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EVALUATION AND MANAGEMENT OF RISKS IN CONSTRUCTION PROJECTS

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ABSTRACT

Construction field is majorly a risk prone area with complexity in its internal environment which creates an environment of ambiguity and risk. It is exposed to several different types of risk factors such as socioeconomic, political, environmental, management and financial risks. As a result the project gets effected with delays and quality aspects. This ultimately leads to cost overruns and poor quality construction. In view of this, an effective assessment and management of risks must be followed by industry practitioners. The paper aims to investigate and identify risks in construction projects and suggest remedial measures. This was achieved by questionnaire survey collected from local contractors and managers through mail and some by personnel meeting. Some interview was conducted with industrial practitioners for effectiveness of the collected questionnaire. The major risk observed from the experts opinion is the lack of skilled workers that most companies are facing.

Keywords: *Risk management, evaluation, assessment, knowledge.*

I. INTRODUCTION

Literature survey shows that, there is a lot of deficiency in the effectiveness of risk management in construction projects. For an effective and efficient risk management the industry practitioners should follow a proper and systematic methodology and most importantly they have knowledge and experience on various risk factors. In the lack of efficient and effective risk management there will be negative consequences in a project because of not having proper counter measures [1]. Risks are uncertainties and liabilities which causes negative impact on projects. Risks are observed in all type of projects but have major impact on construction industry. It is not possible to completely avoid risks in projects but their impact can be reduced by establishing risk management system. The results from this research will allow clients and practitioners, to develop a risk management function and improve the performance of future projects. The research addresses the risks in projects and based on their importance they are given rankings. On the basis of the research results, the contractors will understood the importance of risk management and adopt preventive measures for positive consequences.

II. BACKGROUND

2.1 Definition of risk

Risk is defined as an optimistic or undesirable deviation of a variable from its expected value. In general phrasing, risk is understood only as a damage [2].

2.2 Risk Management

Risk management is defined as the process of identification and assessing risk, and to apply methods to reduce it to an acceptable extent [1]. The risk management involves mainly four processes [3]. They are as follows:

a) Risk Identification: It is the determination of most expected risks that are affecting the project and then documentation of characteristics of each risk.

b) Risk quantification: It is the assessment of risks and the possible interactions of risks with project activities to evaluate the possible outcomes of the project.

c) Risk response development: Definition of response steps for opportunities and threats associated with risks.

d) Risk response control: Response to the changes implemented to remove risks throughout the project duration.

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With the help of risk management many problems can be avoided through proactive action, the consequences were avoided and also the project manager gain control over the project [2]. The steps in the risk management process are showed in Fig 1.

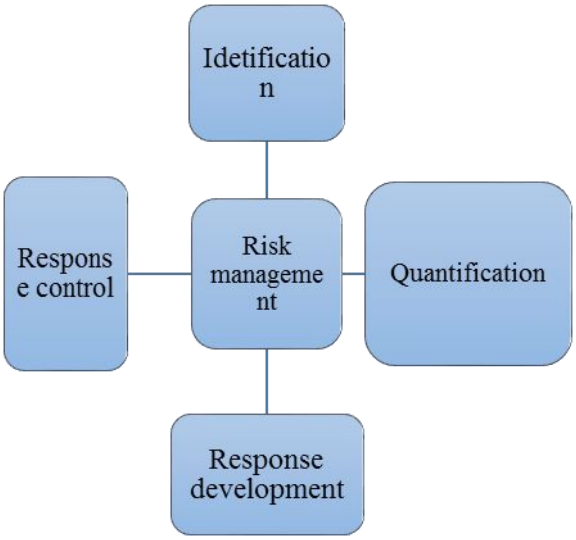

Fig 1. Elements of risk management process

III. SOURCES OF RISKS IN PROJECTS

From the literature survey the major sources of risks are listed as below.

• Variations in project scope and requirements

• Design errors and omissions

• Inadequately defined roles and responsibilities

• Insufficiently skilled staff

• Subcontractors

• Inadequate contractor experience

• Uncertainty about the fundamental relationships between project participants

• New technology

• Unfamiliarity with local conditions

• Force majeure

Risks that are associated in the construction industry can be broadly characterized as the following [2]:

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a) Technical risks

• Insufficient site examination

• Inadequate design

• Relevance of specifications

• Ambiguity over the source and obtainability of materials

b) Logistical risks

• Availability of adequate transportation facilities

• Availability of resources-particularly construction equipment spare parts, fuel and labour.

c) Management related risks

• Uncertain productivity of resources

• Industrial relations difficulties

d) Environmental risks:

• Weather and seasonal consequences

• Natural disasters

e) Financial risks

• Availability and fluctuation in foreign exchange

• Delays in Payment

• Inflation

• Local taxes

• Expulsion of funds

f) Socio-political risks

• Constraints on the availability and employment of expatriate staff

• Customs and import restrictions and procedures

• Complications in organising of plant and equipment

• Insistence on use of local firms and agents

IV. METHODOLOGY

The methodology followed for this study is

- Studying the literature about risk management and its process.
- A questionnaire was prepared which includes different factors for causing the risks.

