Risk Assessment and Management in Construction Projects

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Abstract — *Construction of bridge projects are initiated in complex and dynamic problems resulting in circumstances of high uncertainty and risk, which are compounded by demanding time and cost constrains. The general methodology is to study relies largely on the survey questionnaire which will be collect from the various bridge project construction contractors and project manager of different sizes by mail or personnel meeting. The questionnaire prepared for the survey was formulated by seeing the relevant literatures in the area of construction management. This research seeks to identify the risk factors that affect the performance of bridge projects as a whole and analyze by using appropriate tools and technique and to develop a risk management framework. The responses were analyzed like bar charts were subjected to using the software of SPSS. This questionnaire has been divided in to two factors namely time and finance management. The 25 number of companies related to bridge projects industries. For these factors analysis of t-test and ANOVA were calculated, tabulated and the result are given according to the suitable suggestions.*

Keywords—*Risk Management, Construction Management, SPSS, t-test and ANOVA*

1. INTRODUCTION

Risk management is the systematic process of identifying, analyzing and responding to project risk. It includes maximizing the probability and consequences of positive events and minimizing the probability and consequences of adverse events to project objectives.

Generally, risk is a choice in an environment rather than a fate. It is uncertainty inherent in plans and possibility of something happening that can affect prospects of achieving, business or project goals. The money spend fund shipments overseas was the first example of risk business in the early days of travel. Each and every activity we do involve risk, only the amount of risk varies.

1.1. Definition of Risk

Risk is defined as "a situation where there exists no knowledge of its outcomes".

In Macquarie dictionary, it is defined as "Exposure to the change of injury or loss; a hazard or dangerous chance, to run risks".

In general, "Every risk is proportional to the expected losses which can be caused by a risky event and to the probability of this event".

1.2. Concept of risk and risk management

Risk is a multi-faucet concept. in the context of construction industry, it could be the likelihood of the occurrence of a definite event/factors which occur during the whole process of construction to determine the project a lack of predictability about structure outcome or consequences in a decision or planning situation, the uncertainty associated with estimates of outcomes-there is a chance that results could be better than expected as well as worse than expected etc.,.

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International project tends to be subjected to the external risk such ass unawerness of the social conditions, economic and political scenarios, unknown and new procedural formalities, regulatory framework and governing authority, etc.,.

The main objective is to remove as much as possible the potential impact and to increase the level of control of risk. The more control of one mitigation measure on the risk the more effective the measure is the process of risk management does not aim to remove completely all risks from a project. Its objective is to develop an organized framework to assist decision makers to manage the risks, especially the critical ones, effectively and efficiently.

1.3. Risk exposure

The following are the several factors risk exposure.

- **Team size:** the larger the team, the higher the probability of a problem arising. For example, communications can be more difficult as the number of participants increases. The number of interactions among people increases and thus they require greater coordination.
- **History:** newer projects are riskier because the processes have not been refined. The more times a project of a similar nature has been done, the greater the likelihood of success.
- **Staff expertise and experience:** if the staff lacks direct experience and knowledge of the subject, people will struggle to learn as they go along, robbing the project of time and possibly introducing errors.
- **Complexity:** the more sophisticated a project, there is a greater the opportunity of a mistake or problem.
- **Management stability:** management stability implies unity of direction, which in turn means reaching goals. Management irritability can lead to unrealistic scheduled and insufficient use of resources.
- **Time compression:** if a schedule is highly compressed, then the risks are magnified. Having more times means greater flexibility and the opportunity to prevent or mitigate the impact of errors.
- **Resource availability:** the more resources that are available, the greater the ability to respond to problem as

they arise. Plentiful resource, of course, do not guarantee protection from risk; however they do provide the means to respond to it.

1.4. Sources of Risk In Construction Projects

- Misunderstanding of contract terms and conditions
- Design changes and errors
- Poorly co-ordinated work
- Poor estimates
- Poorly defined roles and responsibilities
- Unskilled staff
- Natural hazards
- Political and legal problems

1.5. Advantages of Risk Management

- Less uncertainty
- Achievement of objectives
- Reliability
- Reduction of capital cost
- Creation of value

1.6. Limitations of Risk Management

- If risks are improperly assessed and prioritized, time can be waste in dealing with risk of losses that not likely to occur
- Spending too much time assessing and managing unlikely risks can divert resources that could be more profitably.
- Unlikely events to occur, but if the risk is unlikely enough to occur, it may be better to simply retain the risk & deal with the result if the loss does in fact occur.

2. LITERATURE REVIEW

Wenzhe Tang, David M.Young (Dec 2007) "Risk Management in the Chinese Construction Industry" studied the empirical Chinese industry survey on the importance of project risks, application of risk management techniques, status of the risk management system, and the barriers to risk management, which were perceived by the main project participants. The study reveals that: Most project risks are commonly of concern to project participants; the industry has shifted from risk transfer to risk reduction.

