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A review of risk management process in construction projects of developing countries

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Abstract. In the construction industry, risk management concept is a less popular technique. There are three main stages in the systematic approach to risk management in construction industry. These stages include: a) risk response; b) risk analysis and evaluation; and c) risk identification. The high risk related to construction business affects each of its participants; while operational analysis and management of construction related risks remain an enormous task to practitioners of the industry. This paper tends towards reviewing the existing literature on construction project risk managements in developing countries specifically on risk management process. The literature lacks ample risk management process approach capable of capturing risk impact on diverse project objectives. This literature review aims at discovering the frequently used techniques in risk identification and analysis. It also attempts to identify response to clarifying the different classifications of risk sources in the existing literature of developing countries, and to identify the future research directions on project risks in the area of construction in developing countries.

1. Introduction

In order to have a better understanding of what we mean by risk, risk can be defined as exposure to loss/gain or the likelihood of an event of loss/gain multiplied by its corresponding magnitude [1]. Project risks are of two categories, known and unknown. Known risks are recognized and can be analyzed, which makes planning and preparing response possible. It's not possible to proactively unravel an Unknown risk. Therefore, to anticipate and provide a risk reserve becomes necessary [2]. Risk can be reduced, managed, transferred, shared or accepted but cannot be overlooked [3].

In construction perspective, risks are generally considered as incidences that influence the principal objectives of a particular project (time, cost, quality) [4]. As a result of its construction activities that are perceived to be unique, the construction industry is exposed to greater risks in comparison with other industries. It has unique features as: projects taken long periods, with processes that are complicated, financial intensity, environment that are abominable and organization structures that are dynamic [5]. Also, when dealing with risks, most construction industries are known for their poor reputation, this is because may projects do not meet their cost targets and proposed deadlines, which in turn adversely affects each of its participants (Contractors, clients the public and others) [6].

Risk management can be defined an organized and comprehensive method tailored toward "analysing", "identifying" and "responding" to risk factors in order to achieve the project goals[4]. Having a good understanding of risks allows the parties involved to take steps in order to reduce their

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negative impacts [7]. The lack of a project risk management approach that is effective has a lot of unpleasant effects on the project participants as a result of deficiency of actions to prevent the uncertainty and risks that are present in a project [8]. Risk identification and assessment is a crucial risk management process. It is not possible to manage all the risks in a construction project. However, it is important to focus on the vital risks. Attempting to identify all the risks can be a waste of time and counterproductive [7]. It was observed that, majority of decisions on construction risk management are done based on intuition, previous experience, and the manger's professional judgement. As a result of ignorance and doubts on the sustainability, formal methods available are not been applied for the activities of the construction [9].

In developing countries, construction projects are liable to a lot of unknown factors [10]. Numerous project challenges are prevented through the implementation of effective risk management in projects [11]. Various publications on risk management are available both online on the internet and in hard copies in books and journals, little information is known on the applications of risk management in practice, most especially in developing countries[12] and the process of risk management has not been adequately focused [11] . According to a study carried out by Bowers and Khorakian (2014), he is of the opinion that in most constructions industries in developing countries of the world, very little facts on successful implementation of risk management systems is known. Due to the minimal attention paid to risk management, the focus of researchers in developing countries has been on encouraging the use and application of risk management systems [13].

This paper shows extensively the result of the review of the published literature on risk management in construction industry, with a focus on developing countries. The focus of this research is on published peer reviewed academic journals, most especially in construction management. The primary goal of this paper is to discover the techniques in risk identification, analysis and respond, that is mostly in use, in other to clarify the different groups of risk sources in the existing literature of developing countries, and identify the directions for future research in construction project risks, in developing countries.

