A PAPER ON QUANTITATIVE RISK ANALYSIS IN CONSTRUCTION

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Abstract: - This paper proposes to study and indentify key risk factors which may result in cost and delay of construction process. This paper proposes to study the Quantitative risk analysis in construction and how these risks adversely affect in completion of construction project. Risk analysis identifies the issues that slow down the process of construction. During recent years, risk analysis has become a major subject of management research. The paper presents the main results of the survey and highlights the effects of Risk analysis in construction that exists in the construction industry

Construction projects are all the same in nature and have a one-time activity. A large number of people are involved in such projects. Contractors, subcontractors, suppliers, engineers, and project management consultants / third party consultants are the agents employed by clients for building projects. Although the construction industry recognises the value of quantitative risk analysis in optimising project execution, research in this area is still lacking.

The main target of the project management is to finish the project within specific time and cost with assured quality. There are more tools and techniques available for optimizing the construction process to prevent the time and cost overruns. Survey is very important for identifying the factors and analysis it. In this a questionnaire survey will be distributed among the contactors and owners. The paper presents the main results of the survey and highlights the effects of critical risks in construction that exists .The this research will be carried out by the help of a questionnaire survey and data analysis will be done by three different statistical tools that are Relative Importance Index Method, Weighted Average Index Method and Spearman's Rank Correlation Coefficient.

Key Words: - Quantitative Risk Analysis, SPSS Statistics Software, Cronbach's Alpha Value, Relative Importance Index Method, Weighted Average Index Method and Spearman's Rank Correlation Coefficient.

I. INTRODUCTION

This paper attempts to provide the reader a complete picture of Quantitative risk analysis through a systematic literature review. It presents main activities of Quantitative Risk Analysis and the step-by-step approach for understanding a complete picture of Quantitative risk analysis . The construction industry is true power of national economy system. In India construction work, about 49.84% projects are running behind the schedule i.e one of them major hurdles for sustaining biggest and higher growth in this sector. Large construction projects are naturally complex and dynamic. Many projects start with good ideas, huge investments, and great efforts. Various of them do not achieve much success. A major contribution to unsuccessful projects is the lack of understanding of scope, time, cost and quality. This Study is attempted to fill the gaps by carrying out research on the delay analysis of construction project with a focus on the factors that affect the delay in construction .

II. LITERATURE REVIEW

By using the data obtained from the survey and the knowledge available in the literature, the paper proposes a framework for implementing the concepts and principles of Quantitative risk analysis in construction industry. Checking research literature shows that in spite of several researches in the field of risk analysis on construction projects, there isn't any logical and systematic approach for identification and quantification of critical risks which result in delay of the construction project. This research aims to provide a suitable and systematic approach for evaluating factor affecting delay in construction project.

III. METHODOLOGY

It is the process which helps the understanding of construction companies concerning the awareness of Risk analysis in Indian construction industry with special emphasis on their relationship to their contractors, engineers and clients. The research methodology will be done by the help of a survey questionnaire and survey questionnaire data analysis will be done by four different statistical tools that are chronbach's alpha value using SPSS software , Relative Importance Index Method, Weighted Average Index Method and Spearman's Rank Correlation Coefficient.

IV.DATA COLLECTION METHOD

To obtain adequate information on the study, both primary and secondary data will be collected. The primary data will involve the review of literature on the research topic and related topics from books and journals. The secondary data will be collected through carefully structured questionnaires form to identify and discuss the thoughts and opinions of the Clients, engineers and Contractors about the implementation of risk analysis in construction.

Table 1:- Rate of responses

Sr. No.	Respondents	Questionnaire distributed	Responses received	Percentage of responses
1	Client	40	30	75%
2	Consultancy	45	30	66%
3	Contractor	50	30	60%
Total		135	90	66%

V. QUESTIONNAIRE DESIGN

The study will be followed by survey design in its conduct by using questionnaires to find out the views and opinions of respondents about certain subject. The questionnaires were mainly pre-coded questions which enable respondents to tick their preferred options from relevant options which will be based on measurement scale. All the useful and necessary data was collected through the medium of survey in which questionnaire form was distributed to different clients, engineers and contractors by means of technology using mail services containing about 18 questions. After designing the questionnaire it was distributed among contractor, clients and engineers and were asked to give rating on the scale of 1 to 5 for each risk . 1 being least likely of a risk being happening and 5 being highly likely of a risk being happening

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VI. DATA ANALYSIS

Once the data had been successfully collected, the researcher sorted the same and coded it appropriately for analysis work. In the thesis work the excel software was used to calculate and analyze the statistical data which was collected by the questionnaire survey so as to carry out the data analysis in this research.

