Risk Factors In Outsourced Software Development: A Systematic Literature Review

Teh Piak San[a], Alawiyah Abd Wahab[a]*

[a]School of Computing, College of Arts and Sciences, UUM, 06010, Sintok, Kedah, Malaysia

*Corresponding author
alawiyah@uum.edu.my

Abstract

Software development outsourcing has recently become part of organizations' overall business strategy to gain global competitiveness. However, it is widely recognized that outsourcing project involves risks and sometimes leads to undesirable consequences. Previous researchers have identified several risks in the software development outsourcing that could cause the project abandonment such as lack of communication and technical skills. The aim of this paper is to examine the literature on outsourced software development in order to identify some risks that could occur during the pre-contract, contract and post-contract phase of the outsourcing life cycle. It is anticipated that by understanding these risks, project managers could better manage them and subsequently increase the possibility of the success of outsourcing project. The findings show that 18 out of 41 studies were concerned with outsourcing software development risk factors. The 15 risk factors found were mapped onto the three phases of the outsourcing life cycle. The most identified risk factors (61%) was lack of required technical skills and competencies.

Keywords: Outsourced software development, risk, risk factors, systematic literature review

1.0 INTRODUCTION

Software development outsourcing is a very important practice in any organization both in the public and private sectors. Recently it has become part of organizations' overall business strategy to gain global competitiveness. Software development outsourcing can be referred to as providing services such as "managing data center operations, software and hardware support and maintenance, network services and other services in software development activities" by other third party companies or vendors [1]. The demands of software development outsourcing in organization are growing rapidly due to the associated benefits of outsourcing and limitation of organizations. Involvement of users and practitioners is an effective way to better manage and control over system development risks during project implementation and development.

Several possible reasons that lead organizations to outsource software development projects include improving organization focus, increasing feasibility, improving software quality, facilitating access to technology, reducing the risk of obsolescence and reducing and controlling operating costs [2]. Furthermore, several potential benefits of software development outsourcing have been recognized such as reduce recruitment, operation and development costs, increase operational efficiency, and access to global resource pools [3]. Although there are significant risks involved in outsourcing if it fails, there are still many organizations outsource their software development projects in the belief that it will lower their operational costs.

The software development outsource has become risky in various situations. The risk factors of software development outsourcing can be classified based on the three phases of the outsourcing life cycle, which are pre-contract, contract and post contract. The pre-contract phase of outsourcing can be defined as the evaluation phase or early stage of the outsourcing process where it emphasizes on outsourcing strategy and evaluation of vendors [4]. The contract phase occurs during implementation of software development through the organization structure and internal process of vendor while the post-contract phase is concerned about the quality and service of software development after contract such as training provided and reliable contract between client and vendor.

A number of researchers have explored the vendors perspectives of risk associated with outsourced software development. For example, Islam et al. [5] conducted a Delphi study to identify the risk factors and the main goals of offshore-outsourced software development in Bangladesh. The study identified and ranked ten risk factors from the developing country context. Lack of involvement and effective communication with the client were found to be the top risk factors. On the other hand, Chatfield and Wanninayaka [6] conducted a content analysis and reported 22 risks pertaining to client's end, 20 risks pertaining to vendor's end and six risks pertaining to inter-firm relationship. Taylor [7] compared the perspective of vendor IT project managers and existing survey of in-house IT project managers. Although the study found the risk factors identified by vendor IT project managers were similar to those identified in the previous survey of in-house IT project managers, some risks are specific to vendor.

While some researchers focused on vendor's perspective, others contributed their insights into risk factors of software development outsourcing from the clients' perspectives. For example, Nakatsu and Iacovou [8] utilized the Delphi method to rank conventional risk factors identified in earlier research. The study sought the input from 15 experienced project managers involved in offshore project. The top ten risk factors identified include lack of top management commitment, miscommunicated project requirement, lack of communication, failure to manage end-user expectations and inadequate user involvement. Using a case study approach, Verner and Abdullah [9] examined an outsourced strategic IT development project to identify the risk factors leading to its failure. They found risk factors that related to contract, requirements, project complexity, planning and control execution and team.

The previous paragraphs have shown that researchers have investigated risks of outsourced software development from both client and vendors perspectives. However, mapping the identified risk factors to its associated phases of the outsourcing life cycle has received little attention. By having knowledge of risk factors associated with each phases of the outsourcing life cycle, project managers could make an informed decision before embarking on an outsourcing project. Hence, in this paper, a systematic literature review is conducted to examine the risk factors in the software development outsourcing.

