

## Risk Management in Construction Projects

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### ABSTRACT

*Construction industry is highly risk prone, with complex and dynamic project environments creating an atmosphere of high uncertainty and risk. The industry is vulnerable to various technical, sociopolitical and business risks. The track record to cope with these risks has not been very good in construction industry. As a result, the people working in the industry bear various failures, such as, failure of abiding by quality and operational requirements, cost overruns and uncertain delays in project completion. In light of this, it can be said that an effective systems of risk assessment and management for construction industry remains a challenging task for the industry practitioners. The aim of the this research is to identify and evaluate current risks and uncertainties in the construction industry through extensive literature survey and aims to make a basis for future studies for development of a risk management framework to be adopted by prospective investors, developers and contractors.*

**KEY WORDS:** *Project management; risk management; risk analysis; construction;*

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### I. INTRODUCTION

The financial and economic crisis has had an adverse impact on the Lithuania's economy and construction industry. The GDP of Lithuania grew slightly in 2010, in contrast to a decrease of 14.7% in 2009. Lithuania's GDP increased from 1.3% in 2010 to 4.6% in 2011. Annual GDP growth decreased from its highest point of 6.7%, reached in the third quarter, to 4.4% in the last quarter of 2011 [1,2]. Some industries, such as construction; trade, transport and communications; and the industry sectors were most affected by the crisis. In 2010, the gross value added within the construction sector decreased by 43.3%, and in the trade, transport and communications sector – by 16.6%. In 2011, a positive change in the gross value added was observed in all groups of economic activities. The largest growth in the gross value added was observed in enterprises engaging in construction (by 15%) and trade, transport and communication services (7.3%) [1,3]. The construction sector, one of the engines of economic growth in Lithuania over the last decade, is now facing with serious challenges as companies' closures, rising unemployment, and postponed or even cancelled investments. These events also have changed the clients' and construction companies' behaviour. A reduced demand and shortage of orders dramatically increased a competition between companies of the construction sector. This increased pressure to improve quality, productivity and reduce costs, and the need for project strategies and management that can appropriately and effectively manage project risk.

Risk management is one of the nine knowledge areas propagated by the Project Management Institute [4]. Furthermore, 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 [5,6]. The benefits of the risk management process include identifying and analyzing risks, and improvement of construction project management processes and effective use of resources. Construction projects can be extremely complex and fraught with uncertainty. Risk and uncertainty can potentially have damaging consequences for the construction projects. Therefore nowadays, the risk analysis and management continue to be a major feature of the project management of construction projects in an attempt to deal effectively with uncertainty and unexpected events and to achieve project success.

Construction projects are always unique and risks raise from a number of the different sources [7]. Construction projects are inherently complex and dynamic, and involving multiple feedback processes. A lot of participants – individuals and organisations are actively involved in the construction project, and they interests may be positively or negatively affected as a result of the project execution or project completion. Different participants with different experience and skills usually have different expectations and interests. This naturally creates problems and confusion for even the most experienced project managers and contractors.

Cost of risk is a concept many construction companies have never thought about despite the fact that it is one of the largest expense items [8]. Risk management helps the key project participants – client, contractor or developer, consultant, and supplier – to meet their commitments and minimize negative impacts on

construction project performance in relation to cost, time and quality objectives. Traditionally, practitioners have tended to associate construction project success with these three aspects of time, cost and quality outcomes.

The current economic downturn and challenges in a highly competitive Lithuania's construction sector require contractors to manage risks by themselves. This paper reports the research that aims to examine the risk analysis and risk management practices in the Lithuanian construction companies.

Project management is the science which applies skills, tools and techniques to fulfill project activities in a way that the expectations and requirements of stakeholders are fulfilled or exceeded. Project risk management is an integral part of the process which aims at identifying the potential risks associated with a project and responding to those risks. It includes activities which aim to maximize the consequences associated with positive events and to minimize the impact of negative events. It is believed generally that risk in an environment is a choice rather than fate, and the inherent uncertainty in the plans can affect the desired outcome of achieving project and business goals[8]. 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 a myriad 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 completion of the project within stipulated time and estimated cost[9,10].

