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Critical Factors Influencing to Management Risk in Construction Projects

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ABSTRACT
Project management, over the last three decades has developed into a systematic way of dealing with all aspects of construction projects. The objective of this study is to identify the risks that are caused in various construction projects and calculating the risks severity to personal and property. The general methodology of this study relies largely on the survey questionnaire which was collected from various sources. Thorough literature review has been conducted to identify the risk factors that affect the performance of the construction industry as a whole. The questionnaire prepared for the pilot survey was formulated based on the relevant literatures in the area of construction risk management. The questionnaire has been sent to three hundred and twelve companies. One hundred and fifty responded. Thus the response rate is 48% which is considered good in this type of survey. This research seeks to identify and assess the risk and to develop a management framework which the investors/developers/contractors can adopt when contracting construction works. The data were analyzed by Descriptive Statistics and ANOVA.

Keywords: Management Risk, Construction Projects Risk, Project Management and Construction management.

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I. INTRODUCTION

Risk is an uncertain event or condition that, if it occurs, has a positive or a negative effect on a project objective [1]. Risk Management (RM) is the systematic process of identifying, analyzing, and responding to project risk. RM includes maximizing the probability and consequences of positive events and minimizing the probability and consequences of adverse events to project objectives [2]. Project management is the application of knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project [3].

Risk Management

Risk management in a project encompasses identifying factors that could potentially negatively impact a project's cost schedule or quality baselines; quantifying the associated potential impact of the identified risk; and implementing measures to manage and mitigate the potential impact [4-12]. The riskier the activity is, the costlier the consequences if wrong decision is made. Businesses would like to quantify risk for many reasons. Knowing how much risk is involved will help decide if costly measures to reduce the level of risk are justifiable. It can also help to decide if sharing the risk with an insurance company is justified. Some risks, such as natural disasters, are virtually unavoidable and affect many people. All choices in life involve risk. Risks cannot be totally avoided, but the choice cans be made so that risk is minimized.

Risk Assessment

Risk assessment is defined in this study as a technique that aims to identify and estimate risks to personnel and property impacted upon by a project. Traditional risk assessment for construction has been synonymous with probabilistic analysis. Such approaches require events to be mutually exclusive, exhaustive, and conditionally independent. However, construction involves many variables, and it is often difficult to determine causality, dependence and correlations [13-15]. As a result, subjective analytical methods that rely on historical information and the experiences of individuals and companies have been used to assess the impact of construction risk and uncertainty.

II. LITERATURE SURVEY

Akintola S Akintoye and Malcolm J MacLeod (1997) studied the construction industry's 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 authors 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.

Risk analysis and management in construction depend mainly on intuition, judgment and experience. Formal risk analysis and management techniques are rarely used due to a lack of knowledge and to doubts on the suitability of these techniques for construction industry activities.

Shen L Y (1997) identified the most serious project delay risks and the effective actions for managing these risks. Practitioners' risk management actions and their effectiveness have been investigated through a questionnaire survey. It revealed that methods where practitioners' experience and subjective judgment are used are the most effective and important risk management action, and that methods using quantitative analytical techniques have been rarely used due to limited understanding and experience. The findings also suggest a need to promote the application and awareness of various analytical techniques for risk management in a proper context in the Hong Kong construction industry.

Thomas E Uher and A Ray Toakley (1999) studied the use of risk management in the conceptual phase of the construction project development cycle in the Australian construction industry through a survey. It was found that while most respondents were familiar with risk management; its application in the conceptual phase was relatively low, even though individuals were willing to embrace change.

Li Bing and Robert L. K. Tiong (1999) categorized the risk factors and their mitigating measures, the most effective risk mitigating measures were categorized into eight groups. Those are partner selection, agreement, employment, control, subcontracting, engineering contract, good relationship, and renegotiation. They proposed a risk management model incorporating measures. Three cases of international construction JVs were analyzed from the perspectives of the execution of these measures.

