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Approaches to Risk Identification in Public–Private Partnership Projects: Malaysian Private Partners' Overview

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Abstract: The complexity of public–private partnership (PPP) projects ensures that risks could emerge and spread in unpredictable ways if they are not well identified and managed. The emergence of PPP projects has brought major changes in the construction industry, the most notable being in procurement methods influencing risk allocation to private parties. Thus, it is crucial to have an effective risk management for public and private partners to eliminate or minimise risks. Formulating an effective risk management system is a crucial challenge faced by both of parties in order to minimise or optimise risks. The aim of this study was to investigate the process of risk identification of private partners in Malaysian PPP projects. Data were collected throughout a 2-month period using a survey with a sample of nine Malaysian companies engaged in PPP projects, and the survey results were analysed using mean scores. The findings indicate that due to a lack of knowledge and experience of Malaysian private partners in the risk identification process, a comprehensive database for risk identification is highly necessary for the private sector. Another issue emerging from the findings is that it may be reasonable to use a combination of risk identification tools for PPP projects with a high level of complexity. The findings of the present study can greatly assist public and private partners to select the most appropriate tools for risk identification at the early stages of PPP projects.

Keywords: risk identification; risk management; PPP; private partner; Malaysia

1. Introduction

1.1. Research Background

Public–private partnership (PPP) in developing countries has become increasingly popular as a way of involving the private sector in the development of public infrastructures (Javed et al. 2013). The special characteristics of PPP are competitive bidding processes, private sector innovation and expertise, and risk sharing between public and private sectors (Adams et al. 2006; Cheung and Chan 2011). On the other hand, a PPP project has a higher risk profile compared with

traditional delivery because of long lead time, high capital expenditures, and long-lived assets with little value in alternative uses (Xu et al. 2014; Chan et al. 2015). In addition, the problems and challenges of the construction industry, particularly in PPP projects, are more complex and fundamental in developing countries compared to developed countries (Hlaing et al. 2008).

It is well understood that PPP is a form of joint venture between government and private entities aimed at social and commercial objectives through cooperation, which includes risk sharing of estimated cost and expected returns (Loosemore and Cheung 2015). However, the differences in interests, corporate culture, and risk perception of the involved parties lead to disparate approaches and tools for dealing with risk (Liu et al. 2018; Song et al. 2018).

Risk management is one of the most important components of project management, as unmanaged risks are one of the primary reasons of project failure (Chou and Pramudawardhani 2015; Loosemore and Cheung 2015; Olechowski et al. 2016). A review of previous studies on risk management showed that there has been a noteworthy increase of knowledge and application of risk management over the past two decades. For instance, Taroun (2014) found that risk management is one of the topics with the highest rate of occurrence in key project management publications. Generally, risk management involves making a thorough investigation of the facts and risks that may have significant consequences on project objectives before making any decisions.

The principle behind risk management is to minimise unfortunate effects by identifying and controlling threats and maximise opportunities (Iqbal et al. 2015). Moreover, accurate risk identification can help to modify the probability of risk occurrence. It is important to understand that risk management is not responsible for completely eliminating all risks in the project. To manage a risk, it first needs to be identified through a risk identification process (Zavadskas et al. 2010; Ameyaw and Chan 2013; Lam 2014). Due to the nature of the construction industry, each project involves some degree of risk. Although all potential risks need to be identified, efforts should focus on the most significant risks. Thus, risk identification should be conducted as part of a project's initial definition process, along with project planning, budgeting, and scheduling. In fact, these other activities cannot be conducted realistically without taking risk into consideration.

In some cases, risk identification leads to project cancellation or major modifications during the initial planning stage. Thus, in order to achieve the successful implementation of a PPP project, it is necessary to identify and allocate risks in the early stages of the project. If risks are identified and managed early on, their consequences on the final outcome of the project will be smaller because the cost to implement changes in the project is also lower at these stage (Maqbool and Rashid 2017). Figure 1 depicts the influence curve, which demonstrates the theoretical capability of risk identification to influence the project schedule, quality, and cost at different stages of the project.

1.2. Literature Review

The topic of risk in PPP projects has become a very popular subject in recent years and is a much-discussed issue amongst all levels of industry and government. Many researchers have offered detailed PPP risk registers and assessed their relative importance, such as the United Nations Development Organization (UNIDO) (1996), Ozdoganm and Birgonul (2000), Zayed and Chang (2002), Hardcastle and Boothroyd (2003), Ke et al. (2012), Sarvari et al. (2014), Fayek and Omar (2016), Shrestha et al. (2017), and Pham and Phan (2018). Some of the frequently adopted risk identification techniques reported in international construction management journals include checklist (Goh et al. 2013; Marcelino-Sádaba et al. 2014) and decision trees, as well as Delphi techniques, as demonstrated by Osei-Kyei and Chan (2017). Research interests in risk management have continued to develop in recent years, with researchers adopting more complicated methods, such as the risk breakdown structure (RBS) (Valipour et al. 2017) and combination method (Wu et al. 2017; Leva et al. 2017), instead of methods used in earlier research work.

Risk management in the project management context is a comprehensive and systematic way of identifying, analysing, and responding to risks to achieve the project objectives (PMI 2017).