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- Questionnaire survey with project managers were conducted and data was collected.
- Analysing the collected data.
- Ranking of risks is done based on the collected data.
- Suggesting possible remedial measures.
- Conclusions and discussions.

4.1 Questionnaire structure

The questionnaire for the study is divided into two sections. The first one is about the general information of the company, position of the respondent, experience of respondent. The second section is about risk factors that are mostly observed in the projects. The risk factors categorized into eight terms such as [2]:

1. Financial risk

2. Legal risk

3. Market risk

4. Management risk

5. Political risk

6. Environmental risk

7. Technical risk

8. Social risk

V. RESULTS OF THE SURVEY

5.1 General analysis

The survey was collected from project managers and the engineers at the site based on the availability. Sometimes consultant provides the data. Email and telephone communication answering was accepted as it is difficult to meet everyone directly. From the contractor response, lack of skilful workers is the major risk rating factor and next to it are time constraint, project delays, subcontractor related problems, and competition from other companies. From owners response maximum risk rating factor is time constraint and next risk rating factors are lack of skilful workers, project delays, distortions in design drawings, incorrect project planning, and fluctuations in inflation rates. Least risk ratings provided by both of them are environmental risks, industrial disputes and local protectionism.

Mean is calculated for all the risks based on the questionnaire data given by the construction experts. Total of 52 sub risks factors are considered and based on the calculated mean overall ranking is given. From the data it is clearly observed that lack of skilful workers is the main risk that most of the companies are facing. Time constraint and sub-contractor related problems are also the major risks. The subcontractor related problems arise because they don't meet the requirements of main contractor. Changes in the material costs and labour costs is also major type of risks which affects the time and cost of constructions. Competition from other companies is also a higher risk faced by small business firms because larger companies attract the clients with their financial strengths. Political and climatic changes are the external risks which are not in the hands of project managers. They show negative impact on project cost and time. According to the calculated data political risks is the least risk among the 52 sub-risks.

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Table 1. Ranking of all risks

Risk factor	Mean	Rank
Lack of skillful workers	4.68	1
Time Changes	4.23	2
Sub-contractor problems	3.99	3
Delays in projects	3.98	4
Incorrect confirmation of contract documents	3.88	5
Competition between companies	3.67	6
Inappropriate planning and budgeting	3.45	7
Changes in materials price	3.17	8
Fluctuations in inflation rate	3.06	9
Poor contacts between clients	3.04	10
Fluctuation in interest rate	2.99	11
Changes of labor costs	2.97	12
Shortage of materials	2.95	13
Management problems occurs internally	2.94	14
Breach of contract	2.92	15
Poor project feasibility	2.88	16
Site conditions	2.86	17
Project organization structure	2.81	18
Rise in fuel prices	2.79	19
Changes in design	2.76	20
Team work	2.64	21

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Corrections in drawings	2.62	22
Adverse impact on project	2.6	23
Lack of experience	2.55	24
Bad quality materials	2.41	25
Wastage of materials	2.39	26
Cost changes due to Govt. policies	2.25	27
Technical risk	2.20	28
Arbitration clause	2.13	29
Difficulty in construction	2.12	30
Environmental conditions	1.99	31
Lack of transportation facilities	1.94	32
Failures in equipment	1.86	33
Late approvals	1.79	34
Excess materials handling	1.75	35
Bankruptcy of project partner	1.71	36
Casualties on site	1.65	37
Increase in accessories price	1.59	38
Fluctuations in exchange rate	1.51	39
Inadequate fuel supply	1.50	40
Improper forecasting of market demand	1.45	41
Unfairness in tendering	1.32	42
Enforcement of legal judgement	1.26	43
Not getting expected income	1.19	44
Unfairness of court justice	1.04	45

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Local protectionism	0.99	46
Deviations in Bank rules	0.95	47
Industrial conflict	0.90	48
Less tendering time	0.88	49
Impact on the environment	0.81	50
Corruption and bribery	0.80	51
Political changes	0.72	52

5.2 Financial risk

In India inflation rate is lower when compared to other developing countries and it causes hefty prices to construction industry. Domestic prices for diesel and petrol were increased which has its effects on construction machinery. Changes in bank interests and policies cause slower growth rate than their respective interest costs. Six factors are considered in financial risks and the ranking is given in Table 2 and corresponding bar diagram in Fig 2.