Li Bing et al (1999) identified the risk factors associated with international construction joint ventures (JVs) from and ''integrated'' perspective. The risk factors were grouped into three main groups: (1) Internal; (2) Project- specific; and (3) External. The study examined the most effective mitigating measures adopted by construction professionals in managing these risks for their construction projects in East Asia. Based on an international survey of contractors, it was found that the most critical risk factors exist in the financial aspects of JVs, government policies, economic conditions, and project relationship. When entering a foreign construction market in the form of a JV, a foreign construction company could reduce its risks if it would carefully select its local partner, ensure that a good JV agreement is drafted, choose the right staff and subcontractors, establish good project relationships, and secure a fair construction contract with its client.

Mulholland Christian (1999) made a model in a systematic way to consider and quantify uncertainty in construction schedules. The study focused on lessons learned from past projects and describes a risk assessment process involving typical inputs and expected outputs. The model incorporates knowledge and experience acquired from many experts, project-specific information, decision analysis techniques, and a mathematical model to estimate the amount of risk in construction schedule at the initiation of a project. The model provides the means for sensitivity analyses for different outcomes wherein the effect of critical and significant risk factors can be evaluated.

Hastak and Shaked (2000) classified all risks specific to whole construction scenario into three broad levels, i.e. country, market and project levels. Macroeconomic stability is partly linked to the stance of fiscal and monetary policy, and to a country's vulnerability to economic shocks. Construction market level risks, for foreign firm, include technological advantage over local competitors, availability of construction resources, complexity of regulatory processes, and attitude of local and foreign governments towards the construction industry while project level risks are specific to construction sites and include logistic constraints, improper design, site safety, improper quality control and environmental protection, etc.

Alfredo del Can et.al (2002) presented a generic project risk management process that has been particularized for construction projects from the point of view of the owner and the consultant who may be assisting the owner. First, the authors explains complete or generic project risk management process to be undertaken by organizations with the highest level of risk management maturity in the largest and most complex construction projects. After that, factors influencing possible simplifications of the generic process are identified, and simplifications are proposed for some cases. Then the application to a real project summarized. As a final validation, a Delphi analysis has been developed to assess the project risk management methodology explained here, and the results are presented. The appropriate contracting method and the contract documents for any construction project depend on the nature of the project, but an appropriate contracting method coupled with clear and equitable contract documents do not by themselves ensure project success where people work together in the face of uncertainty and complexity with diverse interests and conflicting agendas. The attitudes of the contracting parties and the co-operative relationships among the project participants are important for successful project delivery. These are examined in the light of transaction cost economics and relational contracting (RC) principles. It is found that RC may well be a useful route towards reduced transaction costs, while also fostering co-operative relationships and better teamwork that in turn facilitate joint risk management (JRM).The usefulness of the latter is reinforced by relevant observations from a recent Hong Kong-based survey, followed by a case study in Mainland China.

Thomas et al (2003) carried out risk perception analysis to evaluate the risk criticality, risk management capability, risk allocation/sharing preference, and factors influencing risk acceptance of major stakeholders in BOT projects. They surveyed various senior project participants such as government officials, promoters, lenders and consultants of Indian BOT road projects. Eight types of risks have been identified as very critical in the Indian road sector under BOT set up with traffic revenue risk being the most critical. The study revealed that the factors and their relative influence on the risk acceptance of stakeholders are considerably different.

Wong and Hui (2003) identified the importance of risk factors by data collected in a postal questionnaire survey conducted to the building contractors in Hong Kong. Out of 60 factors identified the availability of required cash, uncertainty in costs estimates urgent need for work, past experience in similar projects and contract size are considered most important. The findings suggested that in the upward adjustment of tender prices, the large-size contractors are more concerned with the uncertainty in costs estimates while the medium- and small-size contractors care more about no past experience.

Shen et al (2003) established a risk significance index, based on a survey to show the relative significance among the risks associated with the joint ventures in the Chinese construction procurement practice. Real cases were examined to show the risk environment faced by joint ventures. The paper also investigated practical applications of risk management in the business of joint ventures.