The objective of risk identification is to identify all potential risks and develop solutions for elimination or minimisation of important risks. Risk identification provides a basis for risk analysis and evaluation (Banaitiene et al. 2011). However, each construction project is unique, and similar risks may not recur in similar projects. In practice, a risk checklist is mostly used as a tool to avoid overlooking crucial risks (Wood and Ellis 2003; Bing et al. 2005; Burtonshaw-Gunn 2009). If data are found to be helpful, then they should be specified in more detail. Ezeldin and Orabi (2006) stated that the main reference in risk identification is historical data, past experience, and judgement. Risk identification plays a significant role in detecting and controlling risks and can be used for highlighting the areas that require more attention during design and construction. According to PMI (2017), to act against risks implies identification, analysis, prioritisation, and response in the planning stage and monitoring and control when the project is being executed.

Risks have to be identified and should be critical; otherwise, the whole exercise is a waste of resources; for that reason, it is necessary to prioritise risks. If noncritical risks are identified, analysed, and responded to, and the process is followed, but critical risks have not been considered, this could have a major impact on the project outcome. Thus, the analyst is exposed to risks without realising it. Risk identification is equivalent to risk diagnosis (Hertz and Thomas 1983). A number of approaches to cope with uncertainty, including ignoring its existence, have been successful up to a point, but all seem to fall short of the mark in one way or another. Risks could be identified by a number of methods, and most rely on experience gained from previous projects; thus, if no-one has experience in similar projects, it is important to gather a group of suitably-qualified individuals for a brainstorming exercise.

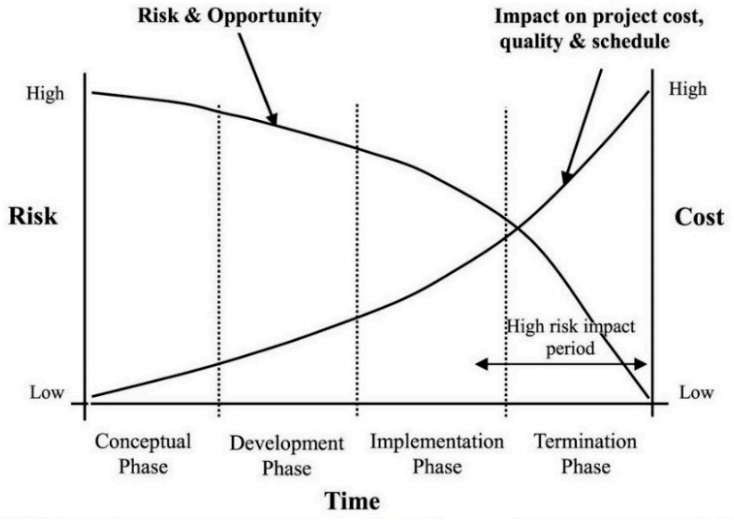

Figure 1. Influence curve (Hlaing et al. 2008).

However, risk identification is a complex task because it varies with different projects and there is no exact or standard procedure to identify risks in construction (Hlaing et al. 2008). It relies strongly on the skills and judgement of the key project personnel. The risk identification process is dependent on a few factors, such as previous experience, personal preferences, and the information possessed. Hence, correct judgement is necessary in order to obtain adequate information for further analyses to be conducted correctly. The reliability of the risk identification step may secure the success of the subsequent risk management process. Various approaches can be used for risk identification. These methods can be grouped into three general categories (Chapman 1998). First, the identification process is conducted only by the risk analyst and based exclusively on his/her personal experience. Second, the identification is performed by interviewing key members of the project team and based on their competency. Third, risk identification is achieved through brainstorming meetings with all interested parties. As pointed out by APM (2018), past experience of the project team, project

experience within the company, and expertise in the construction industry can be valuable resources for risk identification.

Previous research has shown that the checklist is the most frequently used technique for risk identification in the construction sector (Hlaing et al. 2008; Goh et al. 2013; Marcelino-Sádaba et al. 2014). For risk analysis, tools such as sensitivity analysis, probabilistic analysis, influence diagrams, and decision trees, as well as Delphi techniques, are commonly applied by construction practitioners (Chapman 2001; Zwikael and Ahn 2011; Adedokun et al. 2013). Rostami (2016) discovered that the construction industry in the United Kingdom relies on the knowledge and experience of individuals for risk management.

1.3. Research Aim and Objectives

In different infrastructure sectors of PPP projects, the risks encountered vary. Due to the differences in interests, corporate culture, and risk perception, the public and private sectors have a different attitude towards risk. On the other hand, it is widely acknowledged that identification is one of the most important stages of risk management, because the identification process is very important for accurate analysis (Valipour et al. 2018). Attention to differences in attitudes for risk identification can be helpful in improving risk management in PPP projects. To achieve a beneficial risk management process, the risk identification stage should be investigated in detail. Analysis of sector-specific risk identification tools will provide more reliable information for the practitioners to consider appropriate strategies for risk identification (Ke et al. 2012). While a few studies on risk identification and management in practice have been done, these primarily focused on developed construction industries, such as Canada, the United States (Hegazy and Moselhi 1995), the United Kingdom (Akintoye and MacLeod 1997; Baker et al. 1999), and Australia (Uher and Toakley 1999; Lyons and Skitmore 2004). Although numerous studies have been conducted on the subject of risk management as well as PPP implementations in developing countries, the process of risk identification in the Malaysian construction industry, especially in PPP projects, has hitherto not been well studied. In order to enrich the existing body of knowledge and cover the gap in previous literature, the study aimed to ascertain, explore, and assess the risk identification process and approaches, in PPP projects, used by Malaysian private partners. In order to fulfil the main aim of the paper, we decided to establish two main research questions. The first question was "What is the process of risk identification that has been used by private parties in PPP projects?" and the second question was "What are the main techniques and tools that private parties use for risk identification?" These questions are the starting point of this academic endeavour. To achieve the research aim, there are three objectives to this study:

1. To assess risk identification process in private companies;
2. To investigate risk identification techniques used by private parties;
3. To investigate the level of awareness of the benefits of risk identification.