2. Risk management process in construction projects

Risk management can be defined as the systematic process of analyzing, identifying, and responding to projects risk. It consists of maximizing the chances and the impact of positive events while minimizing the probability and the impact of negative events, in other to meet the project objectives [14]. Risk management can be thought of as a decision-making process, and it entails having a full understanding of a known risk and/or necessary actions to reduce the effect and chances of the event of such risks, in other to reduce its complications and increase the chances of success [15]. There are three stages in the methods to managing risk in construction industry a) risk identification; b) risk analysis and evaluation; and c) risk response[16,17]. The term risk identification is refers to identifying and keeping records of the associated risks. Risk assessment on the other hand, means to examine the identified risks critically, refine the description of the risk, and making an estimate of their respective chances and effects on the project. The risk response refers to the identification, selection, evaluation, and the action to implement the project [18]. By making use of the risk management process, one can achieve a major improvement in the performance of the construction project management. The goal of risk management process is not to completely remove all project risks. Its aim is to produce an organized framework that will make management to manage project risks, most importantly the crucial ones, in a more efficient and effective way [16].

2.1.Risk identification

Risk identification can be defined as the process of analytically and constantly identifying, assessing and categorizing the initial importance of the risks related to construction projects [19] and the interrelationships that exists among these risks[20]. The idea of risk identification seems to be very popular and practiced [21]. It is of substantial value as the process of response management and risk analysis may only be implemented on recognized potential risks [16]. It could have effects on project

development and its success [2]. Failure in identifying potential risks can result into inadequacy in the whole process. This can in turn have critically effects on the resources available to the organization. Risk identification however helps organizations involved in risk management to: (a) identify the best and most crucial input data (b) have a better knowledge of the relevance of the process (c) identify risks and the effects they can have (d) provide information for those who make decisions [22].

With the aid of diverse tools and methods, risk identification process can be achieved [22]. These tools and techniques include: brainstorming, Delphi method, interview, cause analysis, SWOT analysis, and presumption analysis. The first four techniques relate with common techniques, but the last two techniques are used in particular to investigate larger scope of possible events [2]. Table1 shows the most four techniques are popularly being used to identify risks in developing countries when it comes to construction of projects [12,14,23,24]:

Table 1. Most techniques used to identify risks in developing countries.

Techniques	Description
Checklists	Know potential points that can fail in previous projects and thus is very helpful in risk identification. This allows project managers to know the risks present and makes them to be involved in the process of risk identification, which will ultimately lead to greater acceptance of any means implemented to minimize the risks.
Interviews with experts	Historical data analysis for projects that appear similar and examine similar past or present projects, risk analysis, lessons learned or project evaluations are other methods available for getting feedback about risks involved in a project.
Past experience	Checking historical data of past projects that are similar can only be useful in a limited number of conditions. Such systems are most often restricted in terms of their usability or important data that are stored.
Brainstorming	Can be of use for projects involving new risks, new management arrangements or for developing initial checklists. This may be useful in risk management workshops.

In previous studies, diverse sources of construction risk have being identified [25]. Various approaches have been proposed in the literature for classifying risk. The manager can better understand the nature of risks by categorizing the risks [26]. Risks can be categorized in various ways for different purposes as shown in table 2.

2.2.Risk analysis

Risk analysis is regarded as the procedure involving the critical evaluation of prospective risks, arranging them according to importance, and allowing the management team to select the important ones [7]. Risk analysis is the most tasking procedure in managing risk. This is due to the fact that it involves assessing the chances of the event of a risk and their outcomes on a project's objectives [36]. Its main aim is to evaluate risk by separating the unnecessary events, the chances of the unwanted event happening, and the size of such events [37]. Meaning that, it is the transitional process between identifying risk and its management. It includes uncertainty in a qualitative and quantitative manner to evaluate the potential effects of risk. The evaluation should largely focus on risks that have high chances or effects [16].

In risk analysis, two main approaches are broadly used. They are: qualitative risk analysis and quantitative risk analysis and sub-category semi-quantitative [24]. The choice of method depends on the following: the type and magnitude of the intended project, available information, the financial implication and time available, the experience of the analysts, the extent of innovation and the ultimate purpose of the results [15]. Quantitative approach is primarily based on probability spreading of risks.