2.0 METHODOLOGY

This study has been undertaken as a standard systematic literature review (SLR) approach by performing all processes such as planning a review, conducting the review and reporting the review based on the guidelines from engineering researchers [10]. SLR is defined as a systematic way of identifying, evaluating and analyzing published studies in order to investigate a specific research question [11]. Figure 1 shows the overall process of SLR for conducting this study.

The steps and activities of SLR are documented below:
Planning the Review

i. Theoretical study

The purpose of the theoretical study is to understand the associated concept of risk factors in software development outsourcing. All information that concerned with risk factors of software development outsourcing are collected and gathered in order to analyze and identify the risk factors. In this stage, the information is obtained from conference proceeding, online journals and books, unpublished theses and other related sources from websites.

ii. Research question

The research question for this study is:
What are the risk factors of software development outsourcing in the three phases of outsourcing life cycle that organizations have to be aware of before embarking on any outsourcing project?

iii. Question structure

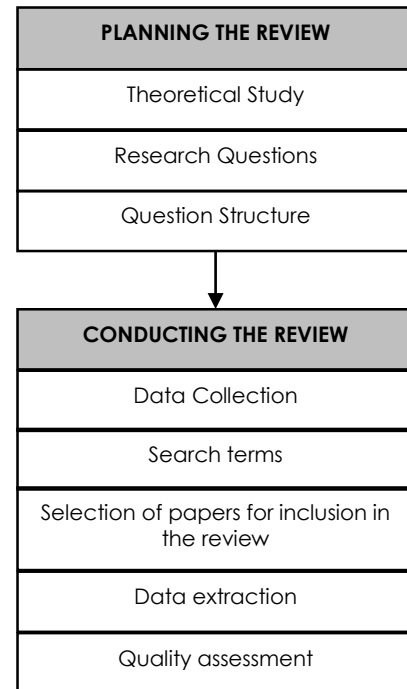The population, intervention, comparison, outcomes, and context (PICOC) structure of questions are shown in Table 1.

Figure 1 The SLR process

Table 1 Summary of PICOC

Structure	Measures
Population	Software outsourcing vendors and clients
Intervention	Risk factors
Comparison	none
Outcomes	Risk factors in the three phases of outsourcing life cycle
Context	Case study, systematic literature review, exploratory study

Conducting the Review

i. Data Collection

In this stage, all published papers related to research questions were manually searched through internet and electronic online databases from year 2005 to 2015. The sources of journals and conference proceedings are shown in Table 2 below.

Table 2 Sources of journals and proceedings

Sources	URLs
Online Database	ACM digital library
	Science Direct
	IEEE
Online search engine	Google Scholar
Library repository	Universiti Utara Malaysia

ii. Search terms

The search terms being used includes "outsourcing", "software development outsourcing", "risk", "risk management", "risk factors" and "systematic literature review". Different kind of search terms were being retrieved from online database, search engine and repository library. Each search terms has interaction/relevant to each others. Besides, all research papers need to be identified and scanned through in order to retrieve the right papers.

iii. Selection of paper for inclusion in the review

By using the search strategies as presented above, a massive amount of the articles listed in the databases were found. The research topic area has been selected based on appropriate previous studies and published from year 2005 to 2015. Articles were included if they were:-
- Reported in English language only.
- Full conference papers based on the topic selection and search term.
- Studies that described the risk factors in software development outsourcing.
- Studies that described the risk factors in software development outsource in every phases of the outsourcing life cycle.

However, those that were not related to the topic have been excluded, which were:-
- Studies that were not related to the research questions.
- Studies that did not describe about outsourcing risk factors in software development outsource

iv. Data extraction

In this stage, each article was reviewed in order to understand the subject where the authors classified and formed a general structure of each article. By reviewing the article, the following information was collected in order to answer research question:-
- Categorization of risks: Risks can be defined in different term in various areas. In this study, we only focused on outsourcing risk in software development outsourcing.
- Categorization of outsourcing: Outsourcing can be differentiated in software and hardware. For this study, we only focused on software development outsourcing. Other outsourcing projects that did not concern software development were excluded such as IT outsourcing and service outsourcing.

- Categorization of risk factors in software development outsource: The risk factors were the key in this study for software development outsourcing. These risk factors were mapped into the three phases of the outsourcing life cycle which were pre-contract, contract and post-contract.
- The data collection forms included all publication information such as title, authors, journal and publication details (Risk Factors in software development outsourcing).
- The number of papers identified from 2005- 2015 are shown in Table 3 below.

