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RISK MANAGEMENT IN CONSTRUCTION: A LITERATURE REVIEW

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Abstract - *Risk management in construction industry is a key for successful undertaking, running and completion of any construction project. It is an important field in construction industry and has gained more attention globally. Construction projects are facing a number of risks which affects project objectives mainly on time, cost and quality. This paper is based on review of essential literature based on Risk Management in construction.*

Key Words: **Project Risk, Risk management, Risk allocation, Construction project.**

1. INTRODUCTION

Risk management is central to any business regardless of size, activity or sector. It is essential in minimizing losses and maximizing profitability. Companies get into losses when they fail to identify and evaluate risk on time. Thus, Risk management is about looking ahead to identify further opportunities for avoiding losses.

'PMI 2000' defines Project Risk as an uncertain event or condition that, if occurs has a positive or a negative effect on a project objective. Risks have a significant impact on a construction project performance with respect to cost, time and quality (iron triangle).

'PMI 2000' defines Project risk management is the systematic process of identifying, analyzing and responding to project risks. As the size and complexity of the projects increases, the ability to manage risks in the construction has become a central element preventing unwanted consequences. Risks and opportunities are linked and there is no opportunity without risk related to them. Risks raises the value of project, generally higher risk brings better opportunity. So while dealing with the risks, project improvement should also be considered.

This paper deals with various aspects of risk management in construction, collected from published papers of various authors from different part of the globe.

2. LITERATURE REVIEW

Alfredo Federico et.al., (2014): One of the major roles undertaken by a project manager is the management of the risk of a project. However, this duty is particularly complex and inefficient if good risk management has not been done from the beginning of the project. An effective and efficient risk management approach requires a proper and systematic methodology and, more importantly, knowledge and experience. This paper addresses the problems of risk management in construction projects using a knowledge-based approach, and proposes a methodology based on a three-fold arrangement that includes the modeling of the risk management function, its evaluation, and the availability of a best practices model. A major conclusion of this research is the fact that risk management in construction projects is still ineffective due to lack of knowledge.

Amita Pawar et.al., (2017): Gaps and inconsistencies in the knowledge and treatment of construction and project risk are identified. The paper describes, on the basis of a questionnaire survey of general contractors and project management practices in Pune, the construction industry's perception of risk associated with its activities and the extent to which the industry uses risk analysis and management techniques. It concludes 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. Risk analysis and management in construction depend mainly on intuition, judgment and experience. Formal risk analysis and management techniques are rarely used due to a lack of knowledge and to doubts on the suitability of these techniques for construction industry activities.

C. Borysowich (2008): Most organizations are aware that risks do not appear on a linear basis and for this reason risk cannot be identified and measured in this way. Assessing and understanding the interrelation of risk and their associated correlated impact is the real challenge. These complex relationships require a different set of tools. Through the use of tools to simulate multiple risk scenarios and correlating risk interdependencies the organization can begin to build an effective map of their risk landscape. The goal of study was to understand the cumulative impact of risks on performance and value in order to select the appropriate mix between risk retention and risk treatments.

Franck Taillandier et.al., (2014): An efficient risk management is mandatory to project success. However, implementing such a management is complex because of the diversity and the dynamic nature of the risk. Moreover, each of the project stakeholders has his/her own risks; his/her own vision and his/her own action on the project and on risks. In this paper, we propose an agent-based model called SMACC to assess the impact of risks on the project. This model allows testing different risk mitigation strategies to measure their impact on the project.

Irem Dikmen et.al., (2013): Risk management paradigms exist as methodologies rather than systems which can fully support the risk management process. The existing risk management support tools are usually based on quantitative risk analysis whereas the other phases are carried out external to the software. Risk registers and risk assessment tools are proposed as decision support systems which can only be used at specific stages of a construction project for specific purposes such as time/cost estimation at the bidding stage, country risk assessment during international market selection etc. Moreover, the proposed risk management support tools usually do not foster integration of risk management activities between the parties involved in the construction supply chain, do not consider impact of risks on all of the project success criteria, and cannot handle subjectivity. The major objective of this paper is to make a critical review of existing risk management support tools and propose development of a risk management corporate memory coupled with a decision support tool for successful management of risk.