The research investigates the techniques and process of the existing risk identification in PPP projects. The contribution is developed through identification of the preferred risk identification process, tools, and techniques for risk management in Malaysian PPP projects. From these premises, the research investigates the factors limiting risk management and factors influencing companies' project decision making. The findings of this research are an unprecedented contribution to the original body of information and to PPP projects and the construction industry. Such an outcome would enable decision makers to make more informative decisions, such as proper risk allocation, bid price, selecting the optimum procurement route, and evaluating different projects. Furthermore, the results would certainly help to improve public policy towards PPP and the way in which various sectors can carry out PPP contracts with due respect to their risk perceptions. The research presents an original contribution to risk management processes in PPP projects. Moreover, we are hopeful that the findings of our research can assist private partners with selecting the most appropriate tools for risk identification in PPP projects.

2. Research Methodology

In light of the lessons learnt from past PPP projects, this study developed an empirical survey to collect feedback from practitioners on the following aspects of risk management in Malaysian PPP projects. A series of structured questionnaires were conducted, targeting managers who had hands-on experience in managing PPP projects in Malaysia. The questionnaire of Ke et al. (2012) was selected as a basis for the structured questionnaire as presented in this paper, with their prior permission. The usage of the following aspects of the risk identification process in Malaysian PPP projects would be examined: The techniques and process for risk identification, factors limiting implementation of risk management, factors influencing a company's project decision making, the importance of identifying the factors that have an impact on a company's decision making and implementation of risk management, the preferred tools and techniques, and the process of risk identification in their companies.

As shown in Figure 2, the research was conducted in a stage-by-stage process. First, a comprehensive analysis of previous research as a literature review was carried out to get in-depth knowledge on tools used in the risk identification process as well as knowledge on PPP. This step led to the development of a pilot study. At the same time, Malaysian companies engaged in PPP projects were identified. The companies were selected in consultation with the Public–Private Partnerships Unit (UKAS). It was believed that UKAS is the most prestigious source to identify Malaysian companies actively participating in PPP projects. This stage also led to the compilation of the final list of PPP experts.

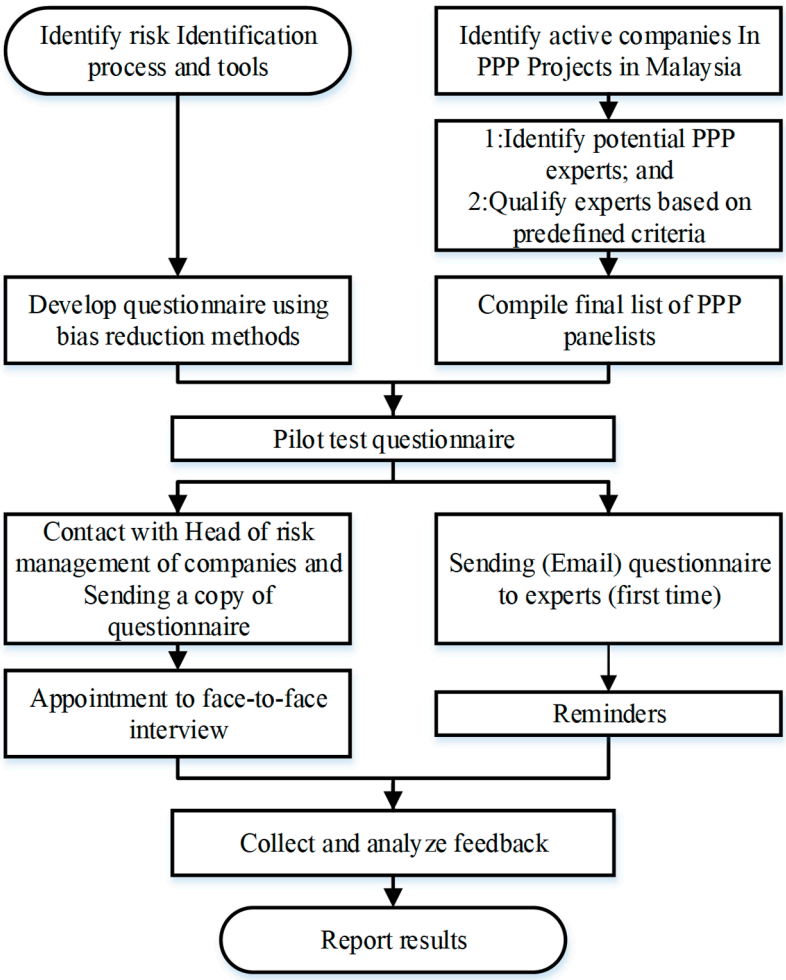

Figure 2. Overall research process. PPP: Public–private partnership.

