
FORAYING INTO INTERNATIONAL CONSTRUCTION MARKET: A REVIEW ON THE INCORPORATION OF FIRMS' CAPABILITIES IN RISK ASSESSMENT METHODOLOGY

Loo Siaw Chuing, Abdul-Rahman Hamzah, Wang Chen

Department of Quantity Surveying, Faculty of Built Environment, University of Malaya, Kuala Lumpur, Malaysia

Abstract

As globalisation of international construction markets emerged, vast opportunities are available for Malaysian firms to foray abroad and compete internationally. Yet, owing to the uncertainties and complexities associated with the international construction domain, the entry decisions for international construction markets are difficult. Numerous researchers studied the risk assessment for international construction projects; however, there is lack of study on firms' capabilities that are to be considered before making risk assessment. The value of this critical review of concepts and methods resides in (1) its incorporation of firms' capabilities to risk assessment and (2) its exploration of the purpose of the existing risk assessment methodologies. The review was undertaken to set the stage for a future study on the incorporation of firms' capabilities in international construction risk assessment among the Malaysian construction firms foraying abroad.

Keywords: risk assessment, firm capabilities, international construction, decision making

1.0 INTRODUCTION

For firms foraying abroad, it is noteworthy that the uncertainties involved in international projects consist of those arise in domestic construction projects and those more complex ones from the international engagements (Lee and Walters, 1989; Hill International, Inc., 1995, as cited in Han and Diekmann, 2001a; Han, Diekmann, and Ock, 2005; Ling and Low, 2007). The exposure to more diverse and complex risks than domestic projects elucidates that international projects are more susceptible to high possibility of loss. Owing to the uncertainties and complexities associated with international construction domains, entry decisions for international construction markets are intricate. Han, Kim, Jang and Choi (2010) added that due to the inherent challenges and vast uncertainties under the overseas market conditions, contractors have to be versatile in managing the different dimensions of construction projects including design, engineering, procurement, and construction. The contractors gradually achieve the balance in such growth as they pursue the opportunities in the overseas markets.

Han and Diekmann (2001a) mentioned a few regional conditions that international construction is inclined to like currency devaluation, currency exchange restrictions, cultural differences, or unstable laws or regulations. Managing risks stemming from both host country's conditions and project-specific factors is the key to be successfully carrying out construction projects in international markets. A successful risk management requires identification of risks for the construction of a risk model, which serves to assess risk magnitudes for the implementation of response strategies, to achieve an acceptable risk-return balance (Dikmen, Birgonul, and Han, 2007). Risk management is a systematic process of planning, identification, analysis, response, and monitoring and control (Project Management Institute, 2004; Kerzner, 2009). Osipova (2008) cited that risk management has an overall goal to maximise the opportunities and minimise the consequences of a risk event. Various researchers (Baloi and Price, 2003; Barber, 2005; Project Management Institute, 2004; Ward and Chapman, 2003) noted that project risks are uncertain events or conditions, which may have

an impact on the project objectives. In addition, a risk has a cause and it is a consequence if being triggered. Overall, risk management is a formal process directed at identifying, assessing, and responding to project risks (Baloi and Price, 2003; Del Cano and De la Cruz, 2002; Flanagan and Norman, 1993; Project Management Institute, 2004; Uher and Toakley, 1999; Ward and Chapman, 2003).

This paper discusses risk assessment whose goal is to prioritise risks for management by identifying, evaluating, and ranking them (Osipova, 2008). Wang, Dulaimi and Aguria (2004) carried out a detailed analysis of international construction risks and identified twenty-eight critical risks associated with international construction projects in developing countries. Bing and Tiong (1999) proposed a risk management model for international construction joint ventures (JVs) consisting of three typical risk management phases (identification, analysis, and treatment). They then identified a set of 25 risk factors applicable to international construction joint ventures.

Hastak and Shaked (2000) recommended an international construction risk assessment model (ICRAM-1) which can assist users in evaluating the potential risk involved in expanding operations in an international market by analysing risks at the macro (or country environment), market and project levels. Hence, ICRAM-1 provided a structured approach, designed to examine a specific project in a foreign country, to evaluate the risk indicators involved in an international construction operation.

Previous researchers who studied the area of risk management for international construction in various contexts mostly worked on the area of risk identification, classification and assessment in order to develop strategies or responses toward the risks encountered. They are also contributing to the knowledge of international construction risk management in the various scenarios of joint venture (Bing and Tiong, 1999; Shen, Wu, and Ng, 2001), developing countries (Wang, Dulaimi, and Aguria, 2004),

and foreign foray (Hastak and Shaked, 2000; Han, Kim, Kim, and Jang, 2008; Bu-Qammaz, Dikmen, and Birgonul, 2009). Despite the vast number of articles on construction risk management, Taroun, Yang and Lowe (2011) concluded from their critical review of the construction risk modeling and assessment literature published over the last 27 years that construction risk modeling is a developing and ongoing process with no satisfactory theory or tool developed or proposed for assessing construction risk.

While there is a plethora of research on what and how the risks encountered may be managed, surprisingly little has been focused specifically on investigating the capabilities of the firms influencing the risk assessment of the international projects. Ultimately, risk assessment remains less accurate if the important component of incorporating firms' capabilities is missing. This is also part of risk planning stage, which is less explored by previous researchers. Dikmen and Birgonul (2006) found that risk assessment depends on many factors related to firms' capabilities of, hence they were considered in their proposed risk rating procedure. Later, Bu-Qammaz, Dikmen and Birgonul (2009) attempted to incorporate the influencing factors such as company's experience, project data availability, type or project delivery system, and contract type into the assessment model using analytic network process (ANP); yet the methodology used was not possible because of the high number of comparison matrices and also difficulties in collecting huge number of expert judgments. The observations on the field study conducted by Abdul-Rahman, Loo and Wang (2012) and Loo (2011) likewise realised the significance of determining the relationships of the firms' capabilities and the risk factors involved in risk assessment.