Table 3 The number of papers selected

ID	Source	Total results found	Final selection
R1	ACM Digital Library	5	1
R2	Science Direct	5	1
R3	IEEE	16	5
R4	Google Scholar	15	11

Quality assessment

The final selection of the primary studies was performed by assessing their quality. The quality assessment was done in parallel with the data extraction stage. The quality of each paper was scored based on the following quality checklist:-
- Was the definition of the risk in software development outsourcing clear?
- Was the aim of the study clearly stated?
- Were the data collection process carried out well?
- Were the study participants clearly described?

3.0 RESULTS AND DISCUSSION

This section presents the findings related to our research question based on the SLR process. Table 4 shows the summary of the risk factors identified from the 18 papers included in the data analysis. Overall, we identified a total of 15 major risk factors. The process of categorizing the risks was quite difficult because authors used various terms to represent one risk factor. For example, "distinctive capability in IT", "expertise in IT operation". Therefore, we clustered the risks based on their meanings where we think they best matched. However, other researchers might use different approach.

Table 4 Risk factors in software development outsourcing

No	Risk factors	R1	R2	R4	R4	Total
1	Lack of communications	0	0	1	7	8
2	Lack of required technical skills and competencies	0	1	2	8	11
3	Poorly articulated requirements/Misunderstanding of requirements	0	1	2	5	8
4	High turnover in either client or vendor staff	0	0	0	1	1

5	Lack of Top Management support	0	1	1	3	5
6	Lack of reliable contract in outsourcing among client and vendor	0	0	1	4	5
7	Poor change controls	0	1	0	1	2
8	Inadequate user involvement	0	0	1	1	2
9	Lack of staff commitment, low morale, inexperience	0	0	1	4	5
10	Hidden cost, over budget	0	0	3	3	6
11	Lack of knowledge in risk management	1	0	1	2	4
12	Loss in innovative capacity	0	0	0	1	1
13	Size of vendor organization	0	0	0	1	1
14	Application complexity/security	0	0	1	1	2
15	Time-zone different/Cross-national cultural differences	0	0	1	4	5

Figure 2 illustrates the frequency of an item being identified as a risk in the selected papers. The most frequently risk factors being cited in the selected papers is "lack of required technical skills and competencies" with 17% frequencies. Three risk factors received less attention within the reviewed papers with only 1% frequency including "loss in innovative capacity", "size of vendor organization", and "high turnover in either client or vendor staff". This finding suggests that the technical skills and competencies are important in the software development outsourcing. In their studies of critical success factors, Alexandrova [12] also found vendors' technical competencies as one of the factors affecting the success of an IT outsourcing partnership.

The identified risk factors were mapped into the three phases of the outsourcing life cycle. As discussed in the introduction section, each phase has distinct activities. Therefore, the risk factors were mapped to each phase based on the activity of each phase.

The Pre-Contract Phase

The first risk factor concerns with the lack of communication. Communication is important for both parties to understand the requirements of software development project. Lack of communication may cause misunderstanding of the client's requirements on the outsourcing project. Poorly written requirements will lead to project failure if the software developed did not meet the client's expectation. The second risk factor is related to the internal skill sets of both client and vendor staff. Furthermore, the size of vendor organization should also be considered at the pre-contract phase. The organization should identify the ability or capabilities of vendor organization in order to ensure that they could handle the project. The top management support should also be considered at this stage. Without the support of the top management, a project could fail due to

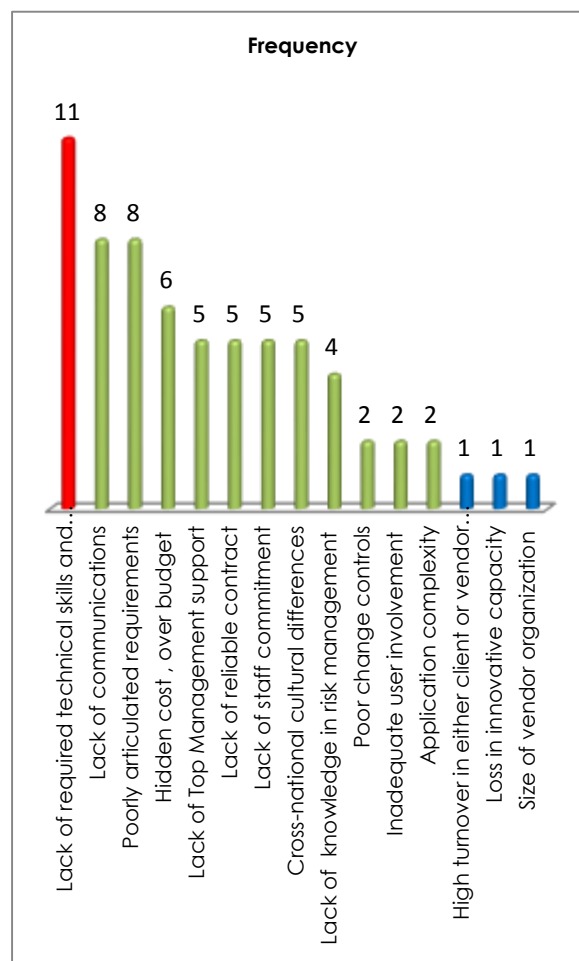insufficient resources such as manpower, budget and resources.