Eric B. Williamson, David G . Winget(Aug 2004) "Risk Management and Design of Critical Bridges for Terrorist Attacks" This study deals with the risk for the government due to the terrorist attacks on the beam column joint. And result in the retro fitting works to be done and it makes increase in the time by disturbing the traffic and increase in cost by allocating the labour, materials and safety.

Riaan van Wyk, Akin tola Akintoye (Mar 2007) "Project risk management practice: the case of a South African utility company "documented the risk management practice of a utility company for its Recovery Plan project to address the risks of power interruptions. The company's corporate risk management process and its practice at divisional and project levels are discussed. The key role of stakeholders in risk identification, analysis, mitigation, monitoring and reporting is emphasized by the company and this drives its risk management practice.

Florence Yean Yug Ling and Linda Hoi (Dec 2006) "Risk faced by Singapore firms when undertaking construction projects in India" studied the risk that Singapore architecture, engineering and construction (AEC) firms face when working in India and investigated the risk response techniques adopted by them. The risk response techniques include having adequate insurances and careful planning and management.

Robin K Mcguire(Jun 1999) "Analyzing of Risk Factors in Construction" This study helps to make the risk factors involved in construction during and after the construction about the resource allocation, procurement, inventory control. And to minimize the time, cost and increase in quality of construction by analyzing the risk during planning itself.

J.De Brito And F.A.Branco(Mar 2006) "Bridge Management Policy Using Cost Analysis" This study helps to make the efficient use of resource to make the right decision for maintenance and rework in process if it is failed to maintain the there will be some loss in structural failures, loss in time and loss of financial aspects.

E.C.Hambly, Feng Fice And E.A. Hambly (Nov 2009) "Risk evaluation and realism" This study helps in risk calculating the risk analyse technique by the fatality accident rate method. The realism states how the government is taking the necessary steps to repair and rework process related to the time, cost and politics.

G.MilIer (Jan 2006) "Time and Cost Risk Analysis" This study helps how to control the time and cost risk analysis by computer aided simulation of project appraisal and its review. These simulations give the result and help to make the precautionary steps during the planning itself.

Pedro Maria Sanchez, Carr. Tijuana-Ensenada (Dec 2005) "Neural-Risk Assessment System for Construction Projects" studied the assessing the risk impacts and as well in forecasting the possible costs of these risks. Transforming the risk impact into money terms certainly is not an easy thing to do. Traditionally within construction companies, risk management has been adopted nevertheless; the work has been concentrated mainly in risk analysis.

Seon-Gyoo Kim, Jae-Jun Kim (Apr 2005) "A Risk Threshold Calculation Methodology for the Construction Projects Applying Value at Risk" studied the risk management technique rapidly becomes one of the critical project management methodologies to achieve project objectives and improve its performance in gradually increasing uncertainties surrounding the construction environment.

Terry Lysons and Martin Skitmore (Mar2004) "Project Risk Management in the Queensland Engineering Construction Industry a Survey" conducted a survey of senior management concerning the usage of risk management techniques. Their survey compared with earlier survey which indicates that the use of risk management is moderate to high, with very little differences between the types, sizes and tolerance of the organizations, and experience, risk management usage in the execution and planning stage, techniques used for risk identification, risk analysis and risk response.

Alfredo del cano, P.E and M.Pilar de la Cruz, P.E (Dec 2002) "Integrated Methodology for Project Risk Management" suggested that generic project risk management process that has been particularized for construction projects. The process could also be adapted to the needs of other project participants. Any project risk management process must be tailored to the

particular circumstances of the project and of the organization undertaking it.

J.H.M.Tah and V.Carr (July 2002) "Knowledge Based Approach to Construction Project Risk Management" suggested that consistent methodology for construction project risk management. The construction industry consistently suffers from poor project performance due to a lack of formalized risk management procedures which helps to facilitate more effective risk management while allowing all project participants to develop and share a great understanding of project risk for improved performance.

Mulholl. B and **J.Christian** (Feb 1999) "Risk Assessment in Construction Schedules" suggested that a description of systematic way to consider and quantify uncertainty in construction schedules. Construction projects are initiated in complex & dynamic environments resulting in circumstances of high uncertainty & risk, which are demanding time constrains.

Akin tola S Akintoye and MacLeod (Mar 1997) "Risk Analysis and Management in Construction" studied the construction industry perception of risk associated with its activities and the extent to which the industry uses risk analysis and management techniques with the help of a questionnaire survey of general contractors and project managers. The author concluded that risk management is essential to construction activities in minimizing losses and enhancing profitability. Construction risk is generally perceived as events that influence project objectives of cost, time and quality.

Roozbeh Kangari (Dec 1995) "Risk Management Perceptions and trends of U.S Construction" discussed the attitude of large U.S construction firms toward and determined how the contractors conduct construction risk management through a survey of the top 100 contractors. The study showed that in the recent years contractors are more willing to assume risks that accompany actual and legal problem in the form of risk sharing with the owner.

