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Risk Analysis in Construction Projects

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Abstract: Risks have significant impact on construction projects in terms of its main aims. Construction projects which are intricate in nature, uncertainty and hazards in the same can develop from different authors. The platter of the construction industry is not acceptable in terms of coping up with risks in projects. Risk management is a procedure which consists of identification of risks, assessment with qualitatively and quantitatively, response with a worthy method for handling risks, and then check the risks by monitoring. This work aims to apply the risk management technique which includes well - documented procedures for the one stop solution all types of hazards most likely to happen during any construction project Lifecycle.
Keywords: Risk, Critical Factor, Contract, Risk Management, Construction Projects,

I. INTRODUCTION

A variety of unexpected events may occur on construction projects and many of them can cause losses to the parties involved. Such uncertain events or set of circumstances that cause an outcome on the achievement of one or more of the project's objectives is commonly called risks. The most of civil engineering employment is done under contract. A contract provides a self-contained statement of responsibilities as between its own parties. The analysis has also named various factors responsible for time and cost overruns, some within the restraint of the enterprises and some beyond their command. The contracts are critical to the achiever of a project is important difficult, costly and protracted proceedings. The contract documents can be utilized as a puppet to manage risk by allocating risks to the various agencies through the several contracts between them. It is really important for all the agencies that they are aware at all times of the extent of risk exposure or the risks that they bear to do. If this awareness is lacking, then it may contribute to a number of disputes, disagreements and disruptions. One of the major reasons of disagreement and difference is a short and defective contract documentation and also inappropriate contract arrangements and an unreasonable burden of risk being allocated to one of the parties of the contract.

The present work proposes to distinguish the central problems in certain vital areas of a building contract, which if not attended properly have the potential to become major barriers in the advancement of the project In the present work, two case studies of infrastructure projects in Mumbai and Pune city of Maharashtra state, India, have been mentioned. The subject area includes identification, classification of the various risks in a dedicated set of contract documents and on the basis of qualitative risk analysis find out severity of these risks, suggests methods to mitigate risks in construction tasks from the client's and the contractor's view point.

II. BACKGROUND

There are various research papers on the risk management in construction projects in various countries and various strategies for managing risk. During literature study, S.Q. Wang proposes Risk management framework for construction projects in developing countries. W. Steam propose Project risk Management by suggesting an essential tool for managing is exposed so that a conscious decision can be taken on how to manage the risks." It also includes; various risks; agencies involved, their roles; exposure of projects to risks; effects of project phase of risk. Contracting in Construction is also discussed and the contract documents essential are enlisted and their significance is spelt. The bridge between the two topics of Contracting and Risk is then discussed and the qualities of a "good" construction contract are enlisted. There are various techniques are available for assessment of risks as per purpose of study.

III. TYPES OF RISK

Risks can be viewed as business, technical, or operational. A technical risk is the inability to build the product that will satisfy the requirements. An operational risk is the inability of the customer to work with core team members. Risks are either acceptable or unacceptable. An acceptable risk is one that negatively affects a task on the non-critical path. An unacceptable risk is one that negatively affects the critical path. Risks are either short or long term. A short-term risk has an immediate impact, such as changing

the requirements for a deliverable. A long-term risk has an impact sometime in the distant future, such as releasing a product without adequate testing. Risks are viewed as either manageable or unmanageable. A manageable risk is one you can live with, such as a minor requirement change. An unmanageable risk is impossible to accommodate, such as a huge turnover of core team members. Risk factors in this study are classified into eight categories namely.

A. Construction risk
B. Design risk
C. Environmental risk
D. Financial risk
E. Managing risk
F. Political risk
G. Procurement risk
H. Subcontractors risk
I. Technology risk

IV. RESEARCH METHODOLOGY

For this inquiry, a questionnaire survey method has been adopted to determine the impact of critical elements that leads to delay on resource related in the Indian construction sector drawing from various international researchers mentioned above in particular (Sambasivan and Soon 2007). A questionnaire study was conducted by construction professionals representing diverse stakeholders involved in construction projects in India.

