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Construction Risk Identification and Assessment

KEYWORDS: Risk Identification, Risk Identification, Relative Important Index

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ABSTRACT *Risks are unavoidable in almost every construction project. Risks have a significance influence on successful & smooth completion of a construction project, whether it is building projects, civil works or any other type of construction works. The present research aims in identifying risk factors that effects the smooth completion of the project. A total of 95 risk factors were identified and listed under nine subgroups. Based on the risk factors questionnaire was prepared and was filled by ten contractors, ten owners, ten project management experts, having wide experience in the construction field. The result gives top ten risk factors which is analysed using Relative Important Index (RII). The research also concludes that there is a strong correlation between Consultant Specific (CNS) and Project Manager Specific (PMS) having Pearson Coefficient of 0.886, which is with the aid of Statistical Product & Service Solution (SPSS).*

1. INTRODUCTION

Construction industry is highly risk prone, with complex and dynamic project environments creating an atmosphere of high uncertainty and risk. Over the past decade, many construction projects have experienced large deviations in terms of project scope, cost overruns, schedule delays and quality issues resulting into unsuccessful project events. The current trend in the construction industry is toward increasing project size and complexity, both of which result in greater levels of risk and uncertainty (Abdelgawad&Fayek, 2011). Therefore, managing project risk of any construction projects leads to successful project completion.

Occurrence of risks and uncertainties in the construction industry are more than any other industries. The process of planning, scheduling, executing and monitoring all construction activities is complex and time-consuming hence, the amount of risk involved in all such construction activities varies from one activity to another. The whole this process requires a numerous amount of manpower with diverse skill sets and the coordination among themselves and support from the top management. The track record of construction industry is very poor in terms of managing 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, in general conflicts arises between clients and contractors.

Therefore, an attempt is made in this study to identify risk factors which effects the smooth completion of the project. On the basis of literature review and inputs from various project experts risk factors have been identified and grouped under various categories.

2. Background & Objective

The construction industry has gained enormous amount of importance in the recent times because of the opening up opportunities in both international and private sector (Subramanyan,Sawant& Bhatt, 2012). With the arrival of megaprojects for infrastructural development, has accelerated the growth of using modern construction equipment's and technologies. In this scenario, Risk management is one such important measure which needs more attention during planning and execution phase of the project.

The objective of this study is to identify risk factors which influence the smooth completion of any project. Statistical Product & Service Solution (SPSS) is used in performing correlation analysis.

3. Literature Review

3.1Definition of Risk & Risk Management

PMBOK defines "risk" as an uncertain event or condition that, if it occurs has a positive or negative effect on at least one or more project objective, such as time delays, cost overruns, project scope or quality issues. A risk will have one or more impacts if it occurs and may have one or more causes. Al-Bahar (1990) and Crandall defined risk as uncertainty of any events that which occurs has a negative or positive affect on the project objective. Risk management is a stepwise procedure involving risk identification, classification, analysis and assessment.

3.2. Construction Risk Management- Models suggested by Researchers

A number of risk management models have been suggested in the literature. Al-Bahar(1990) and Crandall (1990) proposed a Construction Risk Management Model (CRMS) a systematic tool, which helps contractor to identify, analysis and manage construction risk. Cano and Cruz (2002) proposed a hierarchical, structured, Flexible and a generic Project Risk Management (PRM) process, which is particularised for contractor and consultant. It is concluded that any companies which undertakes highest level of risk have to plan for a rigid PRM approach, which must be presented with a flexible methodology based on their organisation and environment. An empherical study on importance, application, status and barriers of risk management in Chinese construction industry reveals that inadequate system for risk management and lack of joint mechanism is the key barrier for the failure of risk management as cited by Tang, Qiang, Duffield, Young and Youmei Lu (2007). Fuzzy Reliability Analyzer (FRA) was developed by Abdelgawad andFayek (2011) which allows the risk analyst to rank the probability of occurrence of basic events linguistically. Many research have been carried out using Fuzzy Analytical Hierarchy Process (AHP) to establish risk assessment model. AHP allows to understand the overall project risk which is the function of significance level of risk and the probability of occurrence of risk factor (Subramanyan, Sawant& Bhatt, 2012).

3.3. Construction Risk Factors Identified in the past

A detailed study of literature shows a number of risk factors which were identified in the past by researchers. Ehsan, Alam, Mirza and Ishaquehavelisted a number of risk factors like 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

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relationships between project participants, New technology, Unfamiliarity with local conditions & Force majeure in Pakistan construction Industry. Tang, Qiang, Duffield, Young and Youmei Lu (2007) identified 32 risk factors which affects Chinese construction industry. A study on Palestine building project, a study on contractor perspective (Mohamed &Mosa, 2008) shows a total of 44 risk factors which were grouped under Physical, Environmental, Design, Logistics, Financial, Legal, Construction, Political and Management. Similarly, a study on Indian construction industry by Subramanyan, Sawant and Vandana Bhatt, 2012 have identified 93 risk factors and grouped under various sub-groups like Owner specific, Project Specific, Consultant Specific, Resource Specific, Project Manager specific, finance Specific, Contract Clause Specific, Contractor Specific & external environment Specific which have a significant influence on smooth completion of the project.