Kansal and Manoj Sharma (2012) present risks are very common in construction sector. Risk is the Possibility of suffering loss and the impact on the involved parties. Risk is identified and then risk assessment and analysis is done. Then risk management and risk mitigation is carried out. Risk affect construction sector negatively and focusing on risk reduction measure it important. The purpose of this study is to assess the use and method of risk identification techniques in the construction industry. They are classified in specialized industrial construction, infrastructure and heavy construction. We conducted a survey research by applying a questionnaire among in the construction industry. The risk identification techniques more frequently applied in construction are checklist, flowchart, Brain storming, Delphi method etc.

Patel Ankit Mahendra et al., (2013) present significant impact on construction projects in terms of its primary objectives. Construction projects which are intricate in nature, uncertainty and risks in the same can develop from different sources. The record of the construction industry is not acceptable in terms of coping up with risks in projects. Risk management is a process which consists of identification of risks, assessment with qualitatively and quantitatively, response with a suitable method for handling risks, and then control the risks by monitoring. This study proposes to apply the risk management technique which includes well - documented procedures for the one stop solution all types of hazards most likely to occur during any construction project Lifecycle.

Renuka et al., (2014) explain infrastructure development will increase the growth of countries economy and generates the large amount of job opportunities. Hence those projects involve a large amount of investment to carry out. In view of that, if any sort of wastage (either time, resources etc) occurs that would lead to the huge monetary losses. These losses occur due to various risks associated with such mega projects. Consequently, these risks play a crucial role for the completion of project within the time schedule and planned budget. In this connection, this study mainly discusses the critical risk factors and its assessment techniques through comparative study of various international construction projects. About 50 relevant articles published over the last 25 years have been reviewed. The review resulted that a simple analytical tool will be developed for each project task to assess the risk easily and quickly, which will encourage the practitioners to do the risk analysis in their project. This review concluded that the earlier risk identification in the

III. OBJECTIVES AND NEED OF STUDY

The risk management technique is used very less because of less knowledge and awareness among the people. The track record is also very poor in terms of coping up with risks in projects, resulting in the affection of project objectives. Risk management is adopted to contain the possible future risks proactively rather than being reactive. It applies to any project to evaluate the most, major, and common risks which cause bad effect on the construction project to achieve its objectives. The risk management concept is very less popular technique in the construction industry, then it is necessary to spread awareness of the same

IV. METHODOLOGY

In this paper, general focus has been made on the general concepts of risk management. Risk identification has been done with the study of literature. A questionnaire was developed after the identified factors affecting the projects. A risk assessment can be done with the aid of Statistical analysis; ANOVA analysis and t-test were used. Risk response could be planned on the basis of the outcome of the study. Risk control is the last step in the process of risk management. Remedial measures to be suggested and the present data to be recorded for future reference

V. QUESTIONNAIRE STRUCTURE

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

VI. RISK RATING

A Likert scale of 0-5 was used in the questionnaire. A Likert scale is a type of psychometric response scale often used in questionnaires, 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 (Likert, 1932). The respondents' were required to indicate the relative criticality/ effectiveness of each of the probability of risk factors and their impact to the management.

VII. MANAGEMENT RISKS

As of now compared with other industries the construction sector suffers a chronic shortage of no past experience in similar projects, though unskilled workers are available in large amount from different part of the country. Employment services company Ma FoI (http://www.mafoianalytics.com) estimates a 20% shortfall in the supply of civil engineers needed by the construction industry. People shortage in the construction industry stems from civil engineers abandoning construction in favor of higher-paying IT industry jobs all these years. Within a short span of two years the whole thing may change to vice versa due to higher pay packages given by International /National companies' par with IT companies or even more. But now, that the infrastructure sector is growing; there is a huge demand and supply gap. Insufficient manpower may slow down infrastructure projects as companies may phase them longer than necessary. In some companies the problem of improper project planning and budgeting, poor relation with government departments, lack of team work, change of top management etc. To overcome these problems, those factor of severity must be identified and reduced to solve the problem.

Factors are under Management Risk (MgR) given below:

MgR-1 - Lack of Team Work
MgR-2 - No Past Experience in Similar Projects
MgR-3 - Improper project planning and budgeting.
MgR-4 - Change of top management.
MgR-5 - Sub-contractor related problem.
MgR-6 - Poor relation and disputes with partner.
MgR-7 - Project delay.
MgR-8 - Time constraint
MgR-9 - Poor relation with government departments.
MgR-10 - Internal management problem.