A. Questionnaire Design

The questionnaire was designed based on critical factors were identified that contributed to the causes of delays. A questionnaire study was prepared to measure the perceptual experiences of various construction professionals of the comparative importance of crusades and the effects of building delays.

The questionnaire was designed into two sections: Section A; section B. Part A is to obtain the requested background information about the respondents. Part B is to get data on the elements that contribute to the causes of delays in construction tasks from the perspective of building professionals.

A full twenty eight resource related factors were identified under three extensive classes, namely manpower related, material related and equipment related topics. The critical factors are listed in Table 1.

A five point Likert scale (1 very low, 2 low, 3 moderate, 4 high, 5 very high) was adopted where respondents were asked to rank the importance and impact of a particular factor on delay in one of their selected projects. Descriptive statistical techniques, namely Relative Importance Index (RII) has been applied to play up the comparative importance of decisive factors as perceived by the respondents (Assaf et. al, 1995; Faridi and El-Sayegh, 2006; Iyer and Jha, 2005; Kumaraswamy and Chan, 1998).

B. Data Analysis

The data analysis will be done by the relative importance index technique used to determine the relative importance of the various cause of factors. The same method is going to be adopted in this study. The five-point scale ranged from 1(very low important) to 5 (very high important) will be adopted and will be transformed to relative importance indices (RII) for each factor as follows:

$$RII = \sum W / A*N$$

Where, W is the weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (i.e. 5 in this case), and N is the total number of respondents.

The RII value had a range from 0 to 4 (0 not inclusive), higher the value of the RII, more important was the causes of delays. The RII was used to rank the different uncertainty factors that cause delay. These ranking made it possible to cross-compare the relative importance of the uncertainty factors as perceived by the respondents.

Tables 1: Numerical conversion for the rating attributes

α , β	
Ratting Attributes	Numerical Conversion
0	0.0
1	0.2
2	0.4
3	0.6
4	0.8
5	1.0

After obtaining an index score for each factor, standard deviation and coefficient of variation of each factor is also determined. Subsequently, ranking of factors is done based on Index score.

V. RESULT AND DISCUSSION

A. Analysis of Data

Total twenty respondents have filled up the questionnaire. Subsequently for analysis of responses following steps are followed:

1) Responses were converted into numerical values based on their rating attributes. A sample is shown in Table
2) After that mean of numerical values of all twenty eight responses is determined
3) Then, Standard deviation and coefficient of variation for each risk factor is determined
4) Afterwards, Index Score for each risk is calculated by using RI Method.

Table 2: Conversion of response into numerical values (Questionnaire 1)

Risk		Probability level of Risk Occurrence(α)					
S.No.		NA	Very small	Small	Normal	Large	Very Large
		0	1	2	3	4	5
1	Financial Reasons					0.8	
2	Availability of Commodity/ Resource			0.4			
3	Quality of Commodity/Resource		0.2				
4	Problem during execution of construction work					0.8	
5	Nature of Human Behaviour	0					
6	Due to delay of work					0.8	
7	Due to variation of cost from current position to after completion of work			0.4			
8	Contract management	0					
9	Delay of work due to information/Communication problem from top Management to lower management			0.4			
10	Due to lack of labour and engineer				0.6		
11	Due to quality of labour and engineer				0.6		
12	Handover of the project after its completion		0.2				
13	Due to environmental issue					0.8	
14	Due to transfer of the project to other			0.4			

	contractor because of any reason							
15	Improper verification of contract			0.4				
16	Change of top management	0						
17	Short Tender Time							1
18	Increase of labour cost							1
19	Team Work				0.6			
20	Due to lack and availability of highly effective equipment			0.4				
21	Due to surrounding local body			0.2				
22	No past experience in similar project			0.2				

