A STUDY OF RISK MANAGEMENT TECHNIQUES FOR CONSTRUCTION PROJECTS IN DEVELOPING COUNTRIES

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ABSTRACT- It is important to manage the multifaceted risks associated with international construction projects, in particular in developing countries, not only to secure work but also to make profit. This research seeks to identify and evaluate these risks and their effective mitigation measures and to develop a risk management framework which the international investors/ developers/ contractors can adopt when contracting construction work in developing countries. A survey was conducted and twenty- eight critical risks were identified, categorized into three (country, market and project) hierarchical levels and their criticality evaluated and ranked. For each of the identified risks, practical mitigation measures have also been proposed and evaluated. Almost all mitigation measures have been perceived by the survey respondents as effective. A risk model, named Alien Eyes' Risk Model, which shows the hierarchical levels of the risks and the influence relationship among the risks, is also proposed. Based on the findings, a qualitative risk mitigation framework was finally proposed which will benefit the risk management of construction project in developing countries Risks have significant impact on construction projects in terms of its primary objectives.

Construction projects which are intricate in nature, uncertainty and risks in the same can develop from different sources. The record of the construction industry is not acceptable in terms of coping up with risks in projects. Risk management is a process which consists of identification of risks, assessment with qualitatively and quantitatively, response with a suitable method for handling risks, and then controls the risks by monitoring. This study proposes to apply the risk management technique which includes well - documented procedures for the one stop solution all types of hazards most likely to occur during any construction project Lifecycle Risk management is one of the nine knowledge areas propagated by the Project Management Institute.

Key word: Risk management, countries

I.INTRODUCTION

The development of infrastructure is one of the most important activities that can boost up the business of various industries, thereby increasing the gross domestic product (GDP) of the country. Construction projects are always unique and risks raises from a number of different sources. Risk is defined as any action or occurrence which will affect the achievement of project objectives. Risk management is a technique which is used in many other industries from, IT related to business, automobile, pharmaceutical industry, to the construction sector. Risks and uncertainties inherent in the construction industry are more than any other industries. Many industries have become more proactive about using risk management techniques in project. However, with respect to the construction industry, the same is not used commonly. Risk is an integral component of any project. Risk is present in all projects irrespective of their size or sector. No project is totally free from risks. If risks are not

properly analyzed and strategies are not trained to deal with them, the project is likely to lead to failures Risk can be defined as the event that negatively affects the project objectives such as time and schedule, cost, quality of work. Risk Management is the process of identifying the potential risk associated with risk and responding to those risks. Risk in any project is a choice rather than fate. According to the characteristic of the construction industry, this has high uncertainty, so it will occurmany risks during the construction phase and or operational building. Risk in construction has been the object of attention because of time and cost over-runs associated with construction projects. Risk is present in all the activities in a project; it is only the amount which varies from one activity to another.Risks and uncertainties inherent in the construction industry are more than other industries. The process of planning,executing and maintaining all project activities is complex and time-consuming. The whole process requires number of people with diverse skill sets and the coordination of a vast amount of complex and interrelated activities. The situation is made complex by many external factors. The track record of construction industry is very poor in terms of coping with risks, resulting in the failure of many projects to meet time schedules, targets of budget and sometimes even the scope of work. As a result, a lot of suffering is inflicted to the clients and contractors of such projects and also to the general public. Risk in the construction industry is perceived to be a combination of activities, which adversely affect the project objectives of time, cost, scope and quality. Some risks in construction processes can be easily predicted or readily identified; still some can be totally unforeseen. Construction risks can be related to technical, management, logistical, or sociopolitical aspects or can be related to natural disasters. In the domain of project management, some of the critical effects of risks are failure to achieve operational requirements and the required quality, non completionof the project within stipulated time and estimatedcost

II.LITERATUREREVIEW

Risk Analysis and Management in Construction Akin tola S Akintoye and MacLeod (Mar 1997) "Risk Analysis and Management in Construction" studied the construction industry perception of risk associated with its activities and the extent to which the industry uses risk analysis and management techniques with the help of a questionnaire survey of general contractors and project managers. The author concluded that risk management is essential to construction activities in minimizing losses and enhancing profitability. Construction risk is generally perceived as events that influence project objectives of cost, time and quality.

Integrated Methodology for Project Risk Management Alfredo del cano, P.E and M.Pilar de la Cruz, P.E (Dec 2002) "Integrated Methodology for Project Risk Management" suggested that generic project risk management process that has been particularized for construction projects. The process could also be adapted to the needs of other project participants. Any project risk management process must be tailored to the International Journal of Scientific & Engineering Research.