Before launching a main questionnaire survey, a pilot study was carried out to enhance the appropriateness of the survey. The field work started with a pilot study, including a meeting

with construction professionals in a construction company actively participating in PPP projects. The company is specialised in residential and highway projects. It is based in Kuala Lumpur. Four managers attended the workshop: The operational manager, the financial manager, the risk and safety manager, and the contracting and tendering manager. It was an exploratory study for gaining better appreciation and understanding of the real risk analysis practice. Simultaneously, a pilot survey form was sent to ten experts of construction and PPP projects in Malaysia, and they were requested to vet the draft survey form and give their comments, including on the way the questions were set, the clarity of the questions, and the suitability of the options available for improvement of the draft survey questionnaire. The questionnaire was then modified based on the results of the pilot study. During this phase, the researchers conducted a consultation with our advisory group members about their priorities for the provision of a number of different formats for the questionnaire. Eventually, risk reviews, contact, research, and site visits were selected to investigate how risks are identified by the companies. In addition, a tender review by departments and their joint meeting, by a group of persons from the tender department, the opinion of 1 or 2 persons experienced within the company, judgement of the estimator only, and brainstorming and/or engaging consultants were selected as final items of company procedure for risk identification. Meanwhile, during the pilot survey, documentation reviews, brainstorming, questionnaires, interviewing, SWOT analysis, checklist analysis, similar cases comparison, cause-and-effect/influence diagrams, system or process flow charts, scenario assumptions analysis, risk management databases, and historical risk data usage frequency were approved by experts as risk identification tools used by the companies. Finally, the last version of the questionnaires was ready for distribution after modifications. In this study, the sample involved the private sector in PPP projects in Malaysia. The expert team included a member of a board of directors, a senior executive, a project manager, a technical director, a system engineer, and a quantity surveyor. Approximately 70 percent of them had over five years' experience in PPP projects and were mostly at top management levels. Secondly, the questionnaire survey was executed to collect data regarding PPP projects in Malaysia and, finally, a comparative analysis of PPP project in Malaysia.

The mean score (MS) method was applied by Chan and Kumaraswamy (1996) to evaluate the relative importance of the causes of construction delays in Hong Kong. The MS method also has been used to analyse data by other researchers such as: Xu et al. (2010); Islam et al. (2018) and Xiang et al. (2018). A similar method was employed for data collected analysis in this study. In order to calculate the mean score for each factor, the five-point Likert scale was employed. Then, the ranking from most important to least important was determined. The mean score was calculated using the following formula:

$$MS = (\sum (f \times s))/N, (1 \leq MS \leq 5), \quad (1)$$

where MS is mean score; f is frequency of each rating (1–5); s is a score given by expert based on a five-point scale from 1 to 5; and N is total number of respondents (N = 88).

Due to limitations in time and resources, the geographical scope of the study was limited to Malaysia. From the aspect of the amount of capital invested, Malaysia is one of the ten top countries in the implementation of PPP projects among developing countries; and Malaysia is the most active country in Southeast Asia in terms of PPP projects. However, based on the World Bank Database (2015), the percentage of cancelled PPP projects in Malaysia is 5 times higher than the global average. The private sector in Malaysia has been involved for so long in providing public facilities. It has existed since the mid-1980s, due to a major economic recession that badly affected the whole world and caused the government to be engaged in seeking help and assistance from the private sector for carrying out economic activities and their development (Ismail and Rashid 2007).

The diversity of the states within Malaysia provided a rich source of data and information to the research. However, the major limitation of this study is the fact that, similar to other developing countries, only particular companies within Malaysia are able to implement PPP projects. Therefore, the sample size was limited to a few companies possessing the experience and knowledge of PPPs and actively participating in PPP projects (given by the Public–Private Partnerships Unit (UKAS)).

3. Survey Description

The collection of data is a very essential and complex step of any research. The manner of data collection depends on the question that the research intends to solve, along with the philosophical orientation of the researcher (McCrae et al. 2011). Various tools and methodologies can be used for collecting data. The type of method one decides to choose depends on the objectives, research questions, and the approach one would follow while conducting research. In the case of the mixed-methods approach, the researcher would initiate the research using qualitative research tools to better understand the phenomenon and would then be able to propose a theory (Hertz and Thomas 1983). Thereafter, the researcher would use quantitative tools to test the theory. Alternatively, the researcher could also survey the population and propose a hypothesis, then conduct interviews and case studies for validation of the hypothesis. Out of the numerous data collection tools that are available, conducting surveys (in form of questionnaires or interviews) and case studies are the most commonly used techniques in social science research.

The sample size and the representativeness of the sample should always be a key consideration. At the beginning, a researcher needs to define the population by setting up a sampling frame, which is a list of all cases that form the population (Hoxley 2009). Ideally, the sampling frame should be a complete list of the population members. However, in practice, this may be impossible. In this research project, for instance, the sampling frame was a list of Malaysian construction companies actively participating in PPPs obtained from the UKAS database. Having experience in PPP projects was a key item to selecting a team of specialists.