However, if sufficient data are available it can provide objective results. Qualitative method on the other hand, is subject to personal experience, intuition and judgment. The outcomes can therefore significantly vary from one analyst to another. Consequently, the quantitative approach remains the preferred option by most practitioners [9].

Table 2. Risk identification categories in developing countries.

Classification of risks	Author
project level, country level, market level	[16]
Resource, productivity, design, managerial, payment, client, technical, subcontractors	[27]
Client, Consultant, Labour, Contract, Contractor, Relationship, Materials	[28]
project management, Engineering, execution, suppliers	[29]
Construction safety-related, construction management; engineering design, natural hazards, socio and economic	[30]
Legal, Physical, design, political, fanatical, environmental, Logistics, Management, construction	[31]
Quality related, Environment related, Safety related, Cost related, Time related	[32]
Economic-financial and political, Technical and contractual, Managerial, External and site condition	[33]
Internal (Owners, Contractors, subcontractors, Designers, Suppliers), External (Social & Cult, Economic, Political, Natural, others).	[34]
Health and safety risks, Contractual risks, Financial risks, Design risks, Management risks, Construction risks, External risks	[35]

The core qualitative analysis techniques are: brainstorming, expert judgment; cause and effect diagram; checklists; Delphi; Event Tree Analysis (ETA; Risk Breakdown Matrix (RBM); risk data quality assessment. While the core quantitative techniques are: decision tree analysis; expected monetary value; Fault Tree Analysis (FTA); fuzzy logic; probability distributions; sensitivity analysis/tornado diagram[4, 38]. Also, risk analysis techniques use computer-based simulation tools such as: Monte Carlo simulations and system dynamics applications for PRM [35].
For construction projects, wide research has been done in the area of risk management. Main summary of these attempts are the identification of the project goals related risks and the project phase related risks. While these recognized risks relates to diverse construction projects in the context of different countries, they are all of great importance in directing the risk management research and practice for the Chinese construction industry. Table3 shows the most risk analysis techniques used past research in developing countries.

2.3.Risk response
Acceptable mitigation steps of treating risk must be employed once the project risks have been known and analysed. These mitigation steps are based mostly on the nature and potential consequences involved in the risk. The main objective is to increase the level of control of risk, reduce the negative impact of the risk and remove as much as possible the potential impact. Measure becomes more effective when there is more control of one mitigation measure on one risk [16]. Six distinctive risk responses are retention, reduction, control, sharing, transfer and avoidance as it is being detailed in table 4. The choice of response must correspond to the importance of the risk; it should be financially cost effective and realistic with regard to the project timing; it also must be accepted by other parties involved [15].

Table 3. Most risk analysis techniques used in developing countries.

Technique	Description	Author
Risk matrix	Risk classification into a limited number of categories	[39]
Monte Carlo simulation	Aggregate the combined effects resulted from uncertain parameters. Precise experimental statistical data. Computationally expensive	[35]
AHP	Risks events are ranked based on pairwise comparisons. Limited to a few number of pairwise comparisons	[17]
Fuzzy logic assessment	Useful where probabilistic data are absent. Not as precise as probabilistic methods	[40]
FMEA	Identify critical risk events. Only quantify one consequence in a particular time	[41]
Expected Monetary Value Analysis	This looks at the likelihood part of the system states and is based on a gain matrix	[12]
Expert judgment	Based on advice of a professional to analyse the failure rate and chances of success of the total project	[12]

Table 4. Risk management responds [4, 15, 23].

Techniques	Description
Risk retention	Involves considering that a particular risk situation exists and making a conscious steps to accept the level of risk, without engaging in any special efforts to control it.
Risk reduction	An approach adopted to bring the chances and effects of the risk down below a threshold that's acceptable.
Risk sharing	Principally obtained through a contractual mechanism to develop a sense of collective responsibility among the project stakeholders.
Risk control	Does not seek to stop completely the source of the risk, but takes steps to reduce the risk present
Risk avoidance	A refusal to accept the action taken or risk, to ensure that the risk is not going to continue.
Risk transfer	Shifts and changes, along with ownership, from one party to another third party, without changing the total amount of risk or reducing how crucial the risk sources are.