Bridge Management Policy Using Cost Analysis J.DeBrito And F.A.Branco(Mar 2006) "Bridge Management Policy Using Cost Analysis" This study helps to make the efficient use of resource to make the right decision for maintenance and rework in process if it is failed to maintain thethere will be some loss in structural failures, loss in time and loss of financial aspects.

Risk faced by Singapore firms when undertaking construction projects in

India Florence Yean YugLing and Linda Hoi (Dec 2006) "Risk faced by Singapore firms when undertaking construction projects in India" studied the risk that Singapore architecture, engineering and construction (AEC) firms face when working in India and investigated the risk response techniques adopted by them. The risk response techniques include having adequate insurances and careful planning and management.

Risk evaluation and realism E.C.Hambly, Feng Fice And E.A. Hambly (Nov 2009) "Risk evaluation and realism" This study helps in risk calculating the risk analyse technique by the fatality accident rate method. The realism states how the government is taking the necessary steps to repair and rework process related to the time, cost and politics.

Time and Cost Risk Analysis G.MilIer (Jan 2006) "Time and Cost Risk Analysis" This study helps how to control the time and cost risk analysis by computer aided simulation of project appraisal and its review. These simulations give the result and help to make the precautionary steps during the planning itself. pedro Maria Sanchez, Carr. Tijuana-Ensenada (Dec 2005) "Neural-Risk Assessment System for Construction Projects" studied the assessing the risk impacts and as well in forecasting the possible costs of these risks. Transforming the risk impact into money terms certainly is not an easy thing to do. Traditionally within construction companies, risk management has been adopted nevertheless; the work has been concentrated mainly in risk analysis.

III.ANALYSIS OF SURVEY RESULTSAND DISCUSSION

1)Evaluation of risk analysis techniques:

The findings from the survey indicate that a major portion of construction companies in Pakistan deal with project risks on basis of their experience, judgment and intuition. The reasons provided by the companies for not using risk analysis techniques are listed below:

a)The majority of risks are subjective and are related to contracts or construction processes. These risks are better dealt on the basis of previous experience.
b)Risk management techniques require valid data to be available, which is difficult to implement.
c)The clients seldom require risk analysis of construction projects. They expect the project management function to manage and mitigate risks.
d)Doubts are present related to the applicability of risk response techniques to construction industry.
e)The companies are unfamiliar with techniques of risk management.
f)The degree of sophistication involved in the techniques is unwarranted if compared with project size.

2)Evaluation of risk response practices:

The results of this research reveal that the two most utilized measures by Islamabad based contractors are risk elimination and risk transfer. The study also revealed that in case of the companies trying to eliminate risks, they either do not bid for a job or they bid at a very high price. Majority of contractors transfer the risk by subletting the contract. The general contractors use both risk transfer and risk elimination in their projects, but their preferred choice, in the event that expected loss of a risk is high, is to transfer the risk to a specialty sub-contractor. Although, the practice of risk transfer is accepted in the case when the other party has better capability of dealing with it, but the situations where all risks are transferred point towards lack of creativity and innovativeness. Some of the respondents interviewed for the study revealed that this lack of innovation leads to delays in projects, unacceptable quality and low productivity. Public sector organizations concerned with construction industry accept and reduce minor risks by contingency plans. in the literature (He, 1995; Chapman, 1997; Tahand Carr, 2001; Standards Australia/Standards New Zealand, 2004; PMI, 2004; Loosemore et al., 2006), the five main steps in the risk management process are, generally, risk planning, risk identification, risk analysis, risk response and risk monitoring and control. An effective implementation of a risk management system not only brings a higher level of awareness of the consequences of risk but also focuses on a more structured approach, more effective centralised control and better transfer of risk information between parties. It can reduce long-term loss expenses and project time overruns (Edwards, 1995). Risk management can help assess and ascertain the viability of a project to ensure that it is worthwhile (Smith, 2003). Statistical data concerning past projects can be used to model risks more effectively for future projects (Simister, 1994). However, it does not completely remove all risks from a project. It only reduces the probability of occurrence and induced impacts to ensure that the risks are managed in the most efficient and effective manner (Capper, 1995). Successful risk management should convert uncertainty to risk and convert risk to opportunity. The projectand organisationwould hence achieve more gains by maximising opportunity, minimising risk and reducing uncertainty. The first stage in the risk management process, risk planning, involves planning how to approach and perform risk management to ensure that the level, type and visibility of risk management are commensurate with both the size of the risk and the importance