Josef Oehmen et.al., (2015): Risk management is receiving much attention, as it is seen as a method to improve cost, schedule, and technical performance of new product development programs. However, there is a lack of empirical research that investigates the effective integration of specific risk management practices proposed by various standards with new product development programs and their association with various dimensions of risk management success. Based on a survey of 291 new product development programs, this paper investigates the association of risk management practices with five categories of product development program performance: A. Quality Decision Making, B. High program stability; C. Open, problem solving organization; D. Overall NPD project success and E. Overall product success. The results show that six categories of risk management practices are most effective: 1.Develop risk management skills and resources; 2. Tailor risk management to and integrate it with new product development; 3. Quantify impacts of risks on your main objectives; 4. Support all critical decisions with risk management results; 5. Monitor and review your risks, risk mitigation actions, and risk management process; and 6. Create transparency regarding new product development risks. The data shows that the risk management practices are directly associated with outcome measures in the first three categories (improved decision making, program stability and problem solving). There is also evidence that the risk management practices indirectly associate with the remaining two categories of outcome measures (project and product success).

Lehtiranta et.al., (2007): The purpose of this paper is to identify the current developments of Risk Management in construction. The review targeted the three main levels of managing firms and public organizations, businesses, and projects. The 116 eligible concepts vis-à-vis managing risk, uncertainty, and complexity were found, whereof 49 (42%) are construction focused. The method can accommodate various assessments along selected dimensions. Some valuable insights are herein captured along the dimension of theoretical advancement from the three sub-dimensions, i.e. systemic holism, foresight, and human orientation. Along the dimension of practical applicability, the three sub-dimensions include simplicity, integration, and experience. Traditional RM approaches are typically straightforward and formal. Instead, many modern RM methods are less binding in formality and they usually assign more consideration to the human and environmental complexity of risks and to the characteristics of each focal entity (i.e. a firm, a business, or a project). Such modern RM concepts have been enlarged towards or coupled with two way uncertainty management concepts. In addition, a sense of foreseeing and proactive doing have gained the distinct recognition within many risk, uncertainty, and complexity concepts. The perception of the evolutionary trends is grounded on a qualitative comparison between our results and those of one previous review involving risk and RM research between the years 1960 and 1997. In the future, the complex challenges of globalizing, environmentally-friendly, multi-stakeholder, and energy saving construction imply that traditional, mechanistic RM concepts alone are not realistic anymore and efficient enough. It is herein posited that modern views will complement and advance greatly traditional, reactive approaches to risks. It is envisioned that traditional RM concepts will be complemented or replaced with modern, non-deterministic, integrated RM concepts.

Low Sui Pheng et.al., (2008) External risk management encompasses many areas such as finance, politics and national cultures, and there are many literatures that focus significantly on risk management in each area. Managing external risks are not unlike managing project risks and the same principles that are applied to project risk management may well be used to manage external risks. However, although external risk management is a critical success factor for many construction firms who have ventured out of their home countries, like project risks, this is often neglected by construction firms and construction firms generally either do not have sufficient knowledge pertinent to external risk management, or tend to overlook the effects that a lack of external risk management may have on their businesses. The objective of the study is to examine how construction firms attempt to manage external risks during the period that they venture into host countries. The study anchors on the external risk management practices of Chinese contractors that have ventured out of Mainland China into Singapore. A survey was conducted of all Chinese contractors in Singapore to gain a better insight into the external risk management practices which a typical Chinese contractor implements.

Martin Schieg et.al., (2010): By adopting risk management, savings potentials can be realized in construction projects. For this reason, for project managers as well as real estate developers, a consideration of the risk management process is worthwhile. The risk management process comprises 6 process steps. The integration of a risk management system in construction projects must be oriented to the progress of the project and permeate all areas, functions and processes

of the project. In this, particular importance is attached to the risks in the personnel area, for, particularly for enterprises providing highly qualified services, specialized employees are essential for market success.

