 7:13:37

The offshore model is motivated by domain knowledge and project management skills (High).

Similarly, the nearshore model is chosen depending on the nature and intensity of the influencing factors usually (Medium) or it is selected based on the client and vendor's preferences.

VII. STUDY LIMITATION

In the current study, we evaluated a list of influencing factors that were reported in the previous research studies [1], [2]. The primary studies were selected from a limited number of digital repositories for the derivation of factors that might cause some relevant publications to be missing. But it is not a systematic problem as discussed by previous studies [49], [65], [66]. There is also a probability that the data extracted would be unreliable and contain certain inconsistencies. We conducted inter-ratter reliability tests in our previous studies [1], [2] to resolve this issue. The results show that all the extracted data is free of researchers' biasness as well as data was found consistent.

The external threat to the generalization of the study may be the smaller sample scale of the empirical study. In the current study, the total responses received from experts are 96, which might not be considered adequate for the study to be generalized. This sample size is adequate in the field of software engineering to generalize the study findings, according to prior studies [65]–[67].

For evaluation, all the identified factors were included in the questionnaire and the respondents were also asked to report new factors regarding application maintenance

offshoring. The overwhelming majority of the respondents agreed that all the reported factors are related to application maintenance. Likewise, we did not find new factors regarding the application maintenance offshoring. We received a total of 96 responses from 30 countries. Where most of the experts come from developed countries (Europe and America) that make our study results more reliable and generalize.

VIII. CONCLUSION AND FUTURE WORK

The current empirical study aimed at evaluation of influencing factors as identified through systematic literature review. The identified influencing factors were verified by 93 experts in the outsourcing industry across 30 countries. Similarly, the data obtained through online survey was analyzed by 3 variables such as respondents experience level, respondents' locations (continents), experts' positions.

In addition to that, the influencing factors were ranked by two different methods, i.e. by calculating the percentages of responses 'strong influence' and by the 'mean' calculation of the total responses. After that, average ranking of both data sets was determined, i.e. factors identified via systematic literature review and empirical study that lead us to the identification of critical success factors. The critical success factors are 'employees skills', 'poor communication', 'cost', 'legal requirements', 'infrastructure', 'maturity level', 'frequent requirements changes', 'language barrier', 'domain knowledge' and 'project management'. These factors were rated as critical for making offshore outsourcing decisions by both the systematic literature review and empirical study. Service providers and clients must take these factors into consideration in order to make appropriate decisions regarding application maintenance offshoring. Furthermore, we proposed a project evaluation model for choosing a sourcing model for application maintenance. IT professionals and managers will use the proposed model to make appropriate sourcing decisions.

We intend to develop a multi criteria decision support system in the future, based on the identified critical success factors. The decision support system will be evaluated with various cases in the outsourcing industry. The decision support system will bring automation to the project assessment model that are proposed in current study.

APPENDIX

The appendices of the current study are as follows:

APPENDIX (A)

Questionnaire Sample:
(https://tinyurl.com/1h54j1vb).

APPENDIX (B)

Table 13. Outsourcing groups of LinkedIn.

APPENDIX (C)

Fig 7, Country wise received responses.

APPENDIX (D)

Table 14 and 15: Demographics of respondents.

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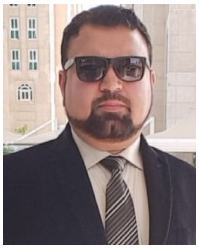

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