3. Scope And Objectives

- To identify the various risk factors in construction of bridge projects.
- To analyze the sources of risk factors arising in the bridge projects.
- The pilot studies were conducted from various reputed companies.
- Using the pilot study the questionnaire is prepared.
- The survey will be conducted to the construction industries through questionnaire.
- The result will be analyzed from the questionnaire.
- The risk will be solved using the software like SPSS.
- The result and discussion about the risk factors solving in the construction projects.

4. Methodology

The methodology adopted in this project is given below:

- Study of literature related to Time and Financial Management risks.
- Preparation of questionnaire.
- Site visit to major construction project.
- Questionnaire survey and personal interviews with Site-Engineers, Supervisor and managers.
- Analyzing the questionnaire.
- Factor analysis of data obtained from site and identifies the root cause.
- Remedial measures are to be suggested and the present data is to be recorded for future reference.
- Conclusions, recommendations and suggestions for future study.

4.1. Method of Surveying

The general methodology of this study relies largely on the survey questionnaire which will be collected from the various multi project construction contractors and project manager of different sizes by mail or by personnel meeting. A thorough literature review was initially conducted to identify the risk factors that affect the performance of construction industry as a whole. This study has adopted the more general and broad definition of risk as presented by Shen et al (2001) on china's construction joint ventures and more risk factors from other literature. Also some interviews with industrial practitioners were conducted to produce to check of questionnaires.

4.2. Questionnaire Structure and Design

The questionnaire was tested with a pilot survey for clarity, ease of use, value of the information that could be gathered. The questionnaire survey is divided into two parts. The first part consists of general information like type of company, experience, value of their project etc., and the second part consists of the construction risk factors for evaluation.

Risk factor for this study classified into eight categories, namely: financial risk, legal risk, management risk, market risk, policy & political risk, technical risk, environmental risk, social risk.

The survey questionnaire survey is designed to probe the cross-sectional behavioral pattern of construction risks construction industry. The questionnaire was prepared for the pilot survey was formulated by seeing the relevant literatures in the area of construction risk. The interviewer was free to ask additional questions that focused on issues arising during the course of the interview. The freedom to follow the interviewee, to ask for clarifications, and to focus on the specify projects, risk practices and knowledge, made the interviews insightful.

4.3. Risk Rating

A Likert scale of 1-5 was used in the questionnaire. A Likert scale is a type of psychometric response scale questionnaire, and is the most widely used scale in survey research. When responding to a Likert questionnaire item, respondents specify their level of agreement to a statement. The scale is named after Rensis Likert, who published a report describing its use. The respondents were required to indicate the relative critically/effectiveness of each of the probability of risk factors and their impact to the management.

4.4. Design of Survey

The respondents were requested to judge the significance or "expected loss" of each risk. There are many criteria that respondents may need to consider. One alternative approach adopted by previous researches is to consider two attributes for each risk: the probability level of risk occurrence, denoted by *o;* and the degree of impact or the level of loss if the risk occurs denoted by p. The same type of evaluation is followed in this study also. Therefore, risk significance, denoted as RS,

can be described as the function of the two attributes RS=f (α, β).

By applying this approach, the respondents were asked to respond to the two attributes for each risk. For considering a, the respondents were required to judge the probability level of risk occurrence by selecting one from among five levels namely, very small, small, normal, large and very large. For considering p, the respondents were required to judge the degree of impact if the risk concerned occurs, by selecting one from among five grades namely, very low, low and medium, high and very high.

4.5. Analysis Of Survey Results

The survey result has to be analyzed using SPSS software (Statistical Package of Social Studies). This software is one of the management tool helps to analyse the 5-scale likert factor analysis. The various formulas were used to calculate the factor analysis are listed below. To assess the relative significance among risks, previous literatures study suggests establishing a risk significance index by calculating the significance score for each risk. For calculating the significance score is to multiply the probability of occurrence by the degree of impact Thus, the significance score of each risk assessed by each respondent can be obtained through the model

$$S_p^i = \sigma_j^i \beta_j^i$$

Where S_i = significance score assessed by respondent j for risk i; a, = probability of occurrence of risk i, assessed by respondent j; and p, = degree of impact of risk i, assessed by respondent j. By averaging scores from all responses, it is possible to get an average significance score for each risk, and this average score is called the risk index score and is used to rank among all risks. The model for the calculation of risk index score can be written

$$RS^i = \frac{\sum_{i=1}^{T} S_j^i}{T}$$

Where RS^1 = index score for risk i; and S^1 = significance score assessed by respondent j for risk I and T=Total number of responses. To calculate S', the five scales for o and (3, this will be converted into numerical (Likert scale) scales.

4.6 Pilot Survey

A pilot questionnaire survey and follow-up interviews with local contractors was conducted. The purpose was to identify the factors out of the 68 factors that applied overseas could also apply to the construction industry. The small number interviews and the structure of the questionnaire in die pilot study does not allow for statistical analysis.

Responses to the interviews have been used to identify consistent themes, common practices, and insight provided by active and influential project participants that would provide additional guidance and assistance to the research team.