VIII. STATISTICAL TECHNIQUES USED

- Descriptive analysis (Mean, Standard Deviation),
- Differential analysis (t-test and ANOVA)

a. Mean (M)

The mean of a distribution is commonly understood as the arithmetic average. It is perhaps the most familiar, most frequently used and well understood average.

The mean of a set of observations or scores is obtained by dividing the sum of all the values by the total number of values.

a) For ungrouped data

$$M = \frac{\sum X}{N}$$

b) For grouped data

$$M = A.M + \frac{\sum fx^{1}}{N} x \ i$$

b. Standard deviation (σ)

The average of squared deviations of the measures of scores from their mean is known as the variance. The standard deviations is the positive square root of variance.

a) for ungrouped data

$$\sigma = \sqrt{\frac{\sum x^{2}}{N}}$$

b) for grouped data

$$\sigma = \sqrt{\frac{\sum x^{2} - (\sum x)^{2}}{N}}$$

c) ' F' test

In order to find out the significant difference of three and more variables, 'F' test is used. The formula for the 'F'' test is

$$F \text{ ratio} = \frac{\text{mean square between}}{\text{mean square with in}}$$

The One-Way ANOVA procedure produces a one-way analysis of variance for a quantitative dependent variable by a single factor (independent) variable. Analysis of variance is used to test the hypothesis that several means are equal. This technique is an extension of the two-sample test.

In addition to determining that differences exist among the means, you may want to know which means differ. There are two types of tests for comparing means: a priori contrasts and post hoc tests. Contrasts are tests set up before running the experiment, and post hoc tests are run after the experiment has been conducted. You can also test for trends across categories.

d) t- Test

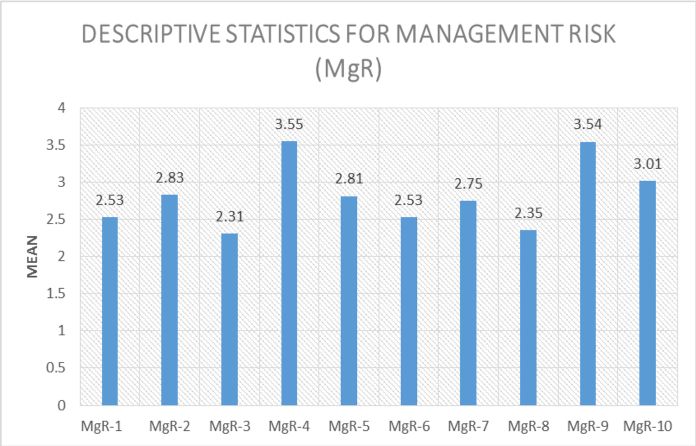
Statistics will help us to find whether one group differs from another set or not. We calculate the mean of each group and then out whether the means of the two groups differ or not. To find out the difference between two means we use't' test.

10. RESULTS (1)

Factor Number and Name	Mean	Std. deviation
MgR-1 Lack of Team Work	2.53	1.268
MgR-2 No Past Experience in Similar Projects	2.83	1.110
MgR-3 Improper project planning and	2.31	1.237
MgR-4 Change of top management.	**3.55**	**1.126**
MgR-5 Sub-contractor related problem.	2.81	1.267
MgR-6 Poor relation and disputes with	2.53	1.352
MgR-7 Project delay.	2.75	1.117
MgR-8 Time constraint	2.35	1.354
MgR-9 Poor relation with government	3.54	1.123
MgR-10 Internal management problem.	3.01	1.417

Table (1): Statistical Analysis

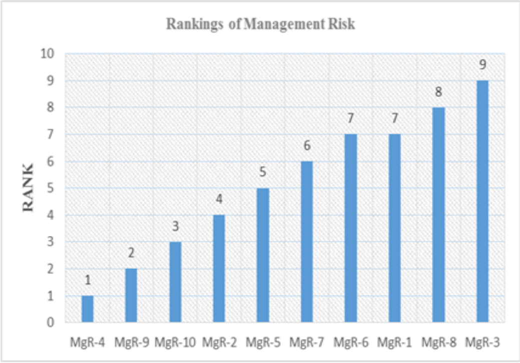
In the case of management Risk, **MgR4** *(Change of the top management)* scored (3.55±1.126) higher mean vale than the other groups. So Change of top management have high level of management risk than the other in the group