Since the importance of considering the capabilities of firms or influencing factors is highly related to the accuracy of the results of risk assessment, this paper seeks to contribute to the existing body of knowledge relating to the international construction risk management by identifying firms' capabilities and the extent of influence towards risk factors. Not much has been done to empirically investigate the degree to which firm's capabilities affect risk factors, and thereby to develop a risk assessment framework that could help firms best choose projects to venture on.

2.0 LITERATURE REVIEW

2.1 Risk assessment methodology

In order to assess project risks of different milieus, various risk assessment methodologies have been adopted (See Table 1). Researchers employed Program Evaluation and Review (PERT) to assess and estimate project duration, range estimate to assess project cost, and Monte Carlo Simulation (MCS) to assess both project duration and cost.

Table 1: Construction project risk assessment methodology (compiled from literature review)

| Purpose of assessment | Risk assessment methodology | Author |
|-----------------------|--|--|
| Time | Program Evaluation and Review Technique (PERT) | Chapman and Cooper, 1983; Hull, 1990; Yeo, 1990; Mulholland and Christian, 1999 |
| Cost | Range estimates | Yeo, 1990 |
| Time and Cost | Monte Carlo Simulation (MSC) | Hull, 1990; Oztas and Okmen, 2004; Molenaar, 2005 |
| Risk rating | Probability distribution | Chapman and Cooper, 1983; Franke, 1987 |
| | Probability-Impact (P-I) | Dey, Tabucanon, and Ogunlana, 1994; Baccarini and Archer, 2001; Hillson, 2002; Jannadi and Almishari, 2003; Cagno, Caron, and Mancini, 2007; Cioffi and Khamooshi, |

| | | |
|-----------------------|------------------------------------|---|
| | | 2009; Hastak and Shaked, 2000; Shang, Anumba, Bouchlaghem, Miles, Cen, and Taylor, 2005; Molenaar, 2005; Thomas, Kalidindi, and Ganesh, 2006; Santoso, Ogunlana, and Minato, 2003 |
| | Significance-Probability-Impact | Han, Kim, Kim, and Jang, 2008 |
| Decision support | Decision trees | Chapman and Cooper, 1983; Dey, 2001 |
| | Fault tree | Thomas, Kalidindi, and Ganesh, 2006 |
| | Belief network/Influence network | Nasir, McCabe, and Hartono, 2003; Poh and Tah, 2006 |
| | Case-based reasoning | Dikmen, Birgonul, and Gur, 2007 |
| Subjective assessment | Analytical Hierarchy Process (AHP) | Mustafa and Al-Bahar, 1991; Dey, Tabucanon, and Ogunlana, 1994; Hastak and Shaked, 2000; Dey, 2001; Dikmen and Birgonul, 2006; Hsueh, Perng, Yan, and Lee, 2007; Zayed, Amer, and Pan, 2008 |
| | Fuzzy Sets Theory (FST) | Kangari and Riggs, 1989; Paek, Lee, and Ock, 1993; Wirba, Tah, and Howes, 1996; Tah and Carr, 2000; Baloi and Price, 2003; Shang, Anumba, Bouchlaghem, Miles, Cen, and Taylor, 2005; Choi, Cho, and Seo, 2004; Diekman, Birgonul, and Han, 2007 |
| | Fuzzy-AHP | Zeng, An, and Smith, 2007; Zhang and Zou, 2007 |
| | Fuzzy-Delphi | Thomas, Kalidindi, and Ganesh, 2006 |
| | Analytic Network Process (ANP) | Dikmen, Birgonul, and Ozorhon, 2007; Bu-Qammar, Dikmen, and Birgonul, 2009 |
| | Structural Equation Modeling (SEM) | Eybpoosh, Dikmen, and Birgonul, 2011 |
| | | |

For traditional risk management, copious researchers have derived rating for construction project risks from different angles or perspectives using probability distribution, probability-impact, and significance-probability-impact approaches.

Decision support tools like decision trees, fault tree, belief network, influence network, and case-based reasoning use graph or model of decisions and their possible consequences including probability event outcomes, resource costs, and utility. These tools are commonly used in operation research, specifically in decision analysis to help identify strategy such as management risk.

Some researchers realized that human factors such as personal experience, intuition and judgment affect the ratings given. Hence, Analytical Hierarchy Process (AHP), Fuzzy Sets Theory (FST), Fuzzy-AHP, Fuzzy-Delphi, and Analytic Network Process (ANP) were introduced to handle subjective assessments. These tools develop qualitative risk assessment models which incorporate linguistic variables to assess the risk probability and impact and the interdependencies of risks. Fuzzy generally makes use of linguistic variables used to assess risk probability and impact, while AHP is used to structure and prioritise diverse risk factors.

Since the interdependencies or extent of influence of firms' capabilities towards risk factors are the focus of this study, subjective assessment tools are handpicked. Although AHP is an effective tool in quantifying relative importance using a pair-wise comparison (Saaty, 2003), this method may not be possible to apply when too many factors and experts are involved in the weighting process. To process Page 5 complex relationships of capabilities a factors, this study attempts to adopt the Partial Least Square of Structural Equation Modeling (PLS-SEM) approach. Recently, Kim, Han, Kim and Park (2009) and Eybpoosh, Dikmen and Birgonul (2011) were the first in the international construction field to utilise SEM techniques in identifying risk paths during risk assessment of construction projects. This PLS-

SEM technique is a quantitative technique in determining the weight of the relationships among variables to handle subjective assessments.

2.1.1 Partial least square-structural equation modeling (PLS-SEM)

The Structural Equation Modeling (SEM) approach, a second generation multivariate analysis that integrates systematic combination of confirmatory factor analysis, multiple regression analysis, and path analysis was chosen to develop a risk assessment model to facilitate international foray decision based on firm's capabilities and project risks involved. SEM allows the estimation of simultaneous relationships among latent variables and observed variables. Since both confirmatory factor analysis and path analysis are run simultaneously in a single structural model, the relationships of the variables can be represented in the final outcome (Kline, 2005). Page 4 The Partial Least Square of Structural Equation Modeling (PLS-SEM) approach is opted in this study due to a few reasons (Fornell and Larcker, 1981; Hair, Anderson, Tatham, and Black, 2006; Gotz, Liehr-Gobbers, Krafft, 2010). First, it is a predictive application. Second, Page 3 analyse a complex model without a large sample size (30-100 datasets) and meticulous checks on data distribution. Last, it tends to estimate constructs as a linear combinations of observed variables using weight relations.