The survey results formed the basis of modifying the questionnaire for the subsequent full-scale survey. The pilot study attempts to short-list locally relevant factors. The criteria for a shortlisting are that the chosen factors are relevant in the local construction industry. As a result, only important and relevant factors can be chosen for inclusion in the full-scale survey in the second phase research.

5. Analysis And Discussion

Ranking of various factors of risk are tabulated with its corresponding bar chart, mean, standard deviation, T-test and ANOVAs results from SPSS statistical tool are also obtained.

5.1. Demographical Analysis & Results of Survey

Table 1. Age of the Respondent

Sl No	Age	No Of Resonance	%
1	30 to 35 years	7	28
2	35 to 40 years	12	48
3	Above 40 years	6	24
	Total	25	100

The table reveals that 28 % of respondents are 30 to 35 years, 48 % of respondents are 35 to 40 years, 24 % of respondents are above 40years, so the majority of the respondents are 35-40 years of age, The majority of the respondents are 35 to 40 years.

Table 2. Position of the Respondent

Sl No	Position	No of Resonance	%
1	Director	2	8
2	Vice director	12	48
3	Project manager	3	12
4	Site/Office engineer	8	32
	Total	25	100

The table reveals that 8 % of respondents are Directors, 48 % of respondents are Vice Directors, 12 % of respondents are Project managers, 32 % of respondents are Site Engineers so the majority of the respondents are Site Engineers.

Table 3. No of labours in the project

Sl No	No. of labours	No of Resonance	%
1	50-60	2	8
2	60-70	6	24
3	70-80	8	32
4	80-90	6	24
5	90 above	2	8
	Total	25	100

The table reveals that 8 % of respondents are 50-60 labours, 24 % of respondents are 60-70 labours, 32 % of respondents are 70-80 labours, 24 % of respondents are 80-90 labours, 8 % of respondents are 90 above.

Table 4. No of projects in hand

Sl No	No. of labours	No of Resonance	%
1	Below 10	3	12
2	11-20	6	24
3	21-30	5	20
4	31-40	8	32
5	40 above	3	12
	Total	25	100

The table reveals that 12 % of respondents are below 10 Projects, 24 % of respondents are 11-20 Projects, 20 % of

respondents are 21-30 Projects, 32 % of respondents are 31-40 Projects, 12 % of respondents are 40 above labours so the majority of the respondents are Project in hand are 31-40.

Table 5. Experience of the Respondent

Sl No	Experience	No of Resonance	%
1	Less than 1 year	4	16
2	From 1 to 3 years	7	28
3	More than 3 to 5 years	5	20
4	More than 5 to 10 years	4	16
5	Over 10 years	5	20
	Total	25	100

The table reveals that 16 % of respondents are below 1 year of experience, 28 % of respondents are 1-3 year of experience, 20 % of respondents are 3-5 year of Experience, 16 % of respondents are 5-10 years of Experience, 20 % of respondents are above 10 years of Experience so the majority of the respondents are 3-5 years of Experience in the projects.

5.2. Descriptive Analysis & Results of Survey

Totally for fifty companies the questionnaire were given, out of which twenty five had an effective reply. Thus the response rate is 90% which is considered a good response in this type of survey. All the questionnaire survey was done from project manager, site engineer or contractor of the project. Even email reply was accepted since it was difficult to get the direct one to one meeting with the project managers. Sub-contractor related problems, time constraint, and increase in inflation were the major problems concerned with the construction companies. The full results were shown in the table 6.

As far as the contractor is concerned shortage of skillful workers has the maximum risk rating and other risks which have maximum risk rating are time constraint, sub-contractor related problems, project delay, improper verification of contract documents, and competition from other companies. For the construction companies, time constraint has the maximum risk rating and other risks which have maximum risk rating shortage of skilful workers, project delay, errors in design drawings, improper project planning and budgeting, and loss due to fluctuation of inflation rate. The least risk rating is environmental risk, social risk, relation with government departments, local protectionism and industrial disputes and problem from near project.