RESULTS (2)

Table (2): Rankings of Management Risk

FACTOR NUMBER AND NAME	MEAN	Rank
MgR-4 Change of top management.	3.55	**1**
MgR-9 Poor relation with government departments.	3.54	**2**
MgR-10 Internal management problem.	3.01	**3**
MgR-2 No Past Experience in Similar	2.83	**4**
MgR-5 Sub-contractor related problem.	2.81	**5**
MgR-7 Project delay.	2.75	**6**
MgR-6 Poor relation and disputes with	2.53	**7**
MgR-1 Lack of Team Work	2.53	**7**
MgR8 Time constraint	2.35	**8**
MgR-3 Improper project planning and budgeting.	2.31	**9**

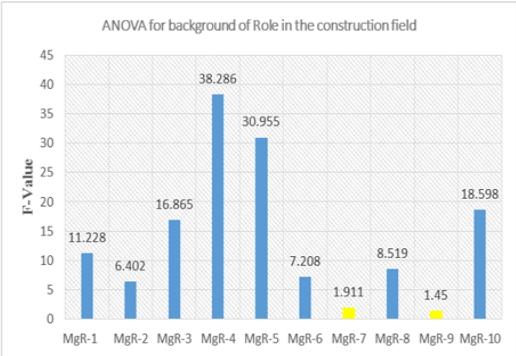


In the case of Management risk, **Change of Top Management** has high mean value hence it stands in ranking one that means its severity is high, similarly all the risk factor's rank position has tabulated above depending on its mean value

RESULTS (3)

Table (3): Results of ANOVA for background of **Role** in the construction field

FACTOR NUMBER AND NAME	F-value	Sig.
MgR-1 Lack of Team Work	11.228	0.01
MgR-2 No Past Experience in Similar Projects	6.402	0.01
MgR-3 Improper project planning and	16.865	0.01
MgR-4 Change of top management.	38.286	0.01
MgR-5 Sub-contractor related problem.	30.955	0.01
MgR-6 Poor relation and disputes with	7.208	0.01
MgR-7 Project delay.	1.911	0.130
MgR-8 Time constraint	8.519	0.000
MgR-9 Poor relation with government	1.450	0.231
MgR-10 Internal management problem.	18.598	0.000

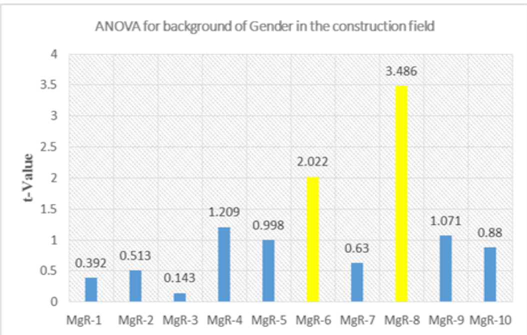


Eight factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their role in the construction field. These factors are **MgR1, MgR2, MgR3, MgR4, MgR5, MgR6, MgR8, and MgR10.**

RESULTS (4)

Table (4): Results of ANOVA for background of **Gender** in the construction field

FACTOR NUMBER AND NAME	t-value	Sig.
MgR-1 Lack of Team Work	0.392	0.696
MgR-2 No Past Experience in Similar Projects	0.513	0.609
MgR-3 Improper project planning and	0.143	0.887
MgR-4 Change of top management.	1.209	0.229
MgR-5 Sub-contractor related problem.	0.998	0.320
MgR-6 Poor relation and disputes with	**2.022**	**0.01**
MgR-7 Project delay.	0.630	0.530
MgR-8 Time constraint	**3.486**	**0.01**
MgR-9 Poor relation with government	1.071	0.286
MgR-10 Internal management problem.	0.880	0.380