of the project. The project objectives are established and the responsibilities are assigned to the relevant parties in the risk planning stage (PMI, 2004). Risk identification, the second stage in risk management, identifies potential risks by recognising, filtering and ranking the risks in a risk profile. According to Zou, Zhang and Wang (2007), risk classification is an integral part of risk identification. Risks of different types are placed in different categories by considering their predetermined characteristics (Aleshin, 1999). The third step is risk analysis, which captures all feasible options and assesses the various outcomes of any decision (Flanagan and Norman, 1993). There are three approaches used in risk analysis, qualitative risk analysis, semi quantitative risk analysis and quantitative risk analysis (Loosemore et al., 2006). The choice of approach depends on the type and size of the project, information available, the cost and time available, the expertise of the analysts, the extent of innovation and the ultimate use of the results (Smith et al., 2006). Qualitative risk analysis is a simplistic technique describing risks in linguistic variables, subjectively, making a quick assessment, or it may be of specific use in identifying attitudes to risk (Morledge, Smith and Kashiwagi, 2006; Godfrey, 1995). A risk-scoring matrix (or a probability/impact matrix) is a tool commonly used in qualitative risk analysis. Semi quantitative risk analysis makes a subjective assessment of the frequency of risk and an objective assessment of risk consequences (Mead, 2006). Additionally, quantitative risk analysis represents risks in mathematical form to quantify them in terms of performance in quality, time and cost (Morledge, Smith and Kashiwagi, 2006). Risk response, the fourth stage of risk management, is the establishment of a strategy to mitigate the potential threats and maximise the potential opportunities (PMI, 2004). Six typical risk responses are retention, reduction, control, sharing, transfer and avoidance (Loosemore et al., 2006; Kerzner, 2003). The selection of response must be appropriate to the significance of the risk; it must be Cheng SiewGohand Hamzah Abdul-Rahman 22/PENERBIT UNIVERSITI SAINSMALAYSIA cost effective and realistic with regard to the timing of the project; it also must be agreed upon by other involved parties. Risk retention involves acknowledging that a particular risk situation exists and making a conscious decision to accept the associated levelof risk, without engaging inany special efforts to control it (Kerzner, 2003). Risk reduction is an approach used to bring the probability and impact of the risk down below an acceptable threshold and risk sharing is principally achieved through a contractual mechanism to develop a sense of collective responsibility among the project stakeholders (Loosemore et al., 2006). Risk control does not attempt to remove the source of the risk, but seeks to reduce the risk itself (Kerzner, 2003). Risk avoidance is a refusal to accept the risk, or action taken to ensure that the risk is not going to happen. Risk transfer shifts and reallocates, along with ownership, from one party to another third party, without changing the total amount of risk or reducing the criticality of risk sources (Smith, Merna and Jobling, 2006; PMI, 2004). In the risk monitoring and control stage, it is essential to ensure that the desired effects of the implementation of risk responses are achieved throughout the project life cycle. Risk management documentation is reviewed and updated from time to time and the outputs of risk monitoring and control can provide lessons for future decision makers (Morledge, Smith and Kashiwagi, 2006). The effectiveness of risk response is evaluated on an on-going basis throughout the project to correct any inappropriateness of the implemented strategy and to realign it with the project objectives. Feedback is necessary to review the treatment plan. It may loop back to the risk identification stage, whenever new risks arise or risks change their nature during the course of theproject.

RESULTS

Risk factors on construction projects can be split into two major groups:

1.Internal risks, which fall within the control of clients, consultants andcontractors.

2.External risks, which include risk elements that are not in the control of keystakeholders.

The potential risk sub-factors were adapted from studies by Chapman and Ward [25], Tah and Carr [32], Perera et al. [40], Pinto et al. [51], Baloiand Price [63], Kartamand Kartam [66], Lahdenperä [67], Majamaa et al. [68], Mbachu and Nkado [69], Mitkusand Trinkūnienė[70], and Yang et al.[71].

In order to illustrate the respondents' opinions regarding the importance of analysed risk

factors, an average was calculated for each factor. Next, the Kendall coefficient of concordance W [72,73] was calculated to test the reliability of the responses, and significance testing was based on the Chi-square distribution at the 1% significance level. The W coefficients were calculated for each defined group of risk factors created by the analysis perspectives.

In both surveys, the respondents agree as regards the external risks impact and probability.Therespondents agree as regards the external risks impact, what can be judged by values W=0.183; $\chi 2$=34.7 (α=0.01), in the first survey; W=0.10; $\chi 2$=12.4 (α=0.01), in the second survey. The identified external risks according to their potential effect on construction project objectives were ranked. In the first survey, the top three important external risks identified are:

- Natural forces;
- Inflation and interest rate;
- Fiscal policy.