Maytorena E et.al., (2004): Both the identification and analysis phases of the risk management process are considered the most important, for they can have a big impact on the accuracy of the risk assessment exercise. Currently it is assumed that construction project managers rely largely on experience to identify projects risks. These decisions, influenced by individual perception and attitudes, are made primarily under conditions of uncertainty. How individuals respond to risky or uncertain situations therefore requires an understanding of how individuals intuitively assess the situation they perceive, before expressing a response. The project interviewed fifty one construction project managers using Active Information Search (AIS) as a data collection method and cognitive mapping as a data capturing tool. Results suggest that the role of experience in the risk identification process is much less significant than is commonly assumed to be. By contrast, level of education and style of enquiry do play a significant role in risk identification performance.

Mehdi Ebrat et.al., (2013): Managers require a good understanding about the nature of risks involved in a construction project because the duration, quality, and budget of projects can be affected by these risks. Thus, the identification of risks and the determination of their priorities in every phase of the construction can assist project managers in planning and taking proper actions against those risks. Therefore, prioritizing risks via the risk factors can increase the reliability of success. In this research, first the risks involved in construction projects has been identified and arranged in a systematic hierarchical structure. Next, based on the obtained data an Adaptive Neuro-Fuzzy Inference System (ANFIS) has been designed for the evaluation of project risks. In addition, a stepwise regression model has also been designed and its results are compared with the results of ANFIS. The results show that the ANFIS models are more satisfactory in the assessment of construction projects risks.

Mike Mentis, (2015): This article considers threats to a project slipping on budget, schedule and fit-for-purpose. Threat is used here as the collective for risks (quantifiable bad things that can happen) and uncertainties (poorly or not quantifiable bad possible events). Based on experience with projects in developing countries this review considers that (a) project slippage is due to uncertainties rather than risks, (b) while eventuation of some bad things is beyond control, managed execution and oversight are still the primary means to keeping within budget, on time and fit-for-purpose, (c) improving project delivery is less about bigger and more complex and more about coordinated focus, effectiveness and developing thought-out heuristics, and (d) projects take longer and cost more partly because threat identification is inaccurate, the scope of identified threats is too narrow, and the threat assessment product is not integrated into overall project decision-making and execution. Almost by definition, what is poorly known is likely to cause problems. Yet it is not just the unquantifiability and intangibility of uncertainties causing project slippage, but that they are insufficiently taken into account in project planning and execution that cause budget and time overruns. Improving project performance requires purpose-driven and managed deployment of scarce seasoned professionals aided with independent oversight by deeply experienced panelists who contribute technical insights and can potentially show that diligence is seen to be done.

Nakhon Kokkaew et.al., (2014): In the construction of an infrastructure project, completion delay is one of the major risks to the financial outlook of an infrastructure project under construction. During the construction phase, if the project is delayed, project managers can take specific actions to shorten the duration of certain activities on the critical path in order to restore the project to its original schedule. However, not all management actions to shorten the duration of activities are cost-effective: the cost of reducing some activities' duration may exceed the savings. Risk that project managers cannot economically reduce through management feedback reactions should instead be transferred to third parties such as insurance companies that have risk pooling capacity. This paper present a novel way of managing completion delay risk through "dynamic risk insurance" by combining a technique known as the envelope method with a stochastic-based Monte Carlo method. Two important features of this implementation of dynamic completion risk insurance are (1) a stochastic risk premium between the contractor and the surety over the course of construction and (2) evolution of the risk premium as a function of management feedback reaction. Finally, two illustrative examples, a BOT road and a commercial building, demonstrate how the proposed model may be applied in practice. The new model of dynamic risk insurance presented in this paper may improve risk management practice in large-scale construction projects that are loaded with uncertainty.