Table 6. Overall ranking of risks

S. No	Sub Risk	Mean	Standard Deviation	t-test
1	There is no standing guideline of the numerous resources in India	2.00	0.913	2.83
2	There are many fake and not original varieties of materials	2.96	1.241	3.21
3	Monopoly of some material types	2.88	1.130	2.82
4	The long distance between the project and resources	3.08	1.706	1.42
5	There is no monitoring for high quality	2.72	1.458	3.82
6	There are no regular tests for materials	3.44	1.261	2.42
7	Absence of basic materials in the project	2.68	1.600	1.29
8	Scarcity of resources sometimes, especially basic resources	1.96	0.841	1.89
9	Some materials do not arrive at the assigned site	2.84	0.898	3.42
10	Agreed-upon technical specification are not realized	3.28	1.696	2.14
11	The contractor takes into account the resource of lowest price	3.32	1.464	3.42
12	Heavy equipment are not maintained periodically	3.04	0.978	4.14
13	Fluctuating prices of materials	2.64	1.254	3.42
14	There are no guarantees on imported materials	2.56	1.685	4.92
15	Absence of trained local manpower	3.56	1.758	3.21
16	Wages of local manpower are high	3.08	1.498	4.15
17	Laws of employing foreign manpower are rigid	2.44	1.158	2.82
18	Absence of training centres for local manpower	3.32	1.600	2.74
19	The worker does not abide by regular work-hours	3.48	1.159	3.21
20	Necessary technical skills are not available	2.64	1.254	2.49
21	Public safety rules are not abided by	2.32	0.802	2.64
22	Absence of health insurance	2.56	0.917	2.52
23	Low productive efficiency of the worker	2.52	1.358	2.62
24	There is no care for workmanship	3.00	1.443	3.42
25	Instability of Cadre in the companies	2.92	1.382	3.16
26	Design bureaus are no monitored	2.24	1.165	1.85
27	There are many design bureaus	2.44	1.261	3.14
28	Providing special Cadre is not abided by	3.24	1.615	1.72
29	The designer does not follow up designs and changes made on them	2.92	1.187	2.42
30	The owner's meddling with the design	3.48	1.229	3.60
31	Recurring design errors	3.20	1.443	2.72
32	Errors in the inventory of quantities	2.96	1.767	2.64
33	Supervising the project is not abided by	3.12	1.563	4.42
34	Plans of design are incompatible with execution	2.40	1.581	2.82
35	Survey processes are not precise	2.72	1.173	2.42
36	Many modifications on designs are made during execution	2.40	1.323	3.82

37	The Company obtain large loans	2.52	1.917	2.42
38	Inability to execute the project within specified timetable	3.04	1.485	3.81
39	The owner lags behind in paying the contractor	3.40	1.414	3.42
40	Contractor expands his work simultaneously in more than one project	2.72	1.242	1.92
41	The contractor does not pay worker wages in due time	3.04	1.306	3.42
42	Incompatibility of work progress (completed work) with cash payments	3.00	1.658	1.72
43	Weak remitting	3.36	1.655	2.42
44	Construction prices are low	3.36	1.319	2.64
45	Competition in pricing projects	2.68	1.314	1.59
46	Absence of laws governing payment process and protecting contractor's rights	2.84	1.405	1.82
47	Large number of Construction companies in India	2.64	1.411	3.49
48	Deterioration of general economic conditions	2.36	1.150	3.32
49	Specialists in project financial analysis are not employed	3.04	1.338	1.76
50	Inability to control project financial affairs	3.48	1.584	3.42
51	Taxes and tax burdens	2.60	1.323	2.72
52	Absence of price standing strategy in the market	3.12	0.833	2.59
53	In experience when pricing tenders	2.60	0.764	1.42
54	Absence of clear financing mechanisms	3.24	1.763	1.39

6. Time Management

Inflation rate is very high in India and increasing proportionately with time, this causes the increase in prices of materials like cement, steel which interns causes financial risk to the land developers and construction firms. Banks have also raised their interest rates for the loan given by them, this have affected the residential construction market hugely. Thus the financial part of risk is very is very high than any other risk. Ranking of time management risks are given in the table 7.

Table 7. Ranking of Time management

S. No	Sub Risk	Mean	Standard Deviation
1	Scarcity of resources sometimes, especially basic resources	1.96	0.841
2	There is no standing guideline of the numerous resources in India	2.00	0.913
3	Design bureaus are no monitored	2.24	1.165
4	Public safety rules are not abided	2.32	0.802
5	Plans of design are incompatible with execution	2.40	1.581
6	Many modifications on designs are made during execution	2.40	1.323
7	Laws of employing foreign manpower are rigid	2.44	1.158
8	There are many design bureaus	2.44	1.261
9	Low productive efficiency of the worker	2.52	1.358
10	There are no guarantees on imported materials	2.56	1.685
11	Absence of health insurance	2.56	0.917
12	Fluctuating prices of materials	2.64	1.254
13	Necessary technical skills are not available	2.64	1.254
14	Absence of basic materials in the project	2.68	1.600
15	There is no monitoring for high quality	2.72	1.458
16	Survey processes are not precise	2.72	1.173
17	Some materials do not arrive at the assigned site	2.84	0.898
18	Monopoly of some material types	2.88	1.130
19	Instability of Cadre in the companies		1.382
20	The designer does not follow up designs and changes made on them	2.92	1.187
21	There are many fake and not original varieties of materials	2.96	1.241
22	Errors in the inventory of quantities	2.96	1.767
23	There is no care for workmanship	3.00	1.443
24	Heavy equipment are not maintained periodically	3.04	0.978
25	The long distance between the project and resources	3.08	1.706
26	Wages of local manpower are high	3.08	1.498
27	Supervising the project is not abided by	3.12	1.563
28	Recurring design errors	3.20	1.443
29	Providing special Cadre is not abided by	3.24	1.615
30	Agreed-upon technical specification are not realized	3.28	1.696
31	The contractor takes into account the resource of lowest price	3.32	1.464
32	Absence of training centres for local manpower	3.32	1.600
33	There are no regular tests for materials	3.44	1.261
34	The worker does not abide by regular work-hours	3.48	1.159
35	The owner's meddling with the design	3.48	1.229
36	Absence of trained local manpower	3.56	1.758

7. Financial management

Inflation rate is very high in India and increasing proportionately with time, this causes the increase in prices of materials like cement, steel which interns causes timing risk to the land developers and construction firms. Banks have also raised their interest rates for the loan given by them, this have affected the residential construction market hugely. Thus the

financial part of risk is very is very high than any other risk. Ranking of financial management risks are given in the table 8.