In the second survey, the top three important external risks identifiedare:

1.Fiscalpolicy;
2.Naturalforces;
3.Politicalcontrols.

Probability assessment of risks of the external project constrains is reflected in Fig. 1. Impact assessment of risks of the external project constrains is reflected in Fig.2

The risk management perceivers are the project participants, and a contractor is any entity which has the power to influence project decision making directly. Related to experience, only 11% of the respondents affirmed that they have experience in risk management. Most of them are project manager and have more than 15 years' experience; it proofs that the relationship between risk perception and experience of respondents. And even 34% of the respondents affirmed that they have no experience in risk management, while 55% of the respondents affirmed that they do not have enough experience in risk management. And 97% of the respondents answered that risks must be managed at the early stages of the construction project.

Some questions obtained in the surveys were left incomplete, especially in the section of open ended questions that asked for future suggestions or recommendations. A risk response table was created to examine the preferred risk treatment plan in addressing a unique risk. The respondents might have found Cheng SiewGohand Hamzah Abdul- Rahman 24/PENERBIT UNIVERSITI SAINS MALAYSIA some ambiguity and difficulty in understanding the risk response table because of the complexity of its matrix structure. The final response rate was 7.5%, i.e., 45 of the 600 questionnaires were returned. The responses show that 73.33% of respondents are from the private sector, 15.56% are from both government and private sectors and 11.11% are from the government sector. The majority of the respondents (56%) have worked in construction for five to15 years. Years of experience of respondents in rank order are 10 to 15 years (29%), five to 10years (27%), more than 20 years (20%), less than fiveyears (13%) and 15 to 20 years (11%).

In terms of the sources and providers of the data and information required in the risk analysis, the most frequently used technique is experiential or documented knowledge analysis with 92% of the respondents' agreement in the first survey, and 93% of the respondents' agreement in the second survey (Fig. 3). And the project documentation reviews, project team brainstorming, and analysis of other information resources are frequently used in the risk assessment. Comparison between the two surveys in terms of risk analysis showed a decrease in reviews of project documentation, from 63%inthefirstsurveyto47%inthesecond survey, as well as greater use of experts' judgement, from 26%in the first survey to 43% in the second survey, and project team brain-storming, from 45% in the first survey to 53% in the second survey, in the risk assessment.