Samer Ezeldin et.al., (2006): This paper presents a comprehensive methodology that addresses the risk identification and response methods for developing countries represented by Egypt. The paper is based mainly on the approaches used by large contractors either domestic or international. The investigation, via a comprehensive questionnaire survey, tries to identify the most critical and significant risks that face the contractors working in the Egyptian construction industry and their associated effectively employed risk mitigation/elimination measures. Twenty-nine (29) construction project risks are classified into six (6) main categories according to their type and hundred and forty (140 risk) mitigation/elimination measures are introduced to overcome the impact of risks under each of these risk categories. According to the collected data and the results of the statistical analysis procedures employed, the most critical risk encountered by the contractors working in the Egyptian construction industry are: 1)the financial inability of the client; 2)the

improper management of construction projects; 3)inflation and interest rates; 4)in-house cash shortage; and 5)Foreign exchange and convertibility. 101 risk response methods were found to be effective from the 140 methods introduced. The most commonly used risk response method was the risk reduction technique.

Shahid Iqbal et.al., (2015): Construction projects are facing a number of risks which have negative effects on project objects such as time, cost and quality. The study is based on findings of a questionnaire-based survey on risk management in construction projects in Pakistan, reporting the significance of different type of risk, ultimate responsibility for them and the effectiveness of some most common risk management techniques practiced in the industry. Two types of risk management techniques were considered: preventive techniques which can be used before the start of a project to manage risks that are anticipated during the project execution; and remedial techniques that are used during the execution phase once a risk has already occurred. The study revealed that financial issues for projects, accidents on site and defective design are the most significant risks affecting most of construction projects. As further reported, the contractor is responsible for management of most risks occurring at sites during the implementation phase, such as issues related to subcontractors, labour, machinery, availability of materials and quality, while the client is responsible for the risks such as financial issues, issues related to design documents, changes in codes and regulations, and scope of work. It demonstrate that the productions of proper schedule by getting updated data of the project and guidance from previous similar projects are the most effective preventive risk management techniques while close supervision and coordination within projects are the most effective remedial risk management techniques. The study recommends preparation of a proper schedule and good coordination during the implementation stage very important as they may help project managers to focus on critical areas for better management of projects in Pakistan.

Terry Lyons et.al., (2004): This paper provides the results of a survey of senior management involved in the Queensland engineering construction industry, concerning the usage of risk management techniques. These are described in comparison with four earlier surveys conducted around the world and indicate that: the use of risk management is moderate to high, with very little differences between the types, sizes and risk tolerance of the organizations, and experience and risk tolerance of the individual respondents; risk management usage in the execution and planning stages of the project life cycle is higher than in the conceptual or termination phases; risk identification and risk assessment are the most often used risk management elements ahead of risk response and risk documentation; brainstorming is the most common risk identification technique used; qualitative methods of risk assessment are used most frequently; risk reduction is the most frequently used risk response method, with the use of contingencies and contractual transfer preferred over insurance; and project teams are the most frequent group used for risk analysis, ahead of in-house specialists and consultants.

Wael Sharmak et.al., (2008): Numerous risks impact construction projects and cause changes in their management plans. Unfortunately, not all of them can be identified in advance. Hence, risk management in construction requires proactive as well as reactive treatment. Among the other risk management tasks, risk treatment requires a sound methodology to rapidly develop concrete change actions and alter the corresponding project management plans. In this paper, process modeling techniques are used to develop configurable treatment templates, which describe how treatment can change the schedule plan. Such templates can contribute in structuring configurable reference models which in turn can be tailored and assembled to form up-to-date project schedules. Risk data as a part of reference repository may serve as means of knowledge management by providing all available risk-related information as response to critical events.

3. CONCLUSIONS

Different aspects presented by various authors on project risk and risk management in construction are identified and analyzed. Risk management is a challenging task in the construction industry and is complex in its structure. It affects large number of participants who work together in the project. Project manager plays a major role in management of the project risk and rely on their experience to identify projects risks, which is influenced by individual perception and attitudes.

According to studies, it is found that financial issues of projects, accidents on construction sites, improper management of construction projects, defective design are some of the major risks that affect construction projects. Risk identification and risk assessment along with risk response and risk documentation constitutes an efficient risk management.

A major conclusion of this paper is that risk management in construction projects is still ineffective due to various reasons. Therefore, there is an urgent need for further research for improving risk management in construction sector which should employ sophisticated techniques yielding better result.

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