Table 8. Ranking of Financial management

S. No	Sub Risk	Mean	Standard Deviation
1	Deterioration of general economic conditions	2.36	1.150
2	The Company obtain large loans	2.52	1.917
3	Taxes and tax burdens	2.60	1.323
4	In experience when pricing tenders	2.60	0.764
5	Large number of Construction companies in India	2.64	1.411
6	Competition in pricing projects	2.68	1.314
7	Contractor expands his work simultaneously in more than one project	2.72	1.242
8	Absence of laws governing payment process and protecting contractor's rights	2.84	1.405
9	Incompatibility of work progress (completed work) with cash payments	3.00	1.658
10	Inability to execute the project within specified timetable	3.04	1.485
11	The contractor does not pay worker wages in due time	3.04	1.306
12	Specialists in project financial analysis are not employed	3.04	1.338
13	Absence of price standing strategy in the market	3.12	0.833
14	Absence of clear financing mechanisms	3.24	1.763
15	Weak remitting	3.36	1.655
16	Construction prices are low	3.36	1.319
17	The owner lags behind in paying the contractor	3.40	1.414
18	Inability to control project financial affairs	3.48	1.584

Table 9. Showing the One-way ANOVA for time management on the basis of their Age

S.	Age	Number	Mean	SD	F-value	P-value
1.	30 to 35 years	7	95.86	31.17	4.182	0.01 (S)
2	35 to 40 years	12	104.92	30.95		
3.	Above 40	6	104.83	41.21		
	Total	25	102.36	32.45		

S – significant

The above table clearly shown that below 40 years of age group scored higher mean value (104.92) than the other groups. The calculated F-ratio (4.182) to confirmed the mean difference between the groups, which is significant. Therefore irrespective of the age group all the respondents have same opinion about the time management.

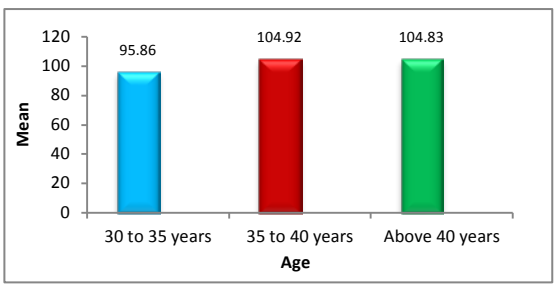

Fig 1. Time management on the basis of their Age

Table 10. Showing the One-way ANOVA for time management on the basis of their position

S. No.	Position	Number	Mean	SD	F-value	P Value
1.	Director	2	109.50	28.991	4.146	0.01 (S)
2.	Vice director	12	108.83	35.396		
3.	Project manager	3	117 00	25.981		
4.	Site/Office engineer	8	85.38	28.645		
	Total	25	102 36	32.450		

S -significant

The above table clearly has shown that Project manager group scored higher mean value (117.00) than the other groups. The calculated F-ratio (4.146) to confirm the mean difference between the groups, which is significant. Therefore irrespective of the position group all the respondents have same opinion about the time management.

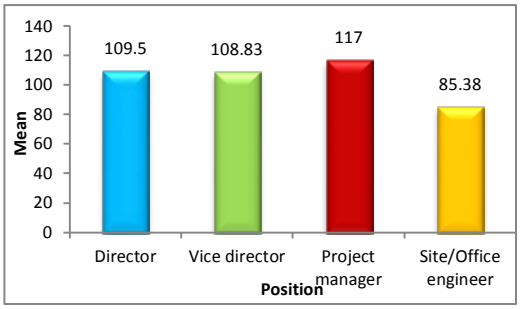

Fig 2. Time management on the basis of their position

Table. 11 Showing the One-way ANOVA for time management of the basis of their experience

S. No.	Experience	Number	Mean	SD	F value	P Value
1.	Less than 1 year	4	96.50	27.086	4.109	0.01 (S)
2	From 1 to 3 years	7	96.86	35.396		
3.	More than 3 to 5 years	5	120.40	29.492		
4.	More than 5 to 10 years	4	80.50	24.839		
5.	Over 10 years	5	114.20	38.271		
	Total	25	102.36	32.450		

S - significant

The above table clearly shown that more than 3 to 5 years of experience group scored higher mean value (120.40) than

the other groups. The calculated F-ratio (4.109) to confirmed the mean difference between the groups, which is significant. Therefore irrespective of the experience group all the respondents have same opinion about the time management.