Questionnaire Survey

The questionnaire included two sections in total. In section A, four questions were asked to get information about the type of PPP projects, type of role, and years of experience in the construction industry and PPP projects. These questions were to identify the background of the respondents and to certify their responses. Section B included the main questions about the techniques and process for risk identification, factors limiting the implementation of risk management, and factors influencing a company's project decision making. The creation of the questionnaire was based on all previously published research papers and the information that was collected from the literature review about the risk identification stage in PPP projects. In this section, the experts were asked to convey their views regarding the importance of identifying the factors that have an impact on a company's decision-making and implementation of risk management. Additionally, the respondents were asked to indicate the preferred tools and techniques and the process of risk identification in their companies.

As for B, the answers were presented in a 5-point Likert scale, i.e., 1 = very low, 2 = low, 3 = moderate, 4 = high, and 5 = very high. A five-point Likert scale can help interviewees to clarify their views of agreement or disagreement on the importance of different factors (Burns et al. 2008; Yuan et al. 2018). The use of 5-point Likert scales has been popular in construction management research, and they have also been successfully employed by several studies focusing on the identification and assessment of risks in construction projects (Shrestha et al. 2017); thus, it was considered to be a trustworthy approach for collecting data for this study. Meanwhile, open-ended questions were employed for the last part of the questionnaires to gain more information based on the experts' experience and understanding in this subject matter. These open-ended questions provided more freedom to respondents in sharing their knowledge and experience.

As a research tool, the questionnaire was used in order to gain expert views. In addition, the feedback collected from the questionnaire survey was analysed using various statistical methods by the Statistical Package for Social Sciences (SPSS). Prior to conducting the statistical analyses, the internal consistency and reliability of the factors was evaluated by Cronbach's alpha (McCrae et al. 2011) to ensure validity. The value of Cronbach's alpha was calculated to be 0.832, indicating that a high level of uniformity among the survey responses was received. The value was greater than the threshold

recommended by Nunnally and Bernstein (1978), who suggested that a reliability of 0.70 or higher should be sufficient in an early study on a construct's prediction tests or hypothesised measures.

Content validity defines how representative and comprehensive the items were in presenting the hypothesis. It is assessed by examining the process that was used in generating the scale item (Badri et al. 1995). As the questionnaire was designed based on a literature review and the opinions of interviewed experts, the content validity of the critical risk factors needs to be proven. It is believed that the items listed in the survey were highly comprehensive.

In this study, in-person consultation with the professionals and experts were chosen due to the fact that research on practical risk identification and risk management of PPP projects in Malaysia was found to be insufficient. Meanwhile, there are good numbers of practitioners and experts with hands-on experience in a specialised field. Participants were contacted by email for this research. The identity of the panellists chosen for the questionnaire analysis was undisclosed. The survey was launched in November and December 2014. The response rate to a questionnaire for the study was 44%. The percentage of experts is usually between the ranges of 40 to 77 percent. This statement can also be confirmed by Lipnicka and Dado (2013). The size of the sample was considered adequate for the purposes of data analysis when compared to other studies in the field of PPPs (Yuan et al. 2018; Ng et al. 2010).

4. Results and Discussion

The selection of the panel list and survey question formulations play a significant role in determining the reliability of the research; experience and knowledge in PPP projects are the most important criteria in deciding the credibility of the study. Adopting Ke et al. (2010), a purposive method was provided to select the panel of experts who should satisfy at least one of the following criteria:

1. Having vast experience handling PPP projects in Malaysia;
2. Having a recent/current direct association in risk management and Malaysian PPP projects;
3. Having in-depth knowledge of risk management in PPP procurement.

4.1. Selection of Expert Panel

In order to ensure the credibility of this study, the respondents were carefully selected and consisted of personnel with vast hands-on experience with PPP projects. The questionnaire was distributed to approximately 200 respondents from all over Malaysia. A total of 88 completed questionnaires by experts was collected, representing a success rate of 44%; out of them, 71 were from the private sector and the other 17 from the academic sector, representing answer rates of 80.7% and 19.3%, respectively. The survey was carried out without any participants from the public sector. Obtaining a high response rate has always been a significant hindrance in questionnaire employment (Robinson 1991). The reasons behind the low response rate, apart from refusal to participate, was failure to meet the criteria fixed for selection, as practice of PPP in Malaysia is relatively new; thus, participants with comprehensive experience and knowledge are lacking (Chan et al. 2011).

Table 1 shows the background information of the respondents. These experts represent a vast spectrum of PPP practitioners in PPP projects in Malaysia and provide a balanced view for the questionnaire survey. As shown in Table 1, participants were mainly drawn from the transport, refurbishment, building, and civil sectors, and their professional backgrounds include client and contractor quantity surveyors, project managers, architects, and engineers. Various respondents have participated in more than one PPP project. Furthermore, more than 80 percent of them have more than five years' experience in the construction industry, which explained why most of them have experienced more than one PPP project. To ensure the credibility of this study, the experts chosen as respondents were selected from those with extensive experience in handling a PPP project who held a high position and came from reputable organisations. It should be noted that the panel size used in this study is bigger than that of previous related studies, which had 19 (Choi et al. 2010) and 12 (Salman et al. 2007) respondents.

Table 1. Background information of the respondents.