4. Overview of the research

It has been clear from literature that many researches have tried to list out risk factors under various sub-groups. Therefore, this research decided to include previously studied risk factors along with the additional risk factors under the same sub-groups which was considered for the Indian construction industry. The study area is considered is Bangalore Region. Likert scale of 1 to 5 is used for rating the level of risk and the probability of occurrence of risk factor, scale 1 corresponds to "least level of risk" & "least probability of occurrence", scale 2 corresponds to "low level of risk" & "low probability of occurrence", scale 3 corresponds to "medium level of risk" & "medium probability of occurrence", scale 4 corresponds to "high level of risk" & "high probability of occurrence and scale 5 corresponds to "very high level of risk" & "very high probability of occurrence". Factor weights are combined to get overall project weight, which indicates that distribution of each factors and level of each risk to which project exposed. SPSS is used for correlation analysis and Microsoft Excel is used for Relative Importance index (RII).

5. Identification of Risk factors

The list of risk factors identified in the present research is based on literature review and it was further revised on the basis of interaction with the help different project members. The factors under the following sub-groups are listed from the Table 1-9 which used questionnaire

1. External Environment specific (EES) 2.Project Specific (PS) 3.Owner specific (OS) 4.Contractor Specific (CS) 5.Consultant specific (CNS) 6. Resource specific (RS) 7. Project Manager specific (PMS) 8. Finance specific (FS) 9. Contract Clause specific (CCS)

6. Methodology

This paper is based on the quantitative approach which is used to identify the overall risk factor. Therefore, Overall risk factor = function of individual risk factor.

Individual risk factor= function of product of level of risk and probability of occurrence (Subramanyan, Sawant&Vandana Bhatt, 2012). The following is the stepwise methodology adopted in this study:

Step1: A list of risk factors were identified and prepared and grouped under 9 sub-groups shown in Table 1-9.

Step2: The list of risk factors are distributed to various project experts to get the qualitative opinion about level of risk and probability of occurrence and the same is marked in questionnaire quantitatively.

Step3: The weight scale 1-5 for "Probability of occurrence" is reduced to 0.2-1 scale.

Step4: Function of product of level of risk and probability of occurrence is calculated for obtaining individual factor risk

Step5: Relative Importance Index (RII) for level of risk is calculated and top 10 risk factors are listed. Table 10

Step6: Correlation Matrix is calculated using SPSS software.

7. Results&Conclusions

7.1. Relative Importance Index (RII)

The result of Relative Important Index (RII) analysis is shown in Table 10. The table concludes top ten risk factors which affects the project among 95 risk factors from the analysis. The respondents have ranked "shortage of labors" which is related to Resource specific sub-group as the first prime factor having the RII of 0.753, as the most of the experts agree to the fact that availability of the labors for construction project is very less and the variation in labors causes delay in completion of the project. "Timely delivery of drawings & insufficient collection & survey before design" have shared RII of 0.745 which is top second ranking showing equal importance in construction industry. It was noticed that top third ranking with RII 0.733 is the "unrealistic price variation" which is again a major factor for any construction projects.

7.2. Correlation Analysis

Table11 shows the result of correlation analysis matrix 9X9. The analysis reveals that there is a strong correlation between Project Manages Specific (RS) and Consultant Specific (CNS) having Pearson coefficient of 0.886 Likewise, Owner specific (OS) and Consultant Specific (CNS) having Pearson coefficient 0.823. Project specific (PS) and owner specific (OS) with a Pearson coefficient of 0.808, which means that coefficient is significant at the level of 0.01.The more Pearson coefficient closer to 1 stronger the correlation between the groups.

External Environment Specific	Unfavorable economic/ market fluctuations
	Labor/ Material Strikes
	Shortage of Material/ Labor.
	Natural Calamities (Force Majeure)
	Changing Government Policies
	Unfavorable political environment
	Sudden unforeseen events

Table1 External environment Specific risk factors

Project Specific	Size of the project
	Location uniqueness
	Clear title of the land
	Type of project
	Tender selection methodology
	Deviation of scope
	Surrounding Structures
	Construction methods
	Delay penalties
	Flow of finance
	Exposure to accidents
	Legal disputes and lawsuits

Table2 Project Specific risk factors

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Owner Specific	Inadequate definition of project budget.
	Delay in handing over the site to contractor.
	Chances of facing financial crisis
	Delay in revising & approving design document by owner.
	Delay in payments by owner.
	Sudden termination of work by owner.
	Changes made by owner during construction.
	Lack of vision/inability in identifying critical activities.
	Holding key decisions in abeyance
	Owner's lack of exposure to changing trends in industry.