1.Relative Important Index Method :-

Data of all these tables were analyzed by RII method was calculated for each type of claims as follows;

RII method = Σ W / (A * N)

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

2. Weighted Average Index Method :-

Data of all these tables were analyzed by a weighted average was calculated from each type of claims as follows:-

WAI = (W*X)/ N;
Where, W_i is the weight assigned to the i option; X_i is the number of respondents who selected the i option; and N is the total no. of respondents.

3. Spearman's Rank Correlation Coefficient Method :-

Data of all these tables were analyzed by Spearman's rank correlation coefficient method was calculated for each type of claims as follows;

$R = 1 - [(6 \Sigma D^2) / N(N^2 - 1)]$

Where, R = spearman's rank correlation coefficient,
N = Refers to the number of pairs of observations,
D = represents the difference between the pair of same individual in two corresponding rank characteristics ($D= R_1 - R_2$)

4. Data analysis by SPSS software-After collecting all the data, chronbach's alpha value was found out using SPSS software to check the reliability of the data collected

i. Relative Important Index Method (RII)

Sr no.	Delay Category	RII BY CLIENT	RII BY ENGINEER	RII BY CONTRACTOR	AVERAGE OF RII	RANK
1	Staff with no prior experience.	0.56	0.53	0.54	0.52	14
2	Labor shortages	0.47	0.52	0.44	0.47	18
3	Delay as a result of the crisis	0.76	0.64	0.66	0.70	01
4	Construction error & Defective work	0.58	0.53	0.52	0.54	08
5	Inadequate site management	0.55	0.54	0.55	0.54	08
6	Unexpected Cost of materials has increased.	0.63	0.60	0.66	0.63	02
7	Unexpected Cost of fuel is rising.	0.43	0.60	0.52	0.51	15
8	Unprecedented rise in labour costs	0.47	0.62	0.56	0.55	07
9	Design error	0.56	0.47	0.44	0.49	16
10	Payment Delayed	0.52	0.52	0.57	0.53	12
11	Sudden undefined etc. work	0.53	0.61	0.64	0.59	05
12	Quality issue	0.50	0.50	0.48	0.49	16
13	Site dispute	0.49	0.59	0.51	0.53	12
14	Unforeseen ground Condition	0.52	0.57	0.55	0.54	08
15	Equipment operation and maintenance costs	0.64	0.61	0.57	0.62	03
16	Political pressure	0.58	0.63	0.64	0.61	04
17	User, contractor, or engineer misbehaviour	0.64	0.60	0.63	0.62	03
18	a delay in money being approved by the corporation or the government	0.55	0.60	0.62	0.59	05

ii) Weighted Average Index Method

Sr no.	Delay Category	WAI BY CLIENT	WAI BY ENGINEER	WAI BY CONTRACTOR	AVERAGE OF WAI	RANK
1	Staff with no prior experience.	2.23	2.68	2.77	2.56	14
2	Labor shortages	2.38	2.63	2.22	2.41	17
3	Delay as a result of the crisis	3.84	3.22	3.33	3.46	01
4	Construction error & Defective work	2.92	2.68	2.61	2.73	09
5	Inadequate site management	3.15	2.72	2.77	2.88	07
6	Unexpected Cost of materials has increased.	3.15	3.04	3.32	3.17	03
7	Unexpected Cost of fuel is rising.	2.23	3.18	2.61	2.67	11
8	Unprecedented rise in labour costs	2.38	2.00	2.83	2.40	18
9	Design error	2.84	2.36	2.22	2.47	15
10	Payment Delayed	2.61	2.63	2.87	2.70	10
11	Sudden undefined etc. work	2.69	3.09	3.23	3.00	06
12	Quality issue	2.53	2.31	2.44	2.42	16
13	Site dispute	2.46	2.81	2.56	2.61	13
14	Unforeseen ground Condition	2.61	2.86	2.77	2.74	08
15	Equipment operation and maintenance costs	2.00	3.04	2.89	2.64	12
16	Political pressure	2.92	3.18	3.20	3.10	04
17	User, contractor, or engineer misbehaviour	3.38	3.00	3.16	3.18	02
18	a delay in money being approved by the corporation or the government	2.92	3.04	3.11	3.02	05

iii)Spearman's Rank Correlation

Spearman's Rank Correlation between Client and Engineer

Sr no.	Delay Category	Rank by Client (R1)	Rank of Engineer (R2)	Diff. (ΣD)	Diff.^{2} (ΣD^2)
1	Staff with no prior experience.	10	12	-02	04
2	Labor shortages	13	14	-01	01
3	Delay as a result of the crisis	01	01	0	0
4	Construction error & Defective work	18	12	-06	36
5	Inadequate site management	08	11	-03	09
6	Unexpected Cost of materials has increased.	03	05	-02	04
7	Unexpected Cost of fuel is rising.	15	10	05	25
8	Unprecedented rise in labour costs	14	16	-02	04
9	Design error	13	18	-05	25
10	Payment Delayed	10	14	-04	16
11	Sudden undefined etc. work	09	04	05	25
12	Quality issue	12	17	-04	16
13	Site dispute	17	10	07	49
14	Unforeseen ground Condition	07	09	01	01
15	Equipment operation and maintenance costs	06	05	01	01
16	Political pressure	04	02	03	09
17	User, contractor, or engineer misbehaviour	02	08	-06	36
18	a delay in money being approved by the corporation or the government	05	05	0	0
					ΣD^2 220