Category	Respondents	
	Frequency	**Percentage**
Role (Profession)		
Quantity surveyor	14	15.9
Technical director	11	12.5
Systems engineer	11	12.5
Project manager	21	23.9
Member of Board of Director	7	7.95
Senior executive	18	20.45
Others	6	6.8
Experience level (in construction)		
Up to 5 years	14	15.9
6-10 years	22	25
11–15 years	32	36.4
More than 16 years	20	22.7
Experience level (in PPP projects)		
Up to 5 years	26	29.5
6–10 years	32	36.4
11–15 years	19	21.6
More than 16 years	11	12.5
Type of PPP project		
Power	19	21.6
Water	15	17.05
Transport	20	22.7
Housing	27	30.7
Others	7	7.95

4.2. Findings and Discussion

Finance, project type, contract, and risk taking are the most influential factors for decision making in the estimating stage (Koleczko 2012; Ismail 2013; Tang and Shen 2013; Poole et al. 2014). The experts were asked about these factors that, according to them, were affecting project decision making in their company, at the early stages of a PPP project.

As shown in Table 2 and Figure 3, *Finance* was ranked the highest, which indicates the primary factor influencing decision making during the estimating stage, while *Risk taking* was ranked the lowest. Most of the respondents mentioned *Finance* as the most important factor, after which came *Contract*, *Project type*, and finally, *Risk taking*.

Table 2. Factors influencing a company's project decision making in estimating stage.

Category	Respondents		
	Mean	**SD**	**Rank**
Finance	3.10	0.884	1
Type of project	2.41	0.866	2
Contract	2.01	0.877	3
Risk taking	1.61	0.668	4

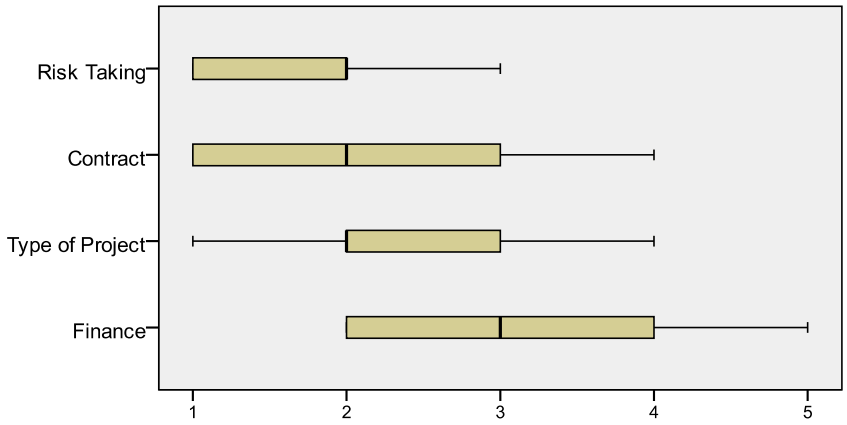

Figure 3. Factors influencing a company's project decision making in estimating stage.

A parametric ANOVA test was also performed to compare the expert opinions of different groups. A test using ANOVA is necessary to determine significance. Table 3 summarises the results of analysis of variance corresponding to each of the four factors. Corresponding to each factor, the sum of squares, degrees of freedom, and mean square are shown. The amount of variation is also shown for each of the four factors. Relative to the role of experts, amongst all the four factors, there are significant differences in respondent opinions on factors of contract and risk taking ($p < 0.05$). From the test, the result has indicated that there are no significant differences in respondent opinions on the factors of finance and type of projects.

Table 3. ANOVA analysis table for factors influencing a company's project decision making.

Factors Influencing		Sum of Squares	df	Mean Square	F	Sig.
Finance	Between Groups	5.899	6	0.983	1.281	0.275
	Within Groups	62.180	81	0.768		
	Total	68.080	87			
Type of Project	Between Groups	8.948	6	1.491	2.145	0.057
	Within Groups	56.325	81	0.695		
	Total	65.273	87			
Contract	Between Groups	17.040	6	2.840	4.605	0.000
	Within Groups	49.949	81	0.617		
	Total	66.989	87			
Risk Taking	Between Groups	9.060	6	1.510	4.104	0.001
	Within Groups	29.804	81	0.368		
	Total	38.864	87			

The questionnaire also asked the respondents to give their opinions on how they identify risks. The results of this part show that these ways include: Risk reviews, contact, research, and site visits. The risk identification process at the estimating stage is employed for risk reviews. *Risk review* assesses all sources of risk and is the first rank among the different processes. Table 4 and Figure 4 show the different processes and their ranking. In addition to that, the risk identification process was also conducted via discussion with experts, especially on pricing issues and the level of difficulties of the process, construction research, PPP projects, the economic environment, etc. It was found that *site visits* had a similar score with *research*. However, it is well acknowledged that reports from site visits provide very valuable information for risk identification since, during the site visit, many of the problems can be solved. Moreover, some issues that could have an effect on pricing and contingency allowance, such as location, obstructions, and accessibility, can be solved by site visits. According to the results in Table 4, *risk reviews* are preferred by managers of the companies.

Table 4. How risks are identified by the companies.