Table 2. Ranking of financial risks

Sub risk	Mean	Rank
Fluctuation in inflation rate	3.06	1
Fluctuation in interest rate	2.99	2
Rise in fuel prices	2.79	3
Bankruptcy of project partner	1.71	4
Fluctuations in exchange rate	1.51	5
Changes in bank regulations	0.95	6

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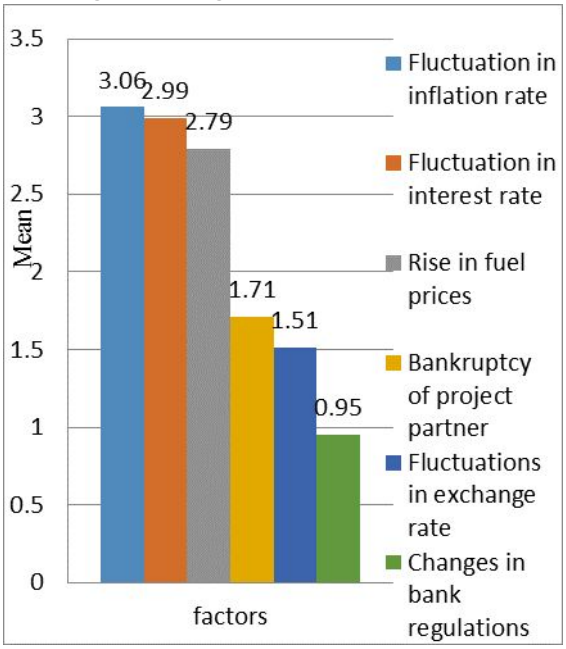

Fig 2. Graphical representation of financial risks

5.3 Management risk

When compared to other industries the construction industry suffers from lack of skilful workers. The unskilled labours are available in large number across different parts of the country. At present the infrastructure sector is growing at fast rate and there is huge supply gap. Insufficient workers/manpower slow down construction process as many companies now facing. Some of the companies faces the difficulty of numerous design changes due to owner wishes, design errors. To overwhelm the design errors, designs are to be revised regularly and if any error happens a specialist has to be used to solve those problems. Management risks are given in Table 3 and Fig 3.

Table 3. Ranking of management risks

Sub risk	Mean	Rank
Lack of skilful workers	4.68	1
Shortage of materials	2.95	2
Site conditions	2.86	3
Changes in design	2.76	4
Corrections in drawings	2.64	5

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Bad quality materials	2.41	6
Wastage of materials	2.30	7
Environmental conditions	1.99	8
Lack of transportation facilities	1.94	9
Equipment failure	1.86	10
Excess materials handling	1.75	11
Casualties on site	1.65	12
Industrial conflicts	0.90	13

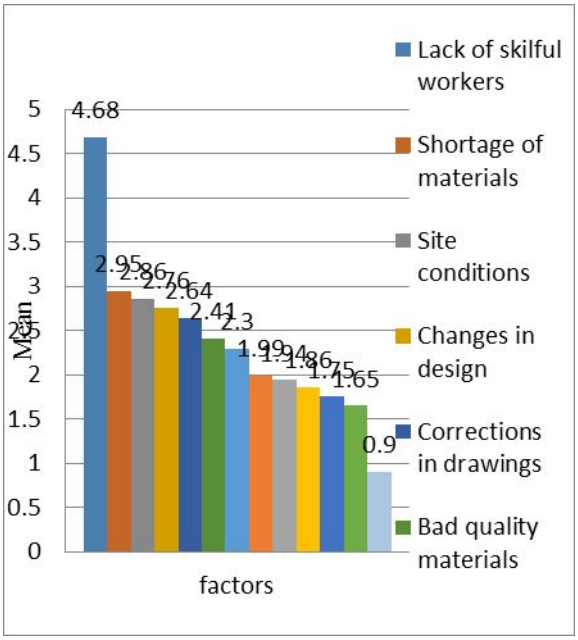

Fig 3. Graphical representation of management risks

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5.4 Market risk

Scarcity of materials and rise in its price also affects the construction industry. In residential building, materials accounts for more than 73 to 76% of construction costs. Competition from other companies is the major risk in market risk. Increase of material and labour costs also affects the construction industry. Ranking of market risk is given in Table 4 and Fig 4.