Figure 2 The frequency of the risk factors

The Contract Phase

Off 15 risk factors, nine were mapped into the contract phase. In this phase, communication was important to verify the project requirements. In addition to communication, user involvement was also important. The involvement of users could help educate them about the risks and challenges of software development. Furthermore, the technical skills were required in both the organization and the vendor sides. For example, the staff in both sides should have skills to manage the outsourcing project. If the project is an offshore outsourcing, different time zone between both countries and cultural difference could also be a risk factor that should be considered during contracting phase.

The Post-Contract Phase

After software development outsourcing project ended, the organization was required to be aware of the risk factors during the post-contract phase. In this

study, only three risk factors were mapped into the pre-contract phase. The hidden cost and budget deficits always occur after outsourcing due to poor control over the expenses when planning for outsourcing.

4.0 CONCLUSION

This paper has described the SLR process undertaken to study the risk factors in the software development outsourcing. A total of 15 major risk factors were identified and mapped into the three phases of the outsourcing life cycle. The risk factors include "lack of required technical skills and competence", "high turnover in either client or vendor", "loss in innovative capacity", "size of vendor organization", "lack of communication", "Poorly articulated requirement/Misunderstanding of requirement", "lack of top management support", "size of vendor organization" and "lack of technical skills and competencies". The results from this SLR can be used by project managers to make an informed decision before embarking on any software development project.

Acknowledgement

References

[27] Kishore, R., Rao, H.R., Nam, K., Rajagopalan, S., and Chaudhury, A.: 'A relationship perspective on IT outsourcing', Communications of the ACM, 2003, 46, (12), pp. 86-92.

[28] Gonzalez, R., Gasco, J., and Llopis, J.: 'Information systems outsourcing reasons and risks: a new assessment', Industrial Management & Data Systems, 2010, 110, (2), pp. 284-303.

[29] Betz, S., and Mäkiö, J.: 'Applying the OUTSHORE approach for risk minimisation in offshore outsourcing of Software Development projects'. Proc. Multikonferenz Wirtschaftsinformatik2008 pp. 1101-1112.

[30] Rantakari, L.: 'Governance in business process outsourcing: case study on call center outsourcing', 2010

[31] Islam, S., Joarder, M.M.A., and Houmb, S.H.: 'Goal and risk factors in offshore outsourced software development from vendor's viewpoint', in Editor (Ed.)^(Eds.): 'Book Goal and risk factors in offshore outsourced software development from vendor's viewpoint' (IEEE, 2009, edn.), pp. 347-352.

[32] Chatfield, A.T., P. Wanninayaka, IT offshoring risks and governance capabilities, in: Proceedings of the 41st Hawaii International Conference on System Sciences, 2008, pp. 1–9.

[33] Taylor, H.: 'The Move to Outsourced IT Projects: Key Risks from the Provider Perspective'. Proc. The 2005 ACM SIGMIS CPR Conference on Computer Personnel Research.

[34] Nakatsu, R.T., and Iacovou, C.L.: 'A comparative study of important risk factors involved in offshore and domestic outsourcing of software development projects: A two-panel Delphi study', Information & Management, 2009, 46, (1), pp. 57-68.

[35] Verner, J.M., and Abdullah, L.M.: 'Exploratory case study research: Outsourced project failure', Information and Software Technology, 2012, 54, (8), pp. 866-886.

[36] Kitchenham, B.: 'Procedures for performing systematic reviews', Keele, UK, Keele University, 2004, 33, (2004), pp. 1-26.

[37] Staples, M., and Niazi, M.: 'Experiences using systematic review guidelines', Journal of Systems and Software, 2007, 80, (9), pp. 1425-1437.

[38] Alexandrova, M.: 'IT outsourcing partnerships: Empirical research on key success factors in Bulgarian organizations', Management: Journal of Contemporary Management Issues, 2012, 17, (2), pp. 31-50