Category	Respondents		
	Mean	SD	Rank
Risk review	3.54	1.016	1
Contact	2.97	0.780	2
Research	2.68	1.023	3
Site visit	2.06	0.708	4

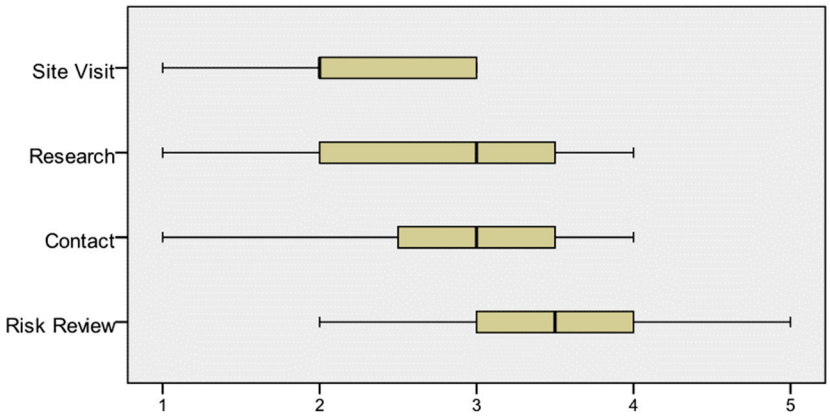

Figure 4. How risks are identified by the companies.

Table 5 lists the survey results of the procedure of the company for the process of risk identification. *Tender review by departments and their joint meeting*, which was ranked first by a score of 4.06, is the method used by most of the respondents. The method, by *a group of persons from the tender department*, was the second highest response (score 3.43). Moreover, the use of the process of *opinion of one or two experienced persons within the company* to record project risks, which was ranked highest in a study conducted in a similar vein by Hlaing et al. (2008), was found to be from low to moderate (score 2.45). In addition, Table 5 and Figure 5 indicated that the *judgements of the estimator only*, *brainstorming* and *engaging consultants* were rarely used in past PPP projects by companies.

Table 5. Company procedure for risk identification.

Category	Respondents		
	Mean	SD	Rank
Tender review by departments and their joint meeting	4.06	0.835	1
By a group of persons from tender department	3.43	0.674	2
Opinion of 1 or 2 persons experienced within company	2.45	0.545	3
Judgment of the estimator only	2.01	0.719	4
Brainstorming	1.89	0.808	5
Engaging consultants	1.59	0.637	6

It is apparent from the results in Figure 5 that there is no single or preferred approach by any company, and in fact, methods vary with the circumstances. A possible explanation for this could be the differing circumstances associated with each PPP project—for example, the procurement type and complexity of the project.

Figure 6 shows that private parties rarely used many of the risk identification approaches in previous PPP projects. Six out of twelve approaches, as shown in Table 6, received a score less than 2.5. *Review of documents*, *similar case comparison*, and *historical risk data usage frequency* were ranked as the first three tools for identifying risks, with a score 4.15, 4.07, and 3.95, respectively. Additionally, as shown in Figure 6, *brainstorming*, *risk management databases* and *system or process flow charts* have been the

other most frequently used approaches to risk identification. Nonetheless, the application frequency of these approaches was slightly better than the *SWOT analysis* approach. *Interviewing* was ranked moderate, with a mean score of 2.28. The *checklist* approach was also a little lower than 2. The result also highlights that *Cause-and-effect/influence diagrams* is a technique that was not much favoured by the respondents. It also shows that the *questionnaire* technique and *scenario assumptions analysis* are the tools least preferred by the companies.

Figure 5. Company procedure for risk identification.

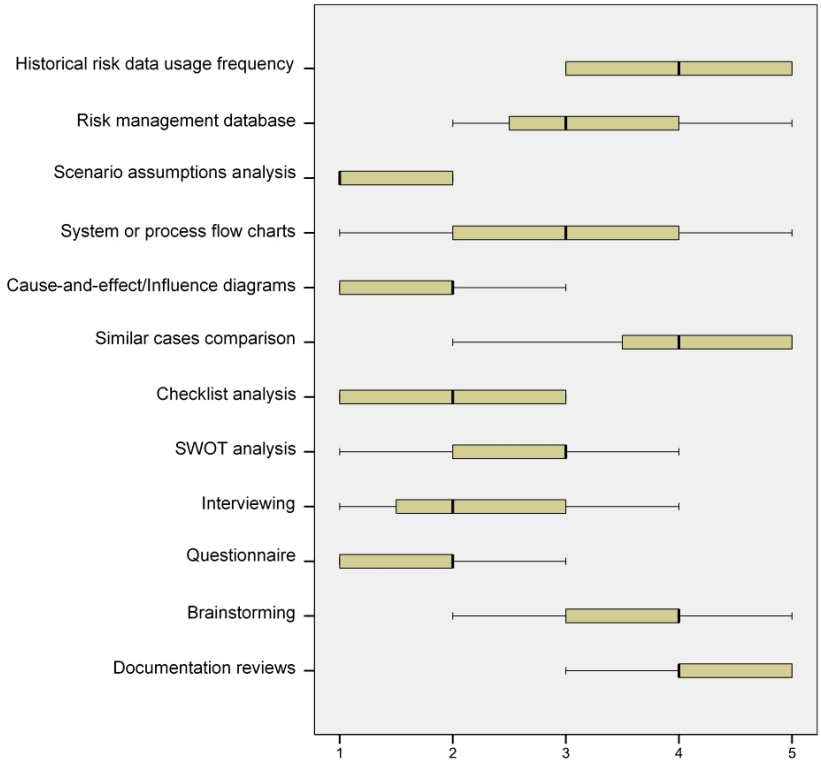

Figure 6. Risk identification tools used by the companies.