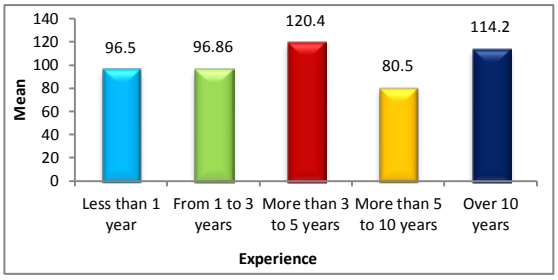

Fig 3. Time management on the basis of their Experience

Table .12 Showing the One-way ANOVA for financial management on the basis of their Age

S - significant

The above table clearly shown that below 40 years of age group scored higher mean value (53.83) than the other groups. The calculated F-ratio (3.04S) to confirmed the mean difference between the groups, which is significant. Therefore irrespective of the age group all the respondents have same opinion about the financial management.

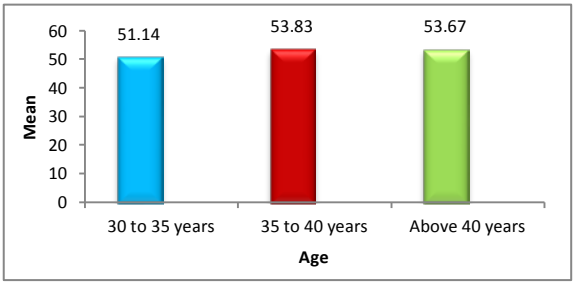

Fig 4. Financial management on the basis of their Age

Table 13. Showing the One-way ANOVA for financial management on the basis of their position

S. No.	Position	Number	Mean	SD	F-value	P Value
1.	Director	2	52.50	19.092	3.677	0.01 (S)
2	Vice director	12	55.42	20.987		
3.	Project manager	3	62,33	14.434		
4.	Site/Office engineer	8	46.12	15.652		
	Total	25	53.04	18.315		

S - significant

The above table clearly has shown that Project manager group scored higher mean value (62.33) than the other groups. The calculated F-ratio (3.677) to confirm the mean difference between the groups, which is significant. Therefore irrespective of the position group all the respondents have same opinion about the financial management.

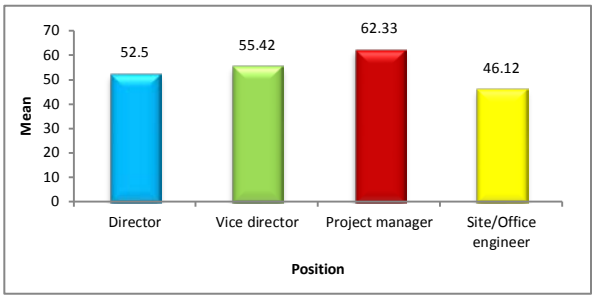

Fig 5. Financial management on the basis of their position

Table 14. Showing the One-way ANOVA for Financial management on the basis of their Experience

S. NO.	Experience	Number	Mean	SD	F-value	P Value
1.	Less than 1 year	4	46.25	17.443	3.685	0.01 (S)
2.	From 1 to 3 years	7	51.43	19.060		
3.	More than 3 to 5 years	5	62.00	18.358		
4.	More than 5 to 10 years	4	45.25	10.751		
5.	Over 10 years	5	58.00	23.948		
	Total	25	53.04	18.315		

S -significant

The above table clearly shown that more than 3 to 5 years of experience group scored higher mean value (62.00) than the other groups. The calculated F-ratio (3.685) to confirmed the mean difference between the groups, which is significant. Therefore irrespective of the experience group all the respondents have same opinion about the financial management.

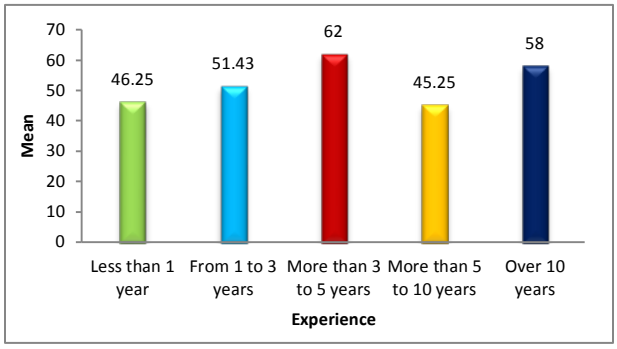

Fig 6. Financial management on the basis of their Experience

Table 15. Showing the Stepwise regression analysis predicting Risk analysis of time & cost in Bridge projects and factors

S. No	Step/ Source	Unstandardized Coefficients Beta	Std. Error	Standardized Coefficients Beta	Step t	P
1	Time management	1.814	0.724	0.849	3.584	0.01

2.	Financial management	2.349	0.692	0.589	2.892	0.01

Two variables viz Time management and financial management have significantly contributed for predicting the Risk analysis of time & cost in Bridge. The first variable Work at Time management seems to be 3.584, when paired with the second variable Financial management is 2.892. The predictive value of these variables separately is 0.01.