Table 4. Ranking of market risks

Sub risk	Mean	Rank
Competition between companies	3.67	1
Changes materials price	3.17	2
Changes of labour costs	2.97	3
Increase in accessories price	1.59	4
Improper forecasting of market demand	1.45	5
Unfairness in tendering	1.32	6
Not getting expected income	1.19	7
Local protectionism	0.99	8

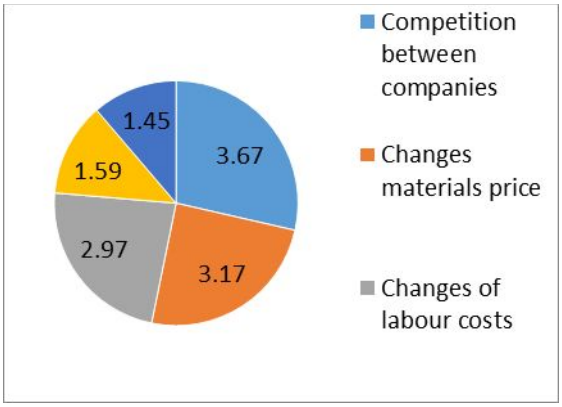

Fig 4. Graphical representation of market risks

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5.5 Legal risk

In India legal risk is not high but if any legal contract problem arises it takes more money and time for settlement of disputes. Nowadays big projects are involved with arbitration clause, but small projects don't involve this arbitration clause. Ranking of legal risk is given in the Table 5 and Fig 5.

Table 5. Ranking of legal risks

Sub risk	Mean	Rank
Incorrect confirmation of contract documents	3.88	1
Breach of contract	2.92	2
Arbitration clause	2.13	3
Enforcement of legal decision	1.26	4
Unfairness of court justice	1.04	5

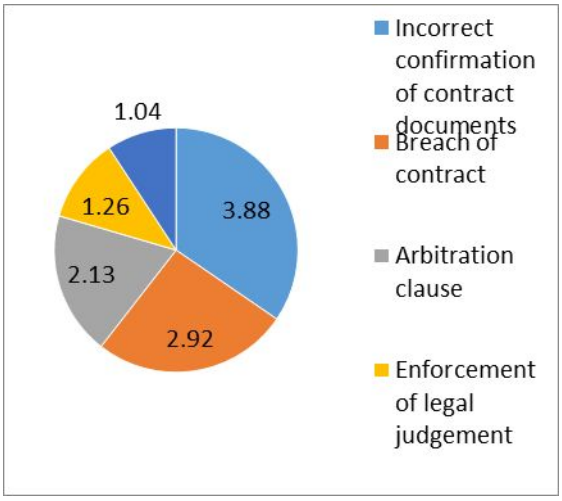

Fig 5. Graphical representation of legal risks

5.6 Technical risk

Inappropriate planning and budgeting, lack of experience in previous projects is some of the technical problems facing by companies. Even leading companies also face the lag in team work and thus causes internal management

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risks. This is due to top to down approach of companies giving commands without taking the opinions of the inferior and midlevel management employees. Table 6 and Fig 6 shows the ranking of various technical risks.

Table 6. Ranking of technical risks

Sub risk	Mean	Rank
Time constriction	4.23	1
Sub-contractor difficulties	3.99	2
Delays in project	3.98	3
Inappropriate planning and budgeting	3.45	4
Poor contacts between clients	3.04	5
Management problems occurs internally	2.94	6
Team work	2.64	7
Lack of experience	2.55	8
Less tendering time	0.88	9

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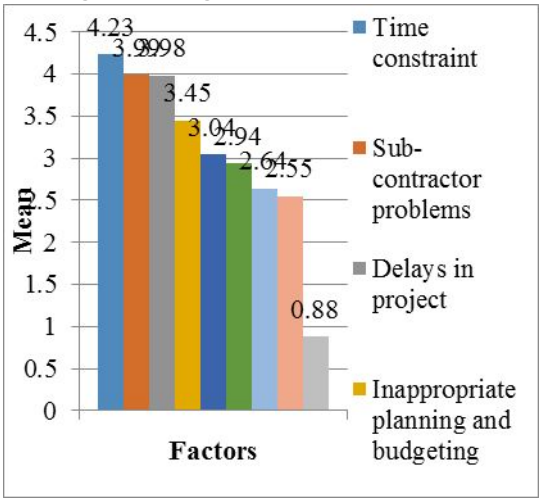

Fig 6. Graphical representation of technical risks

5.7 Political risk

Political risks are always present in the projects but it may vary from state to state. Approval for new projects depend on the government and previous projects face problems when government changes. It leads to delays in the projects and thus cost and time gets affected. Ranking of political risks are given in Table 7 and Fig 7.