2.2 Components of construction risk assessment

As put forth by Dikmen and Birgonul (2006, p. 61), probability and impact values are neither constant for each project nor for each company; instead, they depend on many factors related to capabilities of firm, its experience in the market and in similar kind of projects, etc. In that particular paper, the flowchart, which depicts the factors that affect risk level in an international project, begins with a company's strength and weaknesses consisting of experience, availability of resources, capabilities, and company strategy. Having ascertained the firm's capabilities, the

effect on ability to manage various project risks can then be determined. Hence, the following review contains two main components- the capabilities of firm and the project risk factors.

2.2.1 Capabilities of construction firm

There are seven capabilities of construction firms being discussed, namely track record, specialist expertise, project management, international network and partnership, technology, financial, and equipment, material, and labour support. These capabilities have effect on the ability to manage the risk factors by affecting the probability of occurrence of a risk event. Dikmen and Birgonul (2006) have given an example that if a local company formed a joint venture with the host company, the local company may experience a lower probability of occurrence of risk event like bureaucratic delays.

2.2.1.1 Track Record [FC1]

To venture into a foreign market, companies with a strong track record have the competitive edge in the international construction. Quak (1991) explained that an experienced firm has the capability in solving technical problems efficiently. First, the firm would have either a ready solution or a cheaper solution to a technical problem, similar to the problem faced in the past that has had its solution invested. Second, the firm's previous performances would have demonstrated that the firm has the organisation, technical know-how, and experience to overcome technical challenges that arise in the course of a construction project. Track record, which is most important in specialist engineering, project management, and large contracts, is often determined by the reference projects. With previous projects' successes, a firm can be marketed with goodwill and, this encourages immediate entry strategy. Lack of suitable track record may be an issue for a first-timer construction firm hoping to venture abroad; yet finding for itself a strategic ally that possesses the necessary track record will have given the firm an aggressive entry (Quak, 1991). Loo (2011) found that selecting a project partner with good track record is often the best entry

strategy for a novice forayer. As for consultants, the most important criterion in contractor selection is the work experience on similar project scale and type (Neo, 1976). Overall, a firm with a good track record of its expertise is more marketable to potential international clients and consortium partners.

2.2.1.2 Specialist Expertise [FC2]

To compete for specialist subcontracts or a desired consortium partnership, having specialist technologies enable smaller companies to place themselves in a niche international market (Quak, 1991). Sillars and Kangari (1997) found that the provision of new technologies is a strategy for securing project in situations where competitive pricing (low price), one of the major challenges in foreign market, is often offered by local construction firms. Hence, to be more competitive, foreign companies with the advent of the specialised knowledge in building structures or handling high-tech Page 5 equipments can project their expertise to the need of the host country. Sillars and Kangari (1997) put forth a few specialisation examples like the construction of energy efficient buildings, inclusion of telecommunication requirements, and even practice of modern management methods to achieve on-schedule and within-budget project completion for large and complex infrastructure projects. Strassmann and Wells (1988) related that United States companies have the special expertise for technology based projects. In the international arena, power, industrial, petroleum, hazardous wastes, sewer or waste industries are mainly populated by United States based companies. Conversely, conventional buildings and common infrastructure projects are not won by United States companies due to the lack of cost advantage. Gunhan and Arditi (2005) agreed that one of the major strengths to be possessed by a company looking for opportunities in the international markets is having a special expertise.

2.2.1.3 Project management [FC3]

The common nature of international projects is usually very complex, having multiple ownership, detailed financial provisions, and different political ideologies. With these, projects are without doubt more difficult to manage than domestic projects due to the vast number and uncertain risks involved (Diekmann, and Ock, 2005; Ling and 2007). For that reason, Stallworthy and Kharbanda (1983) suggested a new breed of project manager, who is both a businessman and a technician, whose expertise is to materialise the said 'complex' projects. They further explained that the business role is increasingly important since project financing is crucial in export project development rather than technological excellence alone. Strassmann and Wells (1988) affirmed that United States contractors have the competitive edge due to their efficiencies in project management instead of being familiar with the building methods for structures. Their successes in winning overseas contracts are often attributed to their organisation and management skills rather than experience with advanced technologies.

2.2.1.4 International network and partnership [FC4]

With international marketing network, a firm is able to secure information on technology, impending projects, clients, buyers, competitors, and potential partners. Information works well for construction firm in formulating suitable competitive strategy (Quak, 1991). Loo (2011) studying the risk management for Malaysian firms foraying in the Gulf States pointed out that Malaysian construction firms that formed partnership with host country's firm may be exempted from taxation of profit and also made easy the bureaucracy procedures with different agencies in that particular country. This is in line with Pheng (1996) who stated that an association with host country's construction firm, be it formal or informal, valuable information are made available such as financial institution to liaise for overseas projects funding and local

government agencies to consult for construction investments.

The engagement of service from local firms or agencies assists in scouting for local markets (Pheng, 1996), suppliers, and labours (Loo, 2011). Besides, a government board or statutory agency like Malaysia External Trade Development Corporation (MATRADE) also actively assists Malaysian firms embarking on international ventures by providing valuable information on operating in foreign environment, and business opportunities and contacts (MATRADE, n.d.). In addition, construction firms may also build business relationship with non-construction related companies in own country that may lead to overseas venture due to the said companies' past performances that are well received by the foreign client (Pheng, 1996). All in all, effective marketing network are relevant and important for both foreign and local parties that are interested in investing and or constructing overseas.

2.2.1.5 Technology [FC5]

Technology, which is defined as the knowledge and expertise employed, is significant in technically sophisticated projects. Sophisticated projects in the international markets are such as chemical plants, refineries, power plants, and industrial complexes that emphasize on the merits of sophisticated technology (Neo, 1976). Technology does not remain stagnant; it is growing and developing, and indeed paces with globalisation simultaneously. Accordingly, technology advancement enhances the strategies acquired by industry members to remain competitive (Gunhan and Arditi, 2005).