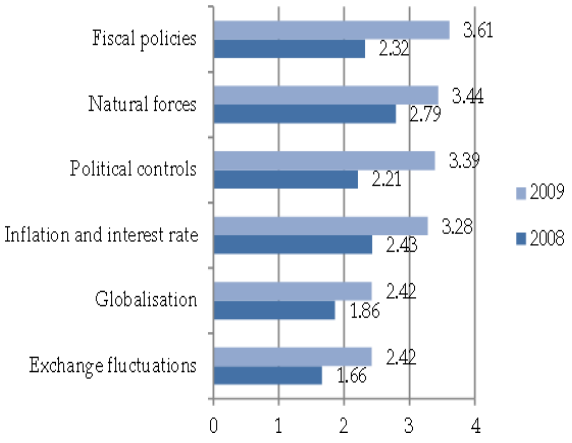

Figure 1. Probability assessment of external project risks

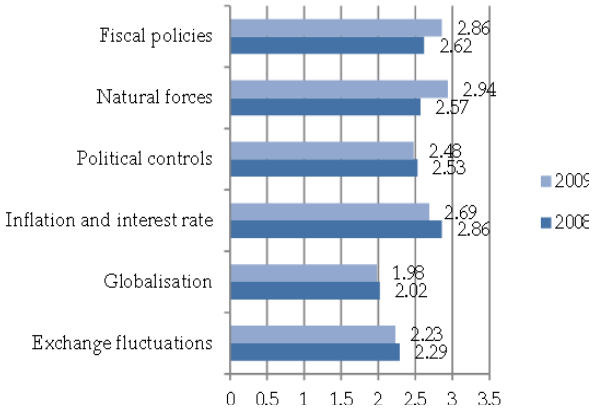

Figure 2. Impact assessment of external project risks

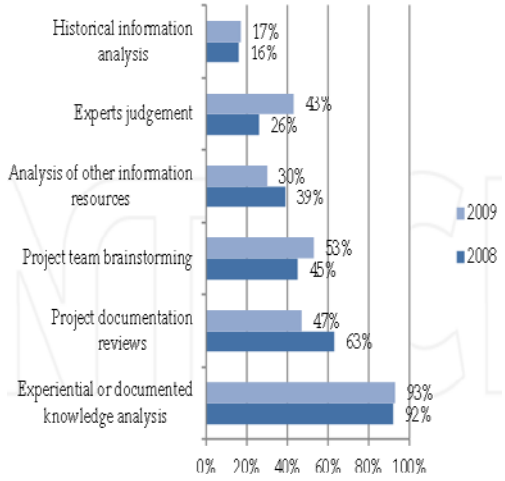

Figure 3. Risk analysis practices in construction projects

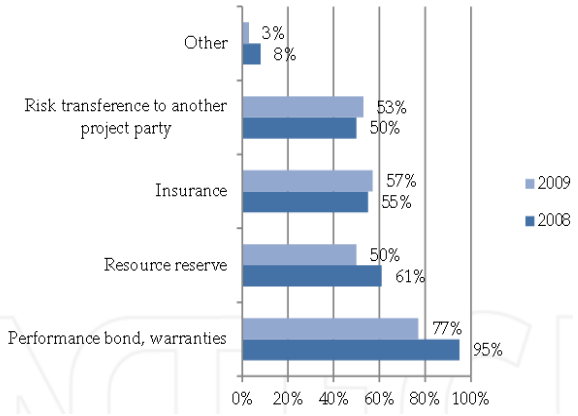

Figure 4. Risk response techniques employed for construction projects

In terms of the risk response tools and techniques, the most frequently used tool is performance bonds and warranties with 95% of the respondents' agreement in the first survey, and 77% of the respondents' agreement in the second survey (Fig. 4). And the some resource reservation, insurance, and risk transference to another project party are frequently used risk response techniques.

Comparison between the two surveys in terms of risk response tools and techniques showed a decrease of performance bond and warranties, from95% in the first survey to 77% in the second survey, and resource reservation, from 61% in the first survey to 50% in the latter survey; as well as greater use of risk transference to another party, from 50% in the first survey to 53% in the second survey, and insurance, from 55% in the first survey to 57% in the latter survey, for the risk responses.

In last survey (2010-2011), the respondents agree as regards the project level risks impact, what can be judged by values $W=0.54;\chi2=51.3(\alpha=0.01)$. As regards the assessment of the project level risks probability, respondents also agree what can be judged by values $W=0.51$; $\chi2=48.5$ $(\alpha=0.01)$. The identified project level risks according to their potential effect on construction project objectives were ranked. The top three important categories of internal risks identified are:

- Construction risks;
- Design risks;
- Project management risks.

Overall assessment of risks of the internal project risks is reflected in Fig. 5. Risk priority is utilized during response planning and risk monitoring. It is critical to understand the priority for each risk as it allows the project team to properly understand the relative importance of each risk.

No.	Condition
1	Season of the year
2	Human resources: skill and availability (concerns also subcontractors)
3	Quality and completeness of design documents
4	Quality of project and construction management systems
5	Labour conditions
6	Financial standing of project participants, project's financeconditions
7	Quality of the supply system
8	Site layout, site location
9	Project environment (economic, political, legal, geographic,labour market, suppliers etc.)
10	Equipment – quality and availability

Construction project conditions affecting project risk

IV. CONCLUSION

Formal risk analysis and management techniques are rarely employed by construction industry owing to the lack of experience and knowledge in the area. The industry also holds disbelief that these techniques are suitable to be employed in construction projects, much in the same manner as employed in other industries. The perception of risk by contractors and consultants is mostly based on their intuition and experience. The most utilized risk response measures are risk elimination and risk transfer. However, the respondents have revealed that these practices cause the problems of delays, low quality and low productivity inprojects.

An effective risk management process encourages the construction company to identify and quantify risks and to consider risk containment and risk reduction policies. Construction companies that manage risk effectively and efficiently enjoy financial savings, and greater productivity, improved success rates of new projects and better decision making.

Risk management in the construction project management context is a comprehensive and systematic way of identifying, analyzing and responding to risks to achieve the project objectives. The research results show that the Lithuanian construction company significantly differ from the construction companiesin foreign countries in the adoption of risk management practices. To management the risk effectively and efficiently, the contractor must understand risk responsibilities, risk event conditions, risk preference, and risk management capabilities.

The lack of experience makes it very difficult to change Lithuanian contractors' attitude towards risk management. Nevertheless, the construction companies need to include risk as an integral part of their project management. The risk management framework for construction projects can be improved by combining qualitative and quantitative methodologies to risk analysis.

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