Spearman's Rank Correlation result is 0.772, Hence the value is near by 1 so result is Reliable

Spearman's Rank Correlation between Client and Contractor

Sr no.	Delay Category	Rank by Client (R1)	Rank of Contractor (R2)	Diff. (ΣD)	Diff.^{2} (ΣD^2)
1	Staff with no prior experience.	10	10	0	0
2	Labor shortages	13	17	-04	16
3	Delay as a result of the crisis	01	01	0	0
4	Construction error & Defective work	18	13	-05	25
5	Inadequate site management	08	10	-02	04
6	Unexpected Cost of materials has increased.	03	01	-02	04
7	Unexpected Cost of fuel is rising.	16	13	-02	04
8	Unprecedented rise in labour costs	13	09	-05	25
9	Design error	13	17	-04	16
10	Payment Delayed	10	07	-03	09
11	Sudden undefined etc. work	09	03	-06	36
12	Quality issue	12	16	-04	16
13	Site dispute	17	15	02	04
14	Unforeseen ground Condition	07	10	-03	09
15	Equipment operation and maintenance costs	06	07	-01	01
16	Political pressure	04	03	01	01
17	User, contractor, or engineer misbehaviour	02	05	-03	09
18	a delay in money being approved by the corporation or the government	05	06	-01	01

ΣD^2 =184

Spearman's Rank Correlation result is 0.810,

Hence the value is near by 1 so result is Reliable

Spearman's Rank Correlation between Contractor and Engineer

Sr no.	Delay Category	Rank by Contractor (R1)	Rank of Engineer (R2)	Diff. (ΣD)	Diff.^{2} (ΣD^2)
1	Staff with no prior experience.	10	12	-02	04
2	Labor shortages	17	14	-03	09
3	Delay as a result of the crisis	01	01	0	0
4	Construction error & Defective work	13	12	01	01
5	Inadequate site management	10	11	-01	01
6	Unexpected Cost of materials has increased.	01	05	-04	16
7	Unexpected Cost of fuel is rising.	13	10	03	09
8	Unprecedented rise in labour costs	09	16	-07	49
9	Design error	17	18	01	01
10	Payment Delayed	07	14	07	49
11	Sudden undefined etc. work	03	04	-01	01
12	Quality issue	16	17	-01	01
13	Site dispute	15	10	05	25
14	Unforeseen ground Condition	10	09	01	01
15	Equipment operation and maintenance costs	7	05	02	04
16	Political pressure	03	02	01	01
17	User, contractor, or engineer misbehaviour	05	08	-03	09
18	a delay in money being approved by the corporation or the government	06	05	-01	01

$\Sigma D^2=183$

Spearman's Rank Correlation result is 0.811,

Hence the value is near by 1 so result is Reliable

(iv) Data analysis by SPSS software-After collecting all the data, chronbach's alpha value was found out using SPSS software to check the reliability of the data collected

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

If the Cronbach's alpha value is between 0.7 to 1 the data is considered to be reliable.

Reliability of data by client

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.828	.822	30

Cronbach's alpha value of client was found to be .828 , as the value is within .7 to 1 hence data is reliable.

Reliability of data by engineer

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.745	.744	30

Cronbach's alpha value of client was found to be .815 , as the value is within 0.7 to 1 hence data is reliable.

Reliability of data by contractor

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.783	.775	30

Cronbach's alpha value of client was found to be .783 , as the value is within 0.7 to 1 hence data is reliable.

CONCLUSION

- Chronebach's alpha value of data collected from client was found to be 0.828, hence data is reliable as value is in between 0.7 to 1.
- Chronebach's alpha value of data collected from contractor was found to be 0.815, hence data is reliable as value is in between 0.7 to 1.

- Chronebach's alpha value of data collected from engineer was found to be 0.78, hence data is reliable as value is in between 0.7 to 1.
- Spearman's Rank Correlation between Client and Engineer is 0.772, Hence the value is near by 1 .so result is Reliable
- Spearman's Rank Correlation between Client and Contractor result is 0.810, Hence the value is near by 1 so result is Reliable
- Spearman's Rank Correlation between Contractor and Engineer is result is 0.811, Hence the value is near by 1 so result is Reliable
- It was found that according to client .Construction error & Defective work, labour shortage are the major reason for delay.
- It was found that according to engineer .Inadequate site management , quality issue and design error result in delay
- It was found that according to contractor labour shortage , design error and defective work are the major causes of delay .

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