Technology is undeniably one of the most effective weapons that make possible the penetration into foreign markets. This statement is true particularly for projects in developing countries with the great need for the latest and the best technology. Companies from industrialized countries, where research and development are emphasised, are commonly the providers for new technologies in the less developed countries (Pheng, 1996). Gunhan and

Arditi (2005) mentioned that evidence has shown that possession of advanced technology put companies, for instance United States, European, and Japanese construction firms, into a great competitive state for monopolising the market owing to their cutting-edge technologies.

2.2.1.6 Financial [FC6]

Financial strength of a company is considered to be an important strategic asset (Warsawski, 1996). Generally, when a company's financial status is robust, it has the capacity to conduct far-reaching and ingenious strategic plans. The said company can also take higher risks with prospects of higher returns. There will be no issue for creditworthiness and reputation among its suppliers, clients, and financial institutions. This is parallel with Pheng (1996) who mentioned that contractors with the ability to provide attractive financing packages to potential clients will often stand a higher chance for winning contracts. Besides, a solid balance sheet is also the first prerequisite to secure attractive financing packages from financial institutions. However, Gunhan and Arditi (2005) found that financial strength is not very important as compared to other capabilities since the investor in a construction project is the owner and not the contractor. An owner is the one who pays contractor to subsequently pay the subcontractors, suppliers and others. Hence, Price (1995) quoted that the financial strength of a construction company is closely related to the strength of working capital and to the adequacy of cash flow even though the size of contractor's working capital is very much smaller than the owner's investment in the project.

2.2.1.7 Equipment, material, and labour support [FC7]

In the assessment of potential bidders in international construction, a contractor's capabilities in terms of qualified personnel, equipment and plant are one of the important factors to be considered (Neo, 1976). Moreover, equipment and field resources have been listed as a primary strength of construction companies (Friedman, 1984). On the contrary, through a

survey by Gunhan and Arditi (2005), this factor is found to be of little importance to the respondents because most construction companies foraying abroad normally procure their equipment and materials from local markets. Likewise, the labour support or key administrative personnel are members of the company who are posted to the host country for the project duration, while most of the operational personnel are hired locally (Gunhan and Arditi, 2005; Loo, 2011).

2.2.2 Risk factors in international construction context

Risk identification determines the potential risks, which are those that may affect the project. Copious researches set forth several methods in classifying project risks and risk sources (Baloi and Price, 2003; Leung, Chuah, and Rao Tummala, 1998; Bing, Akintoye, Edwards, and Hardcastle, 2005; Tah and Carr, 2000). Generally, the risks in a construction projects may be derived from two sources. The first consists of the environmental impacts, or known as external risks (e.g. financial, economic, political, legal and environmental). The second consists of uncertainties existing in the project itself, which are known as internal risks (e.g. design, construction, management and relationships) (Zhi, 1995; Bing and Tiong, 1999; Wang and Chou, 2003; Fang, Li, Fong, and Shen, 2004; Aleshin, 2001; El-Sayegh, 2008).

This study found a risk taxonomy pattern in adopting internal and external risk classification from the literature concerning a specific country's projects. For instance, projects in China (Zhi, 1995; Fang et al., 2004), Russia (Aleshin, 2001), Taiwan (Wang and Chou, 2003), Vietnam (Thuyet, Ogunlana, and Dey, 2007), and UAE (El-Sayegh, 2008) have all adopted the risk classification of internal and external aspects. The reason is that external risks are originated from the project environment or are usually unique to a particular country, while internal risks are initiated inside the project and are relevant to all projects irrespective of whether they are local or international (Flanagan

and Norman, 1993; Aleshin, 2001; Fang et al., 2004; Ling and Hoi, 2006).

2.2.2.1 Proposed risk breakdown structure (RBS)

The proposed RBS (Loo, 2011; Abdul-Rahman, Loo, and Wang, 2012) consists of 109 internal and external risk factors (Figure 1). In the process of compiling the RBS, certain risk factors that carry similar meanings but are represented by different phrases are consolidated and renamed in the categories proposed Page 7 study's RBS. In other words, some risk are being covered in a more relevant category as proposed in the RBS instead of that from the reference.

A number of authors (Perry and Hayes, 1985; Mustafa and Al-Bahar, 1991; Wang, Tiong, Ting, and Ashley, 2000; Egbu and Serafinska, 2000; Han and Diekmann, 2001a; 2001b; Shen et al., 2001; Tchankova, 2002; Bing et al., 2005; Ling and Hoi, 2006; Ling and Lim, 2007; Ling and Low, 2007; El-Sayegh, 2008; Enshassi et al., 2008) were referred to in compiling the list of internal risks, consisting 57 risk factors under 6 categories. These risks are partitioned into financial, managerial, construction, design, operational, and safety and health categories.

external risks, numerous authors (Perry and Hayes, 1985; Mustafa and Al-Bahar, 1991; Leung, Chuah, and Tummala, 1998; Wang, Tiong, Ting, and Ashley, 1999; Wang et al., 2000; Egbu and Serafinska, 2000; Han and Diekmann, 2001a; 2001b; Shen et al., 2001; Tchankova, 2002; Baloi and Price, 2003; Bing et al., 2005; Ling and Hoi, 2006; Ling and Lim, 2007; Ling and Low, 2007; Ling, Ang, and Lim, 2007; El-Sayegh, 2008; Enshassi et al., 2008) were referred to before presenting 52

external risk factors under 7 categories. These risks are categorised into political, social, cultural, economic, legal, logistics, and natural.

3.0 CLOSING

To the best of the authors' knowledge, there is a lack of study on risk assessment of international construction projects in Malaysia. There is a need to improve the decision making of international forayers of construction projects based on a proper methodology. From the literature review, this paper has proposed the incorporation of firm's capabilities in decision making to improve the existing risk assessment methodology (Figure 2).