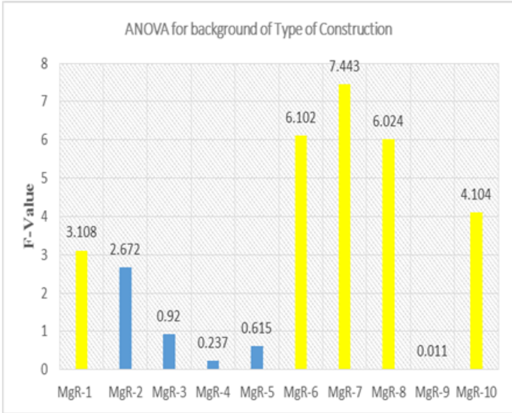


Two factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their **Gender**. These factors are **MgR6 and MgR8.**

RESULTS (5)

Table (5): Results of ANOVA for background of **Type of construction**.

FACTOR NUMBER AND NAME		F-value	Sig.
MgR-1	Lack of Team Work	**3.108**	**0.01**
MgR-2	No Past Experience in Similar Projects	2.672	0.072
MgR-3	Improper project planning and	0.920	0.401
MgR-4	Change of top management.	0.237	0.789
MgR-5	Sub-contractor related problem.	0.615	0.542
MgR-6	Poor relation and disputes with	**6.102**	**0.01**
MgR-7	Project delay.	**7.443**	**0.01**
MgR-8	Time constraint	**6.024**	**0.01**
MgR-9	Poor relation with government	0.011	0.989
MgR-10	Internal management problem.	**4.104**	**0.01**

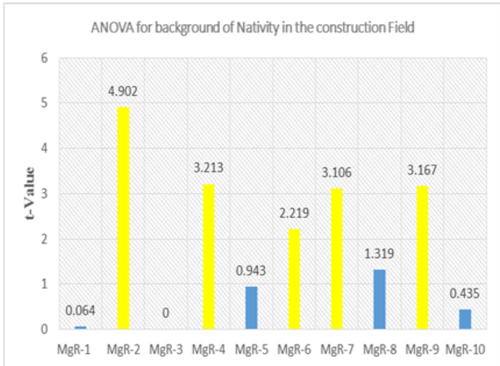


Five factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their **Type of Construction**. These factors are **MgR1, MgR6, MgR7, MgR8 and MgR10**

RESULTS (6)

Table (6): Results of ANOVA for background of **Nativity i**n the construction field.

FACTOR NUMBER AND NAME		t-value	Sig.
MgR-1	Lack of Team Work	0.064	0.949
MgR-2	No Past Experience in Similar Projects	**4.902**	**0.01**
MgR-3	Improper project planning and	0.000	1.000
MgR-4	Change of top management.	**3.213**	**0.002**
MgR-5	Sub-contractor related problem.	0.943	0.348
MgR-6	Poor relation and disputes with	**2.219**	**0.01**
MgR-7	Project delay.	**3.106**	**0.01**
MgR-8	Time constraint	1.319	0.189
MgR-9	Poor relation with government	**3.167**	**0.01**
MgR-10	Internal management problem.	0.435	0.664

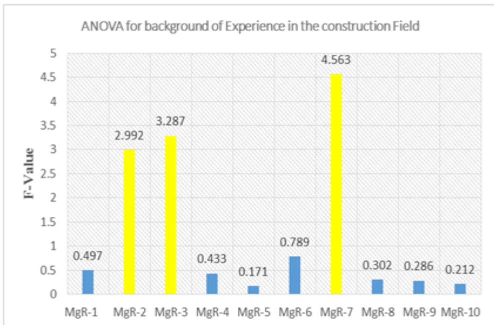


Five factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their nativity. These factors are **MgR2, MgR4, MgR6, MgR7, and MgR9**

RESULTS (7)

Table (7): Results of ANOVA for background of **Experience i**n the construction field.