INTERVIEW NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total	Mean (m)	SD (s)	C.O.V =(s/m)
Financial Reasons	0.36	0.36	0.36	0.36	0.04	0.48	0	0.6	0.04	0.36	0.64	0.64	0.64	0.36	0	0.36	0.36	0.04	0.64	0.48	7.16	0.3583	0.06	0.167
Availability of Commodity/ Resource	0.36	0.64	0.16	0.04	0.04	0.16	0.2	0	0.36	0.04	0.16	0.16	0.16	0.16	0	0.04	0.04	0.08	0.24	0.16	3.2	0.16	0.1	0.625
Quality of Commodity/ Resource	0.08	0.24	0.16	0.04	0.04	0.36	0.2	0	0.04	0.16	0.04	0.04	0.16	0.16	0.2	0.64	0.64	0.08	0.04	0.36	3.72	0.186	0.14	0.752
Problem during execution of construction work	0.16	1	0.04	0.16	0.16	0.36	0.4	0.4	0.48	0.64	0.64	0.64	0.36	0.48	0.2	0.36	0.36	0.08	0.36	0.08	7.32	0.366	0.04	0.109
Nature of Human Behaviour	0.16	0.24	0.04	0	0	0	0.2	0	0	0.04	0	0.16	0.04	0	0	0.04	0.04	0	0	0.24	1.16	0.058	0.04	0.687
Due to delay of work	0.16	0.36	0.8	1	1	0.64	0.4	0.4	0.04	0.08	0.64	0.36	0.04	0.64	0	0.16	0.16	0.36	0.16	0.04	7.4	0.37	0.06	0.162
Due to variation of cost from current position to after completion of work	0.36	0.36	0.8	0.16	0.16	0.16	0	0.4	0.08	0.16	0.16	0.36	0.64	0.24	0.2	0.36	0.36	0.16	0.16	0.36	5.68	0.284	0	0
Contract	0.	0	0.	0	0.	0.	0	0	0.	0	0	0.	0	0.	0	0	0	0.	0.	0.	1.	0.0	0.0	0.256

Management	04		08		36	04			16			04		36	.2			04	04	08	56	78	2	
Delay of work due to information/ Communication problem from top Management to lower management	0.16	0.48	0.08	0.36	0.64	0.16	0.2	0.2	0.36	0.08	0.16	0.36	0.16	0.08	0.1	0.08	0.08	0.64	0.36	0.24	4.88	0.244	0.04	0.163
Due to lack of labour and engineer	0.36	0.36	0.36	0.64	0.64	0.48	0.2	0.4	0.36	0.36	0.36	0.64	0.64	0.64	0.4	0.24	0.24	0.36	0.36	0.64	8.56	0.428	0.14	0.327
Due to quality of labour and engineer	0.36	0.36	0.36	0.64	0.16	0.48	0.4	0.2	0.16	0.36	0.36	0.64	0.64	0.48	0.4	0.24	0.24	0.36	0.16	0.64	7.6	0.38	0.14	0.368
Handover of the project after its completion	0.16	0.04	0.04	0.16	0.36	0.24	0	0.2	0.04	0.16	0.04	0.36	0.36	0.24	0	0.4	0.4	0.04	0.04	0.36	3.68	0.184	0.1	0.543
Due to environmental issue	0.16	0.64	0.04	0.36	0.04	0.64	0.4	0.4	0.48	0.36	0.64	0.64	0.64	0.64	0	0.16	0.16	0.04	0.16	0.16	6.72	0.336	0	0
Due to transfer of the project to other contractor because of any reason	0.04	0.36	0.36	0.04	0.04	0.24	0	0	0.04	0.16	0.08	0.16	0.16	0.16	0	0	0	0.16	0.04	0.36	2.48	0.124	0.16	1.290
Improper verification of contract	0.24	0.04	0.04	0.04	0	0	0	0.2	0.04	0.04	0.08	0.04	0.04	0.36	0	0	0	0.36	0.16	0.08	1.8	0.09	0.08	0.888
Change of top management	0	0.04	0.04	0	0.64	0	0	0	0	0	0	0.04	0.04	0.04	0	0.4	0.4	0.04	0.64	0.16	2.52	0.126	0.08	0.634
Short Tender Time	0.48	0.64	0.04	0.64	0.36	1	0.6	1	0.64	0.64	1	0.04	0.64	0.64	0.2	0.36	0.36	0.36	1	0.64	11.3	0.564	0.08	0.141
Increase of labour cost	0.24	0.36	0.48	0.36	0	1	0.6	0.6	1	0.64	1	0.64	0.64	0.8	0.4	0.36	0.36	0.64	0.36	0.64	11.2	0.558	0.2	0.358
Team Work	0.04	0.04	0.04	0	0.36	0.04	0	0	0.16	0.36	0.36	0.04	0.04	0.16	0.2	0.16	0.16	0.04	0.04	0.16	2.4	0.12	0.06	0.5
Due to lack and	0.1	0.48	0.1	0.3	0.0	0.1	0	0.	0.1	0.3	0.1	0.1	0.1	0.0	0.	0.3	0.3	0.16	0.16	0.04	3.84	0.192	0.06	0.312