8. SUGGESTIONS

Data collected from the questionnaires survey has been analysed through SPSS software and found that the highly risk factors the following points will be helpful to overcome the risk:

- Contracting documents to be legally registered
- Contracting duration must be specified with adjustment in case of natural calamity
- Payment mode to be specified based on progress or duration
- Specification or Dimension changes to be recorded in register
- Disputes and Errors to be solved with record proofs
- Meeting conducting periodically
- Insurance on Equipment, Machineries and Manpower to be pre-determined
- Political and Local issues to be solved by whom must be pre-determined
- Re-work must be denoted under whose scope based on fault.
- Client to be pay the payment as per modes to the contractor
- Client payment should be through BANK transaction
- Client may monitor the contractor's payment to workers
- Workers' wages also to be paid through BANK transaction
- Workers' wages to be paid in weekly or monthly payment
- Delaying payment to Workers will affect the progress
- Do not delay or reduce the wages based on Financial difficulties of contractor
- Incentives or Bonus from profit will enthusiast the workers
- Increment based on experience or efficiency will lead the workers to retain
- Client's Slow payment for completed works will affect contractor pay to labour
- Skilled staff to be deployed for tendering
- Technical skilled person to be execute the work
- Highly technically experienced person to be administrate the project
- Sufficient technical information's to be provided in the drawings and documents
- Necessary technical trainings to be provide to the workers
- High tech technology equipment and machineries to be used to get fast and accuracy.
- Do not awarded the work to inadequate experienced contractor
- To be monitor inadequate resources due to contractor/ lack of capital
- To be corrected the poor contractor management

9. CONCLUSION

This study should assist management in identifying activities where there is a risk of time and financial aspects and hence provide a basis for management to take objective decisions on the reduction of risk to an agreed level. These findings are very important for implementing further effective measures to ensure the right direction of future development. Risk management should be considered a primary tool to assess the project.

9.1. In Time management aspect:

1. The absence of trained local manpower mean value (3.56) and SD value (1.758).
2. Agreed-upon technical specification are not realized mean value (3.28) and SD value (1.696).
3. Providing special cadre is abided mean value (3.24) and SD value (1.615).
4. The absence of training centres for local manpower mean value (3.32) and SD value (1.600).
5. Long distance between the project site and resources mean value (3.08) and SD value (1.706).

Conclusion for the above factor as follows:

- Meeting should be conducted periodically to ensure the labour provided for the work is good.
- Proper training should be allotted for the labours.
- Proper supervision should be given from the management.
- The proper supervision should be taken care from the management during the work in progress.
- Weakly once work progress report should be submitted to know the work is done under the proper specifications.
- The person should have the proper record maintenance.
- Work progress record to be checked for the maintenance of proper specification.
- The site engineers and supervisors are responsible for the training of labours.
- Supervision for the implementation of workers after the training.
- Night time shifting is allowed because there will be reduction of traffic rate.
- Day and night work should be helpful for the construction of bridges.

9.2. In Finance management aspect:

1. Incompatibility of work progress with cash payment mean value (3.00) and SD value (1.658).
2. The owner lags behind in paying the contractor mean value (3.04) and SD value (1.306).
3. Weak remitting mean value (3.36) and SD value (1.655).
4. Inability to control project financial affairs mean value (3.48) and SD value (1.584).

Conclusion for the above factor as follows:

- Depending upon the security and bank documents fund flow should be maintained.
- The cash for the particular work to be given to encourage the labours and to finish the work in progress as soon as

possible.

- For the sub-contractors some 50% finance has to be given for their work,
- During the work 30% of finance should be given for the work in progress.
- After finishing, inspection should be taken care for full settlement of cash.
- The proper record maintenance every weak for the payment of labours.
- This factor should be taken care during the financial budgeting.
- This will not be controlled unless the effective record should be maintained.
- The shift duty should be helpful for the weak remitting.
- The purpose of this thesis was to determine perceived risks of bridge construction projects of such parties involved in it as consultants, contractors to determine difference in perceived risks of contractors, consultants.
- Objects of the thesis were bridge construction projects data was collected by means of questionnaire administration to an interview with respondents consisting of Directors, Vice Directors, Site Engineers and Project managers.
- Data collected was subjected to 5-scale Impact Grid with Scores of Risk. Those scores were the used to determine difference in perceived risks of Directors, Vice Directors, Site Engineers and Project managers which was then analyzed by using the software of SPSS using the formulas of ANOVA test and t- test.
- Results of risk analysis of construction time indicated that, according to the highest risk was poor performance of sub-contractors.
- According to contractor, it was due to under- or unskilled workers. » It was due to difficulty in obtaining workers directly on-site. In terms of construction costs, the highest risk was, according to consultant, low level of productivity.

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