In this phase available options and actions are developed to promote opportunities and to decrease threats to the project objectives. It appears that each party involved in the contract should accept some level of risks, be fully aware of its own share of risks and put into consideration the losses [43]. The significance of awareness of the allotted risks for each party involved and successive preparation necessary for dealing with the risks is imperative and contributes to the success of projects [32]. Based on the degree of severity, there are numerous paths that can be followed to respond to risks. [14].

In developing countries, the method of risk respond frequently takes preventive (avoidance) techniques and remedial techniques as [1, 44] Used in their studies:

- Preventive risk management technique: The best decision to make in managing risk is to eliminate it so that it can be avoided at the stage of planning. Early consideration of risks before the start of a project and making effective plan for it are preventive management approach used during the planning stage to avoid or minimize a necessary risk.

- Remedial risk management technique: Remedial risk management methods are required to minimize the effects of risk and totally stop them if possible. This is because it is obvious that all risk cannot be managed during the planning stage and some risks are going to happen during the operation phase. Therefore, remedial method becomes important.

According to Wang and Chou [45], data obtained of the findings, contractors usually use three means to transfer risk in project construction: through insurance to insurance companies, through modifying the contract terms and conditions to client or other parties, through subcontracting to subcontractor.

3. Conclusion

The method of risk management is sparingly applied because of fewer know-how and awareness among the people. The track record is also small when handling risks in projects, resulting in it affecting the project goals. This paper shows an elaborate review of the risk management process (analysis, identification and respond) of published literature. It is mainly focused on the development of risk process most especially in developing countries of the world. Diverse contributions towards investigating various techniques are also discussed.

In past studies, different sources of construction risk have being identified. Various approach for classifying risk has been recommended in the literature. Management can understand better the nature of risks by categorizing the risks. There are various ways for categorizing risk to achieve different goals. To some, in construction projects, risk can be categorized largely into external risks and internal risks while others classify risk in more elaborate categories. These categories depend on the situation of the project and the surrounding environment.

All the evaluated methods are important for making decisions, and all decision-making suggests considering the risks of the alternatives. Risk is better measured or more specifically measured than others in some of the methods, but they all have things in common: there is need for a medium to high level of experience, time resources and detailed data. Even though the quantitative approach uses more resources than the qualitative approach, they are also more complex. This paper has reviewed the actual practice of risk analysis as published in the literature. The findings refer to a weighty dependence on practical experience and professional judgment when assessing construction risk. Unfortunately, there is still a wide gap between theory and practice. However, the existing body of knowledge establishes a firm basis from which to investigate new options that can bridge the existing gap between theory and practice.

It is impossible to capture risk categories, the interdependencies between risks, the interaction with the complex project environment and the management team experience in improvement proposals. While project management literature is rich in papers addressing risk management, few papers have researched the actual practice of risk assessment and investigated the practitioners' points of view regarding the available tools. That has been established in the review that the literature lacks a comprehensive risk assessment framework which considers the different types of effects of risk on various project objectives concurrently. Such a framework is important for obtaining realistic risk assessments which is the first approach towards obtaining a realistic project risk level.

The current status of risk management approach of the construction industry of developing countries of the world, generally attempts to avoid or shift these risks, which results in the risk in the risk management practices of a large number of the industries being reactive and informal to deal with. Nevertheless, presently the awareness about risk management is on-going and a there is an intense desire to learn from past mistakes.

This research work is considered a fraction of a comprehensive research project that is aimed at re-evaluating construction risk management process and facilitating the elimination of the existing gap between theory and practice of construction risk in developing countries of the world.

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