availability of highly effective equipment	6		6	6	4	6		2	6	6	6	6	6	4	2	6	6						
Due to surrounding local body	0	0.04	0.36	0.04	0	0.04	0.1	0	0.04	0.04	0.04	0.16	0.16	0	0	0.04	0.04	0	0	0.04	1.2	0.06	0.02	0.333
No past experience in similar project	0	0	0.04	0	0.04	0	0.1	0	0.04	0.04	0.04	0.16	0.16	0.04	0	0	0	0	0.04	0.16	0.92	0.046	0.08	1.739

S.N0.	Risks	Index Score(□)	S.D.(□□	C.O.V.(□□□□
1	Financial Reasons	0.358	0.06	0.167
2	Availability of Commodity/ Resource	0.16	0.1	0.625
3	Quality of Commodity/Resource	0.186	0.14	0.752
4	Problem during execution of construction work	0.366	0.04	0.109
5	Nature of Human Behavior	0.058	0.04	0.689
6	Due to delay of work	0.37	0.06	0.162
7	Due to variation of cost from current position after completion of work	0.284	0	0
8	Contract Management	0.078	0.02	0.256
9	Delay of work due to information/Communication problem from top Management to lower management	0.244	0.04	0.163
10	Due to lack of labour and engineer	0.428	0.14	0.327
11	Due to quality of labour and engineer	0.38	0.14	0.368
12	Handover of the project after its completion	0.184	0.1	0.543
13	Due to environmental issue	0.336	0	0
14	Due to a transfer of the project to another contractor because of any reason	0.124	0.16	1.290
15	Improper verification of contract	0.09	0.08	0.888
16	Change of top management	0.126	0.08	0.634
17	Short Tender Time	0.564	0.08	0.141
18	Increase of labour cost	0.558	0.02	0.0358
19	Team Work	0.12	0.06	0.5
20	Due to lack and availability of highly effective equipment	0.192	0.06	0.3125
21	Due to surrounding local body	0.06	0.02	0.333
22	No past experience in similar project	0.046	0.08	1.739

	Table 6.3 Ranking of Risk		
S.No	Risks	Index Score	Rank order
1	Short Tender Time	0.564	1
2	Increase of labour cost	0.558	2
3	Due to lack of labour and engineer	0.428	3
4	Due to quality of labour and engineer	0.38	4
5	Due to delay of work	0.37	5
6	Problem during execution of construction work	0.366	6
7	Financial Reasons	0.358	6
8	Due to environmental issue	0.336	7
9	Due to variation of cost from current position to after completion of work	0.284	8
10	Delay of work due to information/Communication problem from top Management to lower management	0.244	9
11	Due to lack and availability of highly effective equipment	0.192	10
12	Quality of Commodity/Resource	0.186	11
13	Handover of the project after its completion	0.184	12
14	Availability of Commodity/ Resource	0.16	13
15	Due to transfer of the project to other contractor because of any reason	0.124	14
16	Team Work	0.12	15
17	Improper verification of contract	0.09	16
18	Contract Management	0.078	17
19	Nature of Human Behaviour	0.058	18
20	No past experience in similar project	0.046	19
21	Due to surrounding local body	0.06	20

VI. CONCLUSION

The construction companies need to include risk as an integral part of their project management. Decision making, such as risk assessment in construction projects is very important in the construction management. The identification and assessment of project risk are the critical procedures for projecting success. This study determines the key factors of risk in the construction industry. A total of 38 factors influencing risks in construction is analyzed through pilot survey, which include experts on academic (Professors), governmental sectors and construction industry were interviewed, and twenty two evaluation criteria were obtained as the key factor by interviewed experts. This approach provides a more effective, accurate and organized decision support tool.