Table3 Owner Specific risk factors

Contractor Specific	Delay in mobilization
	Poor site management and supervision by contractor
	Improper construction methods/ quality variations
	Delay's in subcontractor's works.
	Poor qualification/ experience of the contractor.
	Holding key decisions in abeyance.
	Frequent change of subcontractors
	Lack of co-ordination b/w different vendors/ parties/ Head office.
	Lack of resource management &labor allocation.
	On time mobilization of PMV equipments
	Key persons (PM) technical & Managing ability.
	Lack of support from Head Office.

Table4 Contractor Specific risk factors

Consultant Specific	Insufficient data collection & survey before designs
	Inadequate experience of consultant with regard to type of project.
	Delay in performing inspection and testing by consultant.
	Complex design
	Timely delivery of drawings
	Unclear & inadequate details in drawings
	Chances of consultant leaving the project midway
	Inflexibility of consultant
	Non-use of advanced engineering design software

Table5 Consultant Specific risk factors

Resource Specific	Selection of material & equipment
	Availability of resource locally
	Delay in material delivery
	Changes in material types & specifications during construction
	Unrealistic price variation in material
	Improper selection of equipment
	Equipment breakdowns
	Poor maintenance of the equipments
	Non availability of maintenance facility in the vicinity for the equipment
	Shortage of equipment
	Quality variations
	Shortage of labors
	Unqualified workforce
	Poor inventory management

Table6 Resource Specific risk factors

Project manager Specific	Project manager's technical capability
	Holding key decision in abeyance
	Lack of induction & training of human resources
	Ability to source manpower resource on time
	Human resource support to sub-ordinates.
	Lack of support/ motivation to his subordinates.
	Identification of critical issues
	Lack of coordinating ability and rapport of project manager with other contractors at site
	Reluctance in maintaining target schedule by top management
	Lack of leadership quality of project manager
	Lack of effective monitoring and feedback by project manager
	Years of experience in the field of work
	Chances of project manager leaving the project

Table7 Project Manager specific risk factors

Finance Specific	Financial policies
	Liquidity
	Market risk
	Credit risk
	Operational risk
	Profitability risk
	Contingency risk
	Time risk

Table8 Finance Specific risk factors

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Contractor clause Specific	Extension of Time clause
	Forfeiture of security deposit clause
	Delay damages clause
	Dispute resolution clause
	Price escalation clause
	Defect liability period clause
	Differing site conditions clause
	Termination of contract clause

Table9 Contractor clause Specific risk factors

Rank	Risk Factors	RII
1	Shortage of Labours	0.753
2	Timely delivery of drawings & Insufficient Data collection & survey before design	0.745
3	Unrealistic price variation in material	0.733
4	Unqualified work force	0.727
5	Complex Design& Lack of Leadership quality of project manager	0.720
6	Frequent Change of Sub contractors, Lack of resource management & labour allocation & Lack of support from head office	0.713
7	Delay in sub-contractors works	0.707
8	Poor site management and supervision by contractor, Lack of co-ordination b/w different vendors/ parties/ Head office & Reluctance in maintaining target schedule by top management	0.700
9	Delay in payments by owner, Delay in material delivery, identification of critical activities.	0.693
10	Improper construction methods & quality variations, Poor qualification/ experience of contractors, poor inventory management	0.687

Table 10 Top Ten Risk factors

	EES	PS	OS	CS	CNS	RES	PMS	FS	CCS
EES	1	.280	.176	.321	.236	.303	.289	.181	.214
PS	.280	1	.808**	.623**	.676**	.641**	.685**	.329	.304
OS	.176	.808**	1	.589**	.823**	.554**	.761**	.598**	.445*
CS	.321	.623**	.589**	1	.658**	.678**	.657**	.457*	.473**
CNS	.236	.676**	.823**	.658**	1	.729**	.886**	.633**	.495**
RES	.303	.641**	.554**	.678**	.729**	1	.808**	.594**	.555**
PMS	.289	.685**	.761**	.657**	.886**	.808**	1	.700**	.461*
FS	.181	.329	.598**	.457*	.633**	.594**	.700**	1	.600**
CCS	.214	.304	.445*	.473**	.495**	.555**	.461*	.600**	1

****. Correlation is significant at the 0.01 level (2-tailed).**
***. Correlation is significant at the 0.05 level (2-tailed).**
Table 11 Correlation Matrix showing Pearson Coefficient

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