Table 7. Ranking of political risks

Sub risk	Mean	Rank
Cost changes due to Govt. policies	2.25	1
Late approvals	1.79	2
Corruption and bribery	0.80	3
political changes	0.72	4

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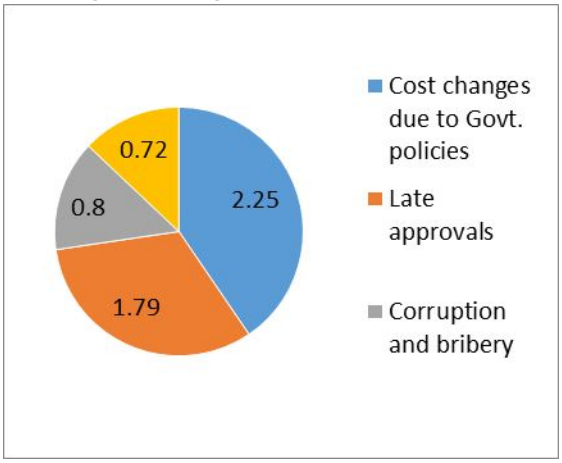

Fig 7. Graphical representation of political risks

5.8 Environmental risk

In rainy season great disadvantage of construction projects is the rain water gets seep into foundation in the initial stage of project. For workers working under hot climates is difficult, so they are provided with safety helmets in some of the companies. Environmental changes are the external risks which are not in the hands any project engineer. Proper mitigation techniques help to reduce their impact on projects. Ranking of environmental risks is given in the Table 8 and Fig 8.

Table 8. Ranking of environmental risks

Sub risk	Mean	Rank
Adverse impact on project	2.9	1
Environmental conditions	1.2	2
Good operational environment to the workers	1.1	3

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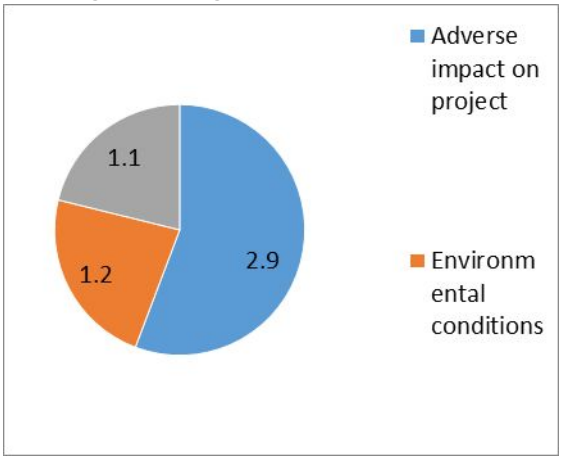

VI. CONCLUSION

1. Most companies experiencing high risk is the lack of skillful labor. This is because the skilled workers are more attracted to Eastern countries as they offers high packages compared to India.
2. Sub-contractor risks are high because they do not meet the standards of the main contractor. Changing of design drawings is also another risk in the management of project. Thus the above response shows that management risks are also critical.
3. Delays in the project are also another critical risk which affects directly on cost and time constraint.
4. In small and medium size companies competition from other companies is the major risk they are facing. Entry of foreign companies to India creates stiff competition for local companies.
5. Inflation rate in India is another major risk which increases the price of the materials, labor costs, machinery rates etc. which in turn causes financial risks to land developers and clients. Increasing the bank interests affects the residential constructions. Hence financial risk is higher than other type of risks.
6. Political and legal risks are very low for large firms.
7. Environmental risks are unavoidable risks but the impact will be reduced by adopting some suitable mitigation techniques.
8. From the overall view of the study management and the financial risks are higher than other risks.

VII. SUGGESTIONS

1. From the study it was clearly observed that, risk management system is not properly followed by some of the construction companies. It has to be considered as an important tool to evaluate the project. It helps to mitigate the adverse effects on projects.
2. From the planning stage onwards risk assessment should be considered in order to curb the risks.
3. Financial risk is the global hazard and this should be carefully handled during the initiation stages only.
4. Monthly once evaluation has to be done after the establishment of risk management within the company.
5. It is good to have a risk consultant person in the industry to observe the impact of risks in projects.
6. Implementation of risk rating by third party should be encouraged so that project's viability improved certainly.

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