Figure 2 shows the main components of the proposed risk assessment, namely For the firm's capabilities, and risk factors. This paper proposes a further study that empirically investigate the degree to which firm's capabilities (7 factors) affect risk factors (109 factors) using Partial Least Squares of Structural Equation Modelling (PLS-SEM) approach.

The consideration of firms' capacities with their quantitative effects on the risk factors is incorporated into the risk assessment methodology to avoid inaccuracies of risk ratings. Finding the relative weights of the capabilities and risk factors has given the room for the actual risk score to shift according to the expected frequency of the occurrence of events. To date, the sets of risk factors and their relative weights carried from the construction firms' capabilities have yet been studied.

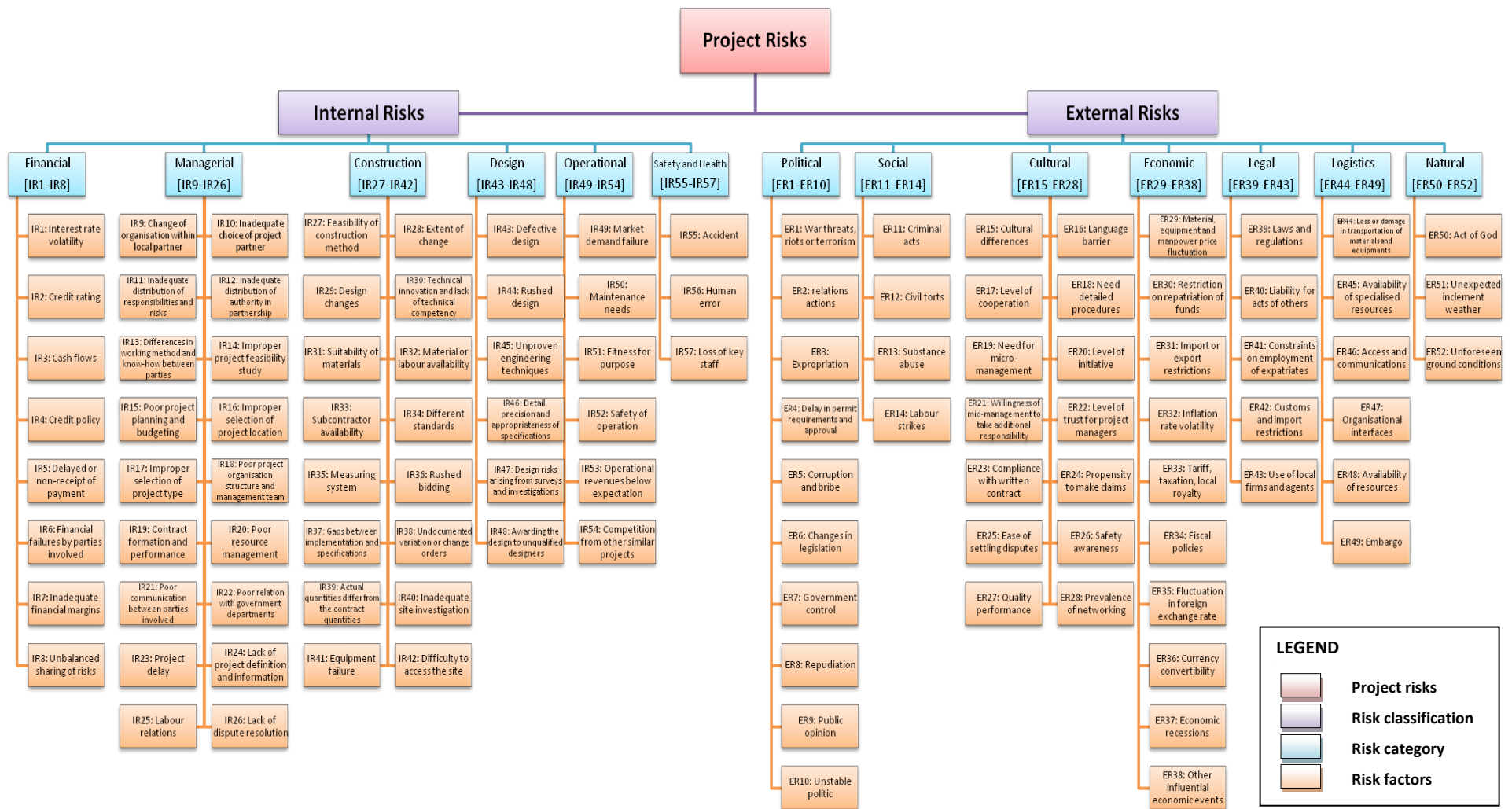


Figure 1: Proposed Risk Breakdown Structure (RBS)
 (Source: Constructed by authors based on review of literature)