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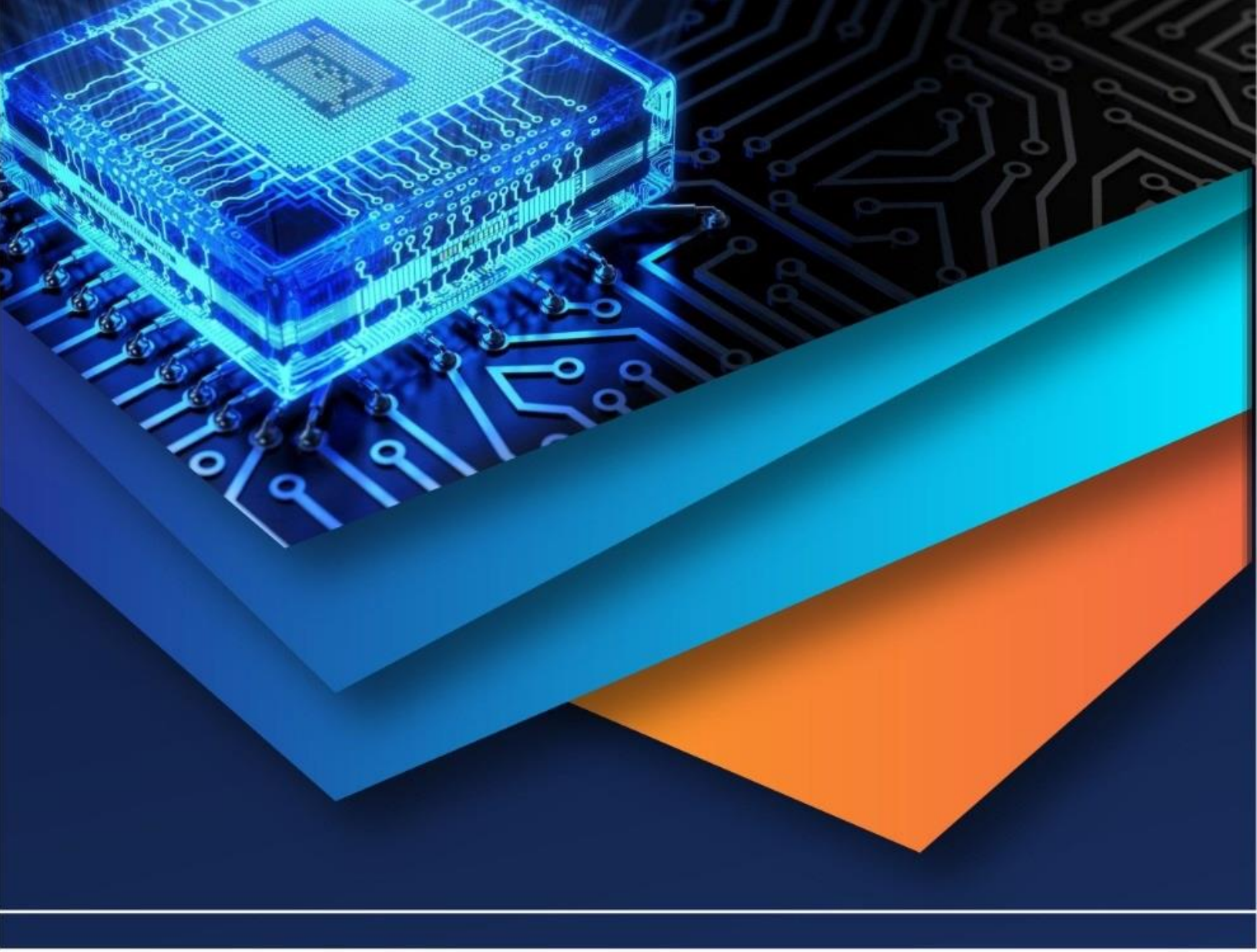

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