Table 6. Risk identification tools used by the companies.

Category	Respondents		
	Mean	**SD**	**Rank**
Documentation Reviews	4.15	0.720	1
Brainstorming	3.61	0.836	4
Questionnaire	1.66	0.659	11
Interviewing	2.28	0.893	8
SWOT analysis	2.45	0.998	7
Checklist analysis	1.98	0.758	9
Similar cases comparison	4.07	0.814	2
Cause-and-effect/Influence diagrams	1.72	0.694	10
System or process flow charts	3.01	1.077	6
Scenario assumptions analysis	1.42	0.496	12
Risk management database	3.19	0.920	5
Historical risk data usage frequency	3.95	0.801	3

4.3. Factors Limiting Implementation of Risk Management

The questionnaire also asked the respondents to give their opinions on the factors, which they consider as potential factors limiting the risk management in their companies. The results of these reviews are provided in Table 7. They show that, in practice, the critical factors limiting the implementation of risk management are a *lack of experts familiar with the tools/techniques* and *human/organisational resistance*. This may be due to the fact that individual knowledge and experience of risk management in PPP projects in developing countries are below moderate. In addition, the *difficulties in seeing the benefits* factor was ranked 3rd.

Table 7. Factors limiting implementation of risk management.

Category	Respondents	
	Percentage	**Rank**
Cost effectiveness	32.9	4
Lack of time	21.8	6
Lack of information	24.1	5
Difficulties in seeing the benefits	47.1	3
Human/organisational resistance	55.1	2
Lack of accepted industry tools/techniques for analysis	11.5	7
Lack of experts familiar with the tools/techniques	63.2	1

The response to the question about *cost effectiveness* was a little greater than 30 percent, and it is ranked 4th. This indicates that among the companies surveyed in this research, money is not the major factor restraining them from employing risk management programmes in PPP projects. Furthermore, the interview results showed that, similarly with other developing countries (Chan et al. 2015), most of the interviewees from Malaysian companies are unfamiliar with the tools for risk identification included in the questionnaires. This indicates the probability that the factor of a lack of accepted industry tools/technique for analysis is not the primary and most crucial reason. It can be concluded that the bigger issues in the implementation of risk management programmes for construction companies in Malaysia is associated with internal factors, such as the willingness of the person-in-charge/organisations as well as inadequate experts that understand the tools and techniques. On the other hand, external factors, such as time constraints, lack of information, and expenses required, are less important.

5. Conclusions

The findings from the current study are impactful to risk management in PPP projects, with implications for both practice and academia, given the limited research studies of this nature. Some of the findings of the study are not unexpected, but the present results are significant in at least two major aspects. One of the issues emerging from the findings is that internal barriers were more important than external factors in limiting the implementation of risk management. This can be reflected in the absence of a risk management culture in the companies. Meanwhile, allocating and managing risks is one of the most important factors for achieving success in the implementation of PPP projects (Valipour et al. 2015).

Although the brainstorming and questionnaire approaches use the experience of the experts as a collective group approach, the results showed that the review of documents, similar case comparisons and historical risk data usage frequency are the most frequently used risk identification techniques, while these techniques rely heavily on the insight and experience of over two experts within the company. Therefore, it is reasonable to use a combination of several risk identification tools, such as questionnaires and checklists, for PPP projects with high level of complexity, which should ensure that all external and internal risks within the project are identified.

Compared with another study about risk management practice in China's PPP projects by Ke et al. (2012), it can be understood that similar identification tools are used by China's companies. Another issue emerging from the findings is that, due to the low level of individual knowledge and experience of risk identification and management in PPPs in developing countries and also the unfamiliarity of most participants with risk identification tools, a database for risk identification can be a suitable alternative.

Based on the outcome of the survey, this study reports on assessing private partners' risk identification approaches for PPP projects in Malaysia at the estimating stage and also evaluates their process of risk identification. The result shows that the most frequently applied risk identification procedure is group exercise, for instance, a tender review by departments and their joint meetings, as well as with a group of persons from the tender department. Historical information and previous experience play an undeniably important role in ensuring a smooth risk identification process. The majority of the previous research related to this field of study agreed that group exercise is always the best option for risk identification, regardless of any technique employed. This is because an individually conducted risk identification process may be not as effective as group exercise, since the experience and knowledge is limited.

The study has explained that lack of time is the primary reason restraining risk management programmes in companies. Meanwhile, money is not listed as the most important factor. This may be due to the fact that in the construction business, production only starts after the client's request. Connivance, an opportunity arising from a proper risk management programme, or lack of attention to the existing potential risks, may jeopardise the project objectives. Thus, the early development of a risk management plan during the initial stage of the project plays a significant role in helping the management to cater for major issues and keep the situation under control. Though it is not possible to generalise risk factors since they are unique to each different project, the findings in this study might contribute by helping both of public and private sectors to make decisions during the bidding, estimating, and tendering stages. Furthermore, it is also helpful in helping them to improve their risk management plan by considering the construction industry risk factors.

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