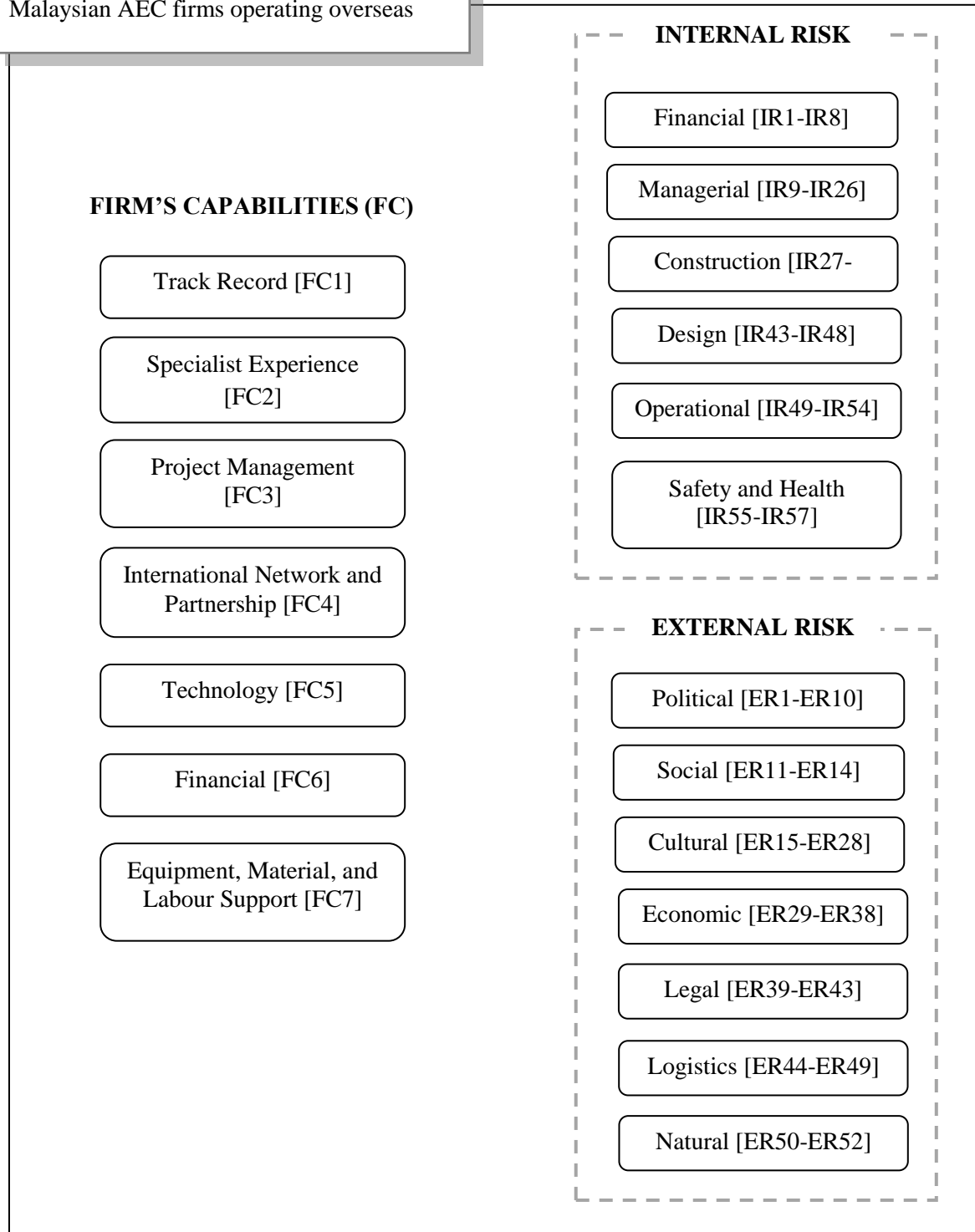


Figure 2: Proposed conceptual framework for international construction project risk assessment

References

- Abdul-Rahman, H., Loo, S. C., and Wang, C. (2012). Risk identification and mitigation for architectural, engineering and construction (AEC) firms operating in Gulf. *Canadian Journal of Civil Engineering*, 39 (1), 55-71.
- Aleshin, A. (2001). Risk management of international projects in Russia. *International Journal of Project Management* , 19 (4), 207-222.
- Baccarini, D., and Archer, R. (2001). The risk ranking of projects: A methodology. *International Journal of Project Management*, 19, 139-145.
- Baloi, D., and Price, A. D. F. (2003). Modelling global risk factors affecting construction cost performance. *International Journal of Project Management*, 21, 261-269.
- Barber, R. B. (2005). Understanding internally generated risks in projects. *International Journal of Project Management* , 23 (8), 584-590.
- Bing, L., and Tiong, L. K. (1999). Risk management model for international construction joint ventures. *Journal of Construction Engineering and Management* , 125 (5), 377-384.
- Bing, L., Akintoye, A., Edwards, P. J., and Hardcastle, C. (2005). The allocation of risk in PPP/PFI construction projects in the UK. *International Journal of Project Management* , 23 (1), 25-35.
- Bu-Qammaz, A. S., Dikmen, I., and Birgonul, M. T. (2009). Risk assessment of international construction projects using the analytic network process. *Canadian Journal of Civil Engineering*, 36, 1170-1181.
- Cagno, E., Caron, F., and Mancini, M. (2007). A multi-dimensional analysis of major risks in complex projects. *Risk Management*, 9, 1-18.
- Chapman, C., and Cooper, D. (1983). Risk engineering: Basic controlled interval and memory models. *Journal of the Operational Research Society*, 34 (1), 51-60.
- Choi, H. H., Cho, H. N., and Seo, J. W. (2004). Risk assessment methodology for underground construction projects. *Journal of Construction Engineering and Management*, 130 (2), 258-272.
- Cioffi, D. F., and Khamooshi, H. (2009). A practical method of determining project risk contingency budgets. *Journal of the Operational Research Society*, 60, 565-571.
- Del Cano, A., and De La Cruz, M. (2002). Integrated methodology for project risk management. *Journal of Construction Engineering and Management* , 128 (6), 473-485.
- Dey, K. P. (2001). Decision support system for risk management: A case study. *Management Decision*, 39 (8), 634-649.
- Dey, P., Tabucanon, M. T., and Ogunlana, S. (1994). Planning for project control through risk analysis: A petroleum pipeline-laying project. *International Journal of Project Management*, 12 (1), 23-33.
- Dikmen, I., and Birgonul, M. T. (2006). An analytic hierarchy process based model for risk and opportunity assessment of international construction projects. *Canadian Journal of Civil Engineering*, 33 (1), 58-68.
- Dikmen, I., Birgonul, M. T., and Gur, K. (2007). A case-based decision support tool for bid mark-up estimation of international construction projects. *Automation in Construction*, 17, 30-44.
- Dikmen, I., Birgonul, M. T., and Ozorhon, B. (2007). Project appraisal and selection using the analytical network process. *Canadian Journal of Civil Engineering*, 34, 786-792.
- Dikmen, I., Birgonul, M.T., and Han, S. (2007). Using fuzzy risk assessment to rate cost overrun