FACTOR NUMBER AND NAME		F-value	Sig.
MgR-1	Lack of Team Work	0.497	0.738
MgR-2	No Past Experience in Similar Projects	**2.992**	**0.01**
MgR-3	Improper project planning and	**3.287**	**0.01**
MgR-4	Change of top management.	0.433	0.785
MgR-5	Sub-contractor related problem.	0.171	0.953
MgR-6	Poor relation and disputes with	0.789	0.534
MgR-7	Project delay.	**4.563**	**0.01**
MgR-8	Time constraint	0.302	0.877
MgR-9	Poor relation with government	0.286	0.931
MgR-10	Internal management problem.	0.212	0.881

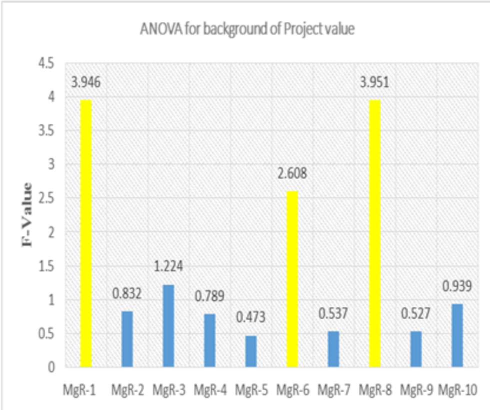


Three factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their Experience. These factors are **MgR2, MgR3, and MgR7**.

RESULTS (8)

Table (8): Results of ANOVA for background of **Project Value.**

FACTOR NUMBER AND NAME	F-value	Sig.
MgR-1 Lack of Team Work	**3.946**	**0.01**
MgR-2 No Past Experience in Similar Projects	0.832	0.507
MgR-3 Improper project planning and	1.224	0.303
MgR-4 Change of top management.	0.789	0.534
MgR-5 Sub-contractor related problem.	0.473	0.755
MgR-6 Poor relation and disputes with	**2.608**	**0.01**
MgR-7 Project delay.	0.537	0.709
MgR-8 Time constraint	**3.951**	**0.01**
MgR-9 Poor relation with government	0.527	0.716
MgR-10 Internal management problem.	0.939	0.443



Three factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their project value. These factors are **MgR1, MgR6, and MgR8.**

X. CONCLUSION

1. In the case of Management Risk, **"Change of Top Management"** scored (3.55±1.126) higher mean value than the other factors. So, Change of top management have high level of management risk than the other in group.

2. Eight factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their **Role in the Construction Field** background. These factors are listed below

MgR1 - Lack of Team Work
MgR2 - No past experience in similar projects
MgR3 - Improper project Planning and budgeting
MgR4 - Change of top management
MgR5 - Sub contractor related problem
MgR6 - Poor relation and disputes with partner
MgR8 - Time Constraint
MgR10- Internal management problem

3. Two factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their **Gender** background. These factors are

MgR6 - Poor relation and disputes with partner
MgR8 - Time Constraint

4. Five factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their **Type of Construction** background. These factors are

MgR1 - Lack of Team Work
MgR6 - Poor relation and disputes with partner
MgR7 - Project delay
MgR8 - Time Constraint
MgR10- Internal management problem

5. Five factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their **Nativity** background. These factors are

MgR2 - No past experience in similar projects
MgR4 - Change of top management
MgR6 - Poor relation and disputes with partner
MgR7 - Project delay
MgR9 - Poor relation with government departments

6. Three factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their **Experience** background. These factors are

MgR2 - No past experience in similar projects
MgR3 - Improper project Planning and budgeting
MgR7 - Project delay

7. Three factors were identified with less than 5% significance, to have been perceived differently by at least one group of the respondents based on their **Project Value Background.** These factors are

MgR1 - Lack of Team Work
MgR6 - Poor relation and disputes with partner
MgR8 - Time Constraint

XI. SUGGESTION

In construction projects, changes are very common and likely to occur at any stage of the project. Most changes, if not managed properly through a formalized change management process will have considerable impact as they disrupt work and affect its orderly sequence, adversely impacting productivity and accordingly causing schedule delays and cost overruns. Analyse all aspects before making change in top management will clear the negative impact in work progress of construction

XII. SCOPE FOR FUTURE STUDY

The factors identified to be critical in this study are not exhaustive. The other factors are the field problems faced by the contractors, consultants. Project managers, project engineers and the field engineers. These factors are on the whole influencing a project. Work Break Down may be done at micro level and critical factors for each every activity may be identified.so that, the critical factors affecting the project performance can be studied by conducting micro scheduling.

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