The current study is focused on concepts of risk management and will cover the related literature on the topic, development of a survey questionnaire and suggestions related to risk management practices in construction industry.

## **II. RESEARCH SIGNIFICANCE AND OBJECTIVES**

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 a country. Due to this fact countries stress on infrastructure development and provide finances for the same in their short term and long term financial plans. The vastness of construction projects leaves a lot of scope for various environmental, socio political and other unforeseen problems during conceptual phase, land expropriation, and execution leading to time and cost overruns in projects and compromise in quality. The cost overruns can be of huge magnitude in a project involving a large amount of money[7,8]. The loss of services given by the project during the time in which the project overruns can be enormous if put into monetary terms. Hence, to reduce the losses, efficient management of a construction project is required. Application of various project management techniques have to be made from the conception to the completion stage, which include managing various risks associated with the project in its every stage. Risk management becomes an important part of project management. The construction industry, perhaps more than most of other industries, is overwhelmed by risks. If these risks are not dealt with satisfactorily there is a maximum likelihood of cost overruns, time delays and low quality, resulting in dissatisfaction of clients and public. On working site, like other developing countries less importance is given to this aspect of project management. The basic aim of the current research is to identify and assess the current risks and uncertainties in the construction industry around the globe and to evaluate the current state of risk management practices and make a basis for future studies for development of a framework for effective risk management which can be adopted by prospective foreign and local investors, developers and contractors[9].

## **III. CONCEPTS OF RISK ANALYSIS AND MANAGEMENT**

The concept of risk is multi-dimensional. In the context of construction industry, the probability that a definite factor detrimental to the overall project occurs is always present. A lack of predictability related to the consequences of a planning situation and the associated uncertainty of estimated outcomes leads to the consequence that results can either be better than expected or can be worse. In addition to the different definitions of risks, risks can be categorized for different purposes as well. The broad categories of construction risks are external risks and internal risks; while some other categories curtail risks as political, social and safety risk etc.

### **3.1. Project Risk**

Risk management in a project encompasses the identification of influencing factors which could negatively impact the cost schedule or quality objectives of the project, quantification of the associated impact of the potential risk and implementation of measures to mitigate the potential impact of the risk. The riskier the activity is, the costlier will be the consequences in case a wrong decision is made. Proper evaluation and analysis of risks will help decide justification of costly measures to reduce the level of risk. It can also help to decide if sharing the risk with an insurance company is justified. Some risks such as natural disasters are virtually unavoidable and affect many people. In fact, all choices in life involve risks. Risks cannot be totally avoided but with proper management these can be minimized.

### **3.2. Determination of Risk**

There are two methods to determine risks in a project, namely the qualitative and quantitative approach. The quantitative analysis relies on statistics to calculate the probability of occurrence of risk and the impact of the risk on the project. The most common way of employing quantitative analysis is to use decision tree analysis, which involves the application of probabilities to two or more outcomes. Another method is Monte Carlo simulation, which generates value from a probability distribution and other factors. The qualitative approach relies on judgments and it uses criteria to determine outcome. A common qualitative approach is the precedence diagramming method, which uses ordinal numbers to determine priorities and outcomes. Another way of employing qualitative approach is to make a list of the processes of a project in descending order, calculate the risks associated with each process and list the controls that may exist for each risk.

### **3.3. Factors affecting Risk**

Several factors expose projects to normal than higher risk.

- a) **History:** Newer projects pose more risk because the process has not been refined with the passage of time. If a project of similar nature has been done many times before, then the likelihood of success with the current project is also enhanced.
- b) **Management Stability:** Management stability means that the whole management team shares the same vision and direction, thereby leading successful achievement of goals. If the management is unstable then it can lead to unrealistic and impractical schedules for the project and inefficient use of resources.
- c) **Staff expertise and experience:** In the event that the members of a project team lack the direct working knowledge and experience of the area, there is a likelihood of time delays, estimated cost upsets and poor quality.
- d) **Team Size:** In case of large teams, the probability of problem occurrence increases due to the team size. One of the reasons can be the difficulty of communication due to the large team size.
- e) **Resource Availability:** If the availability of resources is easy, the probability of responding to problems in real time also increases. For example, easy availability of money makes securing human, material and equipment resources easy on an as needed basis. However, an abundance of resources does not provide guarantee against risks, all it does is to equip the project team with the tactics to respond to risks.
- f) **Time Compression:** In case of highly compressed time schedule, the risks are magnified in the project. When more time is available, more flexibility is present in the project and there is an opportunity to mitigate and reduce the impact of occurring risk.
- g) **Complexity:** In case of a highly complex or sophisticated project, the opportunity of a mistake or a problem is also enhanced.