- risk in international construction projects. *International Journal of Project Management*, 25, 494-505.
- Egbu, C. O., and Serafinska, Z. (2000). Attitudes to risk management in diverse project environments. *COBRA 2000 Conference* (pp. 1-10). Greenwich: RICS Research Foundation.
- El-Sayegh, S. M. (2008). Risk assessment and allocation in the UAE construction industry. *International Journal of Project Management*, 26, 431-438.
- Enshassi, A., Mohamed, S., and Abu Mosa, J. (2008). Risk management in building projects in Palestine: Contractors' perspective. *Emirates Journal for Engineering Research*, 13 (1), 29-44.
- Eybpoosh, M., Dikmen, I., and Birgonul, M. T. (2011). Identification of risk paths in international construction projects using structural equation modeling. *ASCE Journal of Construction Engineering and Management*, 137 (12), 1164-1175.
- Fang, D., Li, M., Fong, P. S. W., and Shen, L. (2004). Risks in Chinese construction market-Contractors' perspective. *Journal of Construction Engineering and Management*, 130 (6), 853-861.
- Flanagan, R., and Norman, G. (1993). *Risk management and construction*. Oxford: Blackwell Scientific Publications.
- Fornell, C., and Larcker, D. (1981). Structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18 (1), 39-50.
- Franke, A. (1987). Risk analysis in project management. *International Journal of Project Management*, 5 (1), 29-34.
- Friedman, W. (1984). *Construction marketing and strategic planning*. New York: McGraw-Hill.
- Gotz, O., Liehr-Gobbers, K., and Krafft, M. (2010). Evaluation of structural equation models using the partial least squares (PLS) approach. *Springer Handbooks of Computational Statistics*, (pp. 691-711). Springer Berlin Heidelberg.
- Gunhan, S., and Arditi, D. (2005). Factors affecting international construction. *Journal of Construction Engineering and Management*, 131 (3), 273-282.
- Hair, J. F., Anderson, R.E., Tatham, R. L., and Black, W.C. (2006) *Multivariate analysis*, 6th ed. New Jersey: Prentice Hall International
- Han, S. H., and Diekmann, J. E. (2001a). Approaches for making risk-based go/no-go decision for international projects. *Journal of Construction Engineering and Management*, 127 (4), 300-308.
- Han, S. H., and Diekmann, J. E. (2001b). Making a risk-based bid decision for overseas construction projects. *Construction Management and Economics*, 19 (8), 765-776.
- Han, S. H., Kim, D. Y., Jang, H. S., and Choi, S. (2010). Strategies for contractors to sustain growth in the global construction market. *Habitat International*, 34 (1), 1-10.
- Han, S. H., Kim, D. Y., Kim, H., and Jang, W. S. (2008). A web-based integrated system for international project risk management. *Automation in Construction*, 17 (3), 342-356.
- Han, S. S., Diekmann, J. E., and Ock, J. H. (2005). Contractor's risk attitudes in the selection of international construction projects. *Journal of Construction Engineering and Management*, 131 (3), 283-292.
- Hastak, M., and Shaked, A. (2000). ICRAM-1: Model for international construction risk assessment. *Journal of Management in Engineering*, 16 (1), 59-69.

- Hillson, D. (2002). Extending the risk process to manage opportunities. *International Journal of Project Management*, 20, 235-240.
- Hsueh, S. L., Perng, Y. H., Yan, M. R., and Lee, J. R. (2007). On-line multi-criterion risk assessment model for construction joint ventures in China. *Automation in Construction*, 16, 607-619.
- Hull, J. K. (1990). Application of risk analysis techniques in proposal assessment. *International Journal of Project Management*, 8 (3), 152-157.
- Jannadi, O. A., and Almishari, S. (2003). Risk assessment in construction. *Journal of Construction Engineering and Management*, 129 (5), 492-500.
- Kangari, R., and Riggs, L. S. (1989). Construction risk assessment by linguistics. *IEEE Transaction on Engineering Management*, 36 (2), 126-131.
- Kerzner, H. (2009). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. New Jersey: John Wiley and Sons.
- Kim, D. Y., Han, S. H., Kim, H., and Park, H. (2009). Structuring the prediction model of project performance for international construction projects: A comparative analysis. *Expert Systems with Applications*, 36, 1961-1971.
- Kline, R. B. (2005). *Principles and practice of structural equation modeling*. 2nd ed. New York: The Guilford Press.
- Leung, H. M., Chuah, K. B., and Tummala, V. M. (1998). A knowledge-based system for identifying potential project risks. *Omega, International Journal of Management Science*, 26 (5), 623-638.
- Ling, F. Y., and Hoi, L. (2006). Risks faced by Singapore firms when undertaking construction projects in India. *International of Project Management*, 24 (3), 261-270.
- Ling, F. Y., and Low, S. P. (2007). Legal risks faced by foreign architectural, engineering, and construction firms in China. *Journal of Professional Issues in Engineering Education and Practice*, 238-245.
- Ling, F., and Lim, H. L. (2007). Foreign firms' financial and economic risk in China. *Engineering, Construction and Architectural Management*, 14 (4), 346-362.
- Ling, F., Ang, A., and Lim, S. (2007). Encounters between foreigners and Chinese: Perception and management of cultural differences. *Engineering, Construction and Architectural Management*, 14 (6), 501-518.
- Loo, S. C. (2011). *Risk management for Malaysian firms undertaking construction projects in the Gulf Cooperation Council (GCC) States*. (Unpublished MSc. thesis). University of Malaya, Kuala Lumpur.
- MATRADE. (n.d.). Exploring business opportunities in the Middle East. *Building and Investment*, pp. 72-76.
- Molenaar, K. R. (2005). Programmatic cost risk analysis for highway mega projects. *Journal of Construction Engineering and Management*, 131 (3), 343-353.
- Mulholland, B., and Christian, J. (1999). Risk assessment in construction schedules. *Journal of Construction Engineering and Management*, 125 (1), 8-15.
- Mustafa, M. A., and Al-Bahar, J. F. (1991). Project risk assessment using the analytic hierarchy process. *IEEE Transactions on Engineering Management*, 38 (1), 46-52.
- Nasir, D., McCabe, B., and Hartono, L. (2003). Evaluating risk in construction-schedule model (ERIC-S): Construction Schedule Risk Model. *Journal of Construction Engineering and Management*, 129 (5), 518-527.
- Neo, R. B. (1976). *International construction contracting*. Essex, UK: Bowker Publishing.

- Osipova, E. (2008). *Risk management in construction projects: A comparative study of the different procurement options in Sweden*. Ph.D. thesis, Luleå University of Technology, Sweden.
- Oztas, A., and Okmen, O. (2004). Risk analysis in fixed-price design-build construction Page 14 *Building and Environment*, 39, 229-237.
- Paek, J. H., Lee, Y. W., and Ock, J. H. (1993). Pricing construction risks: Fuzzy set theory. *Journal of Construction Engineering and Management*, 119 (4), 743-756.
- Perry, J. G., and Hayes, R. W. (1985). Risk and its management in construction projects. *Proceedings of Institution of Civil Engineers*, 78, pp. 499-521.
- Pheng, L. S. (1996). *Theory and practice of construction export marketing*. Burlington, Vermont, U.S.: Ashgate Publishing Company.
- Poh, Y. P., and Tah, J. H. M. (2006). Integrated duration-cost influence network for modelling risk impacts on construction tasks. *Construction Management and Economics*, 24, 861-868.
- Price, A. D. F. (1995). *Financing international projects, international construction management series 3*. Geneva, Switzerland: International Labour Office.
- Project Management Institute. (2004). *A guide to the project management body of knowledge* (3rd ed.). Newton Square, USA: Project Management Institute.
- Quak, S. K. (1991). *Marketing abroad: Competitive strategies and market niches for the Singapore construction industry*. Singapore: Pacific Trade Press Pte Ltd.
- Saaty, R. W. (2003). *Decision making in complex environments, the Analytic Hierarchy Process (AHP) for decision making and the Analytic Network Process (ANP) for decision making with dependence and feedback*. Pittsburg, Penn., USA: The Creative Decisions Foundation.
- Santoso, D. S., Ogunlana, S. O., and Minato, T. (2003). Assessment of risks in high rise building construction in Jakarta. *Engineering, Construction and Architectural Management*, 10 (1), 43-55.
- Shang, H., Anumba, C. J., Bouchlaghem, D. M., Miles, J. C., Cen, M., and Taylor, M. (2005). An intelligent risk assessment system for distributed construction teams. *Engineering, Construction and Architectural Management*, 12 (4), 391-409.
- Shen, L. Y., Wu, G. W., and Ng, C. S. (2001). Risk assessment for construction joint ventures in China. *Journal of Construction Engineering and Management*, 127 (1), 76-81.
- Sillars, D. N., and Kangari, R. (1997). Japanese construction alliances. *Journal of Construction Engineering and Management*, 123 (2), 146-152.
- Stallworthy, E. A., and Kharbanda, O. P. (1983). *Total project management*. Aldershot, Hants, U.K.: Gower Publishing Co.
- Strassmann, W. P., and Wells, J. (1988). *The global construction industry, strategies for entry, growth and survival*. London: Unwin Hyman.
- Tah, J. H., and Carr, V. (2000). A proposal for construction project risk assessment using fuzzy logic. *Construction Management and Economics*, 18 (4), 491-500.
- Taroun, A., Yang, J. B., and Lowe, D. (2011). Construction risk modelling and assessment: Insights from a literature review. *The Built and Human Environment Review*, 4 (1), 87-97.
- Tchankova, L. (2002). Risk identification- Basic stage in risk management. *Environmental Management and Health*, 13 (3), 290-297.
- Thomas, A. V., Kalidindi, S. N., and Ganesh, L. S. (2006). Modeling and assessment of critical risks in BOT road projects. *Construction Management and Economics*, 24, 407-424.

- Thuyet, N. V., Ogunlana, S. O., and Dey, P. K. (2007). Risk management in oil and gas construction projects in Vietnam. *International Journal of Energy Sector Management* , 1 (2), 175-194.
- Uher, T. E., and Toakley, A. R. (1999). Risk management in the conceptual phase of a project. *International Journal of Project Management* , 17 (3), 161-169.
- Wang, M. T., and Chou, H. Y. (2003). Risk allocation and risk handling of highway projects in Taiwan. *Journal of Management in Engineering* , 19 (2), 60-68.
- Wang, S. Q., Dulaimi, M. F., and Aguria, M. Y. (2004). Risk management framework for construction projects in developing countries. *Construction Management and Economics* , 22, 237-252.
- Wang, S. Q., Tiong, L. K., Ting, S. K., and Ashley, D. (2000). Evaluation and management of foreign exchange and revenue risks in China's BOT projects. *Construction Management and Economics* , 18, 197-207.
- Wang, S. Q., Tiong, R. L., Ting, S. K., and Ashley, D. (1999). Political risks: Analysis of key contract clauses in China's BOT project. *Journal of Construction Engineering and Management* , 125 (3), 190-197.
- Ward, S., and Chapman, C. (2003). Transforming project risk management into project uncertainty management. *International Journal of Project Management* , 21 (2), 97-105.
- Warszawski, A. (1996). Strategic planning in construction companies. *Journal of Construction Engineering and Management* , 122 (2), 133-140.
- Wirba, E. N., Tah, J. H. M., and Howes, R. (1996). Risk interdependencies and natural language computations. *Engineering, Construction and Architectural Management* , 3 (4), 251-269.
- Yeo, K.T. (1990). Risks, classification of estimate and contingency management. *Journal of Management in Engineering* , 6 (4), 458-470.
- Zayed, T., Amer, M., and Pan, J. (2008). Assessing risk and uncertainty inherent in Chinese highway projects using AHP. *International Journal of Project Management* , 26, 408-419.
- Zeng, J., An, M., and Smith, N. J. (2007). Application of a fuzzy based decision making methodology to construction project risk assessment. *International Journal of Project Management* , 25, 589-600.
- Zhang, G., and Zou, P. X. W. (2007). Fuzzy analytical hierarchy process risk assessment approach for joint venture construction projects in China. *Journal of Construction Engineering and Management* , 133 (10), 771-779.
- Zhi, H. (1995). Risk management for overseas construction projects. *International Journal of Project Management* , 13 (4), 231-237.