### **3.4. Types of Risks**

Risks can be associated to technical, operational or business aspects of projects. A technical risk is the inability to build a product that complies with the customer's requirement. An operational risk arises when the project team members are unable to work cohesively with the customer. Risks can be either acceptable or unacceptable. An unacceptable risk is one which has a negative impact on the critical path of a project. Risks can either have short term or Long term duration. In case of a short term risk, the impact is visible immediately, such as a requirement change in a deliverable. The impact of a long term risk is visible in the distant future, such as a product released without adequate testing.

Risks can also be viewed as manageable and unmanageable. A manageable risk can be accommodated, example being a small change in project requirements. An unmanageable risk, on the other hand, cannot be accommodated, such as turnover of critical team members. Finally, the risks can be characterized as internal or external. An internal risk is unique to a project and is caused by sources inherent in the project; example can be the inability of a product to function properly. Whereas, an external risk has origin in sources external to the project scope, such as cost cuts by senior management.

Risks associated with the construction industry can be broadly categorized into:

**a) Technical risks**

- Inadequate site investigation
- Incomplete design
- Appropriateness of specifications
- Uncertainty over the source and availability of materials

**b) Logistical risks**

- Availability of sufficient transportation facilities
- Availability of resources-particularly construction equipment spare parts, fuel and labor

**c) Management related risks**

- Uncertain productivity of resources
- Industrial relations problems

**d) Environmental risks**

- Weather and seasonal implications
- Natural disasters

**e) Financial risks**

- Availability and fluctuation in foreign exchange
- Delays in Payment
- Inflation
- Local taxes

**f) Socio-political risks**

- Constraints on the availability and employment of expatriate staff
- Customs and import restrictions and procedures
- Difficulties in disposing of plant and equipment
- Insistence on use of local firms and agents

**3.5. Common sources of risk in construction projects: The common sources of risks in construction industry are listed below**

- Changes in project scope and requirements
- Design errors and omissions
- Inadequately defined roles and responsibilities
- Insufficiently skilled staff
- Subcontractors
- Inadequate contractor experience
- Uncertainty about the fundamental relationships between project participants
- New technology
- Unfamiliarity with local conditions

**3.6. Advantages of Risk Management: Following are Advantages of Risk Management**

- a) Achievement of objectives
- b) Shareholders reliability
- c) Reduction of capital cost
- d) Less uncertainty
- e) Creation of value

**3.7. Limitations of Risk Management**

In the event of improper assessment of risks, important time can be wasted in dealing with risk losses which are unlikely to occur. If too much time is spent on the assessment and management of unlikely risks, then important resources can be diverted which otherwise could have been very profitable. Unlikely events can occur, but if the likelihood of the risk occurrence is too low, then it is better to retain the risk and deal with the result if the risk in fact occurs.

#### **IV. LITERATURE SURVEY**

A lot of researches have been undertaken in the field of risk management in construction industry in the past. Conclusive remarks of the few are narrated as follows:

- 1) According to Akintoye and Macleod, risk analysis and management in construction industry is dependent on three factors; experience, judgment and intuition of team members. Unfortunately, formal activities to analyze and manage risk are rarely used in construction industry. The main reason for this is the ignorance of project teams towards such techniques and the associated myths that these techniques are unsuitable to be used in the construction industry[11].
- 2) Uher and Toakely studied cases from Australian construction industry where risk management was used in the conceptual phase of project development. They found that although a majority of respondents had familiarity with risk management processes and techniques; but despite their willingness to adapt these techniques, they were rarely employed in the conceptual phase of projects.
- 3) In a survey on international construction joint ventures by Lei Bing three main groups were made to identify risk factors; external, internal and project specific. The study examined some cases where risk mitigation measures were used effectively, for risk management, by construction professionals in East Asia. An international survey of contractors revealed that the most critical risk factors existed in the financial aspects of joint ventures, government policies, economic conditions, and project relationships. When a local company enters a foreign construction market by forming a joint venture with a foreign company, risks could be reduced by a careful selection of the partner and by a careful drafting of the contract agreement. The right staff and sub contractors must be chosen, good relationships must be established and fair construction contracts be secured with the clients.
- 4) Hastak and Shaked conducted a study in which they made three broad categories of construction risks; project, market and country level risks. Country risks are associated with macroeconomic stability of the country and are linked with the monetary and fiscal policy of the country and the resistance of the country against economic variability. Market level risks arise from foreign risks, include technical advantage of the firm over local competitors, availability of construction related resources and government support at both local and foreign level towards construction industry. Project level risks are specific to the project activities, and they include improper project design, safety measures for construction site, constraints of logistics, improper control of quality and environmental protection etc[3,10].
- 5) The study by Wand and Dulami identified twenty eight risks related to construction projects in developing countries. They categorized the risks into three levels; country, market and projects. Twenty two risks were deemed as critical or very critical based on a seven degree rating scale. The top eleven critical risks are (in no particular order); termination of joint venture, influence of government on disputes, policies of government, interest and inflation rates, corruption, cost overruns, political instability of the country, credit worthiness of local partner, enforcement of justice, changes in law and permit approval. The three types of risks have precedence in terms of criticality over one another; country risks being most critical, project risk being least critical of the three and market risks lying somewhere in the middle. For identified risks, practical measures of risk mitigation were found to be effective by the respondents, using a seven point rating scale. The respondents suggested that in order to effectively mitigate a task, the measures leading to higher effectiveness should be prioritized in implementation. Since the risks at higher hierarchy level are more critical, risk mitigation measures should also make use of this prioritization and risks at higher level (i.e. country and market level) must be mitigated before moving on to risks at lower level i.e. project risks.
- 6) Ling and Hoi investigated the risks faced by Singapore based architecture, engineering and construction (AEC) firms in India. They also investigated the techniques used for risk response by these firms. Their in-depth interviews with Singaporean experts working on AEC projects in India revealed that the main risks faced by AEC firms were; huge differences of culture between the expatriates and Indians, exchange rate of currency and its fluctuations, high financing cost, political and social risks. The techniques used for responding to risks were to obtain effective insurances and carefully plan and manage all risk response activities[11].

#### **V. QUESTIONNAIRE STRUCTURE**

Risk factors for this study are classified into eight categories namely:

- 1) Financial risks
- 2) Legal risks
- 3) Management risks
- 4) Market risks
- 5) Policy and political risks
- 6) Technical risks
- 7) Environmental risks

8) Social risks

## **VI. ANALYSIS OF SURVEY RESULTS AND DISCUSSION**

### **6.1. Evaluation of Risk Analysis Techniques**

The findings from the survey indicate that a major portion of construction companies 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.

### **6.2. 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 practise 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 repondent 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.

## **VII. CONCLUSION**

Formal risk analysis and management techniques are rarely employed 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 in projects.

## **VIII. RECOMMENDATIONS**

Majority of contractors and construction managers in construction industry are unaware of formal risk management techniques. In light of this finding, it is imperative to educate these professionals about risk management, and thus a formal and informal system of risk management training needs to be developed. Graduate level education in construction project management should be used to provide formal education on the topic. Informal education could be provided by career development programs and trainings, like risk management awareness programs. Such trainings can be organized by academic institutions or professional organizations such as Engineering Council, Institute of Engineers, public sector organizations and engineering universities. Providing such education will yield long term benefits and will be considered as a step in the right direction.

Further researches in this area are welcome and can be done to develop a generic risk management model for construction industry at both global and national level. Such model can help contractors in the correct identification and classification of risk as either controllable or uncontrollable. It can also help them in the correct measurement of impacts of risks and probabilities of risk occurrence. In addition to this, the model could also help the contractors in deciding under different circumstances when to avoid risks, retain them, try to reduce them by taking preventive steps or transfer them to a third party which could handle them in a better manner. Such a model will definitely lead to an increase in profitability and help the companies, employing it, in maintaining a competitive advantage.

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