



# ANALYSIS OF MAJOR RISKS IN CONSTRUCTION PROJECTS

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## ABSTRACT

Risk management is thus in direct relation to the successful project completion. Project management literature describes a detailed and widely accepted risk management process, which is constructed basically from four iterative phases: risk identification, risk estimation, risk response planning and execution, often managing the risk management process is included. Construction project planning is an essential element in the management and execution of construction projects which involves the definition of work tasks and their interactions, as well as the assessment of required resources and expected activity durations. The study, therefore, examined the awareness of professionals in construction industry of the various types of planning techniques and tools used on construction sites, Questionnaires were administered on selected building professionals (Project Managers, Engineers, Architects), and Contractors and Sub-contractors directly involved in construction work on sites in planning and the use of planning tools and techniques as major tools for successful project execution. The data obtained were analyzed using the Statistical Package for Social Scientist for Windows (SPSS), and the results were presented by the use of statistical tools such as frequency tables and pie charts. The study shows that there is low awareness on the functional use of construction planning tools and techniques, and recommended that the use of the construction planning tools and techniques should be applied in all building projects and there should be regular adequate training of professionals on the effectiveness and improvement in Information Technology in the construction industry especially in project planning and execution.

**Keywords:** risk management, questionnaire, SPSS.

## 1. INTRODUCTION

Construction projects are initiated in complex and dynamic environments resulting in circumstances of high uncertainty and risk, which are compounded by demanding time constraints. Construction industry has changed significantly over the past several years. It is an industry driven primarily by private investors; the presence of securitized real estate has increased considerably. It is vulnerable to the numerous technical & business risks that often represent greater exposures than those that are traditional. Thus risk assessment need arises. Risk assessment is a tool to identify those risks in a project and manage it accordingly with proper treatment. 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. The general methodology of this study relied largely on the survey questionnaire which was collected from the local building contractors 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. The survey questionnaire is designed to probe the cross-sectional behavioural pattern of construction risks construction industry. The questionnaire prepared for the pilot survey was formulated by seeing the relevant literatures in the area of construction risk management

In the context of construction industry, it is the likelihood of the occurrence of a definite event or combination of events which occur during the whole process of construction. Construction involves many variables, and it is often difficult to determine cause and effect, dependence and correlations. Hence, those risks play a significant role in decision making and may affect

the performance of a project (wiguna and scott, 2005). Risk is exposure to the consequences of uncertainty. 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. Therefore, Risk assessment is a technique that aims to identify and estimate risks impacted upon by a project.

## 2. LITERATURE REVIEW

Wenzhe Tang, David M.Young (December, 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 Riaan van Wyk, Akin tola Akintoye (March, 2007) Akin tola S Akintoye and MacLeod (March, 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.

Roosbeh Kangari (December, 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.

Florence Yean Yug Ling and Linda Hoi (December, 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 (June, 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.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 (February, 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 and dynamic environments resulting in circumstances of high uncertainty and risk, which are demanding time constrains.

### 3. RISK CONCEPTS

Risk is a multi-facet concept. In the context of construction industry, it could be the likelihood of the occurrence of a definite event/factor or combination of events/factors which occur during the whole process of construction to the detriment of 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. In addition to the different definitions of risk, there are various ways for categorizing risk for different purposes too. Some categorize risks in construction projects broadly into external risks and internal risks while others classify risk in more detailed categories of political risk, financial risk, market risk, intellectual property risk, social risk, safety risk, etc. The classification is shown in the Figure-1. The typology of the risks seems to depend mainly upon whether the project is local (domestic) or international.

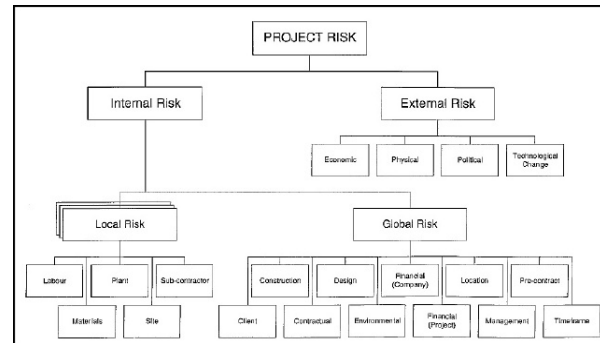


Figure-1. Hierarchical risks involved in a project.

#### a) Project risk management

Risk management in a project encompasses identifying influencing 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. The riskier the activity is, the costlier the consequences if the 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 can be made so that risk is minimized.

Risk = Probability of an event  $\times$  Consequence of loss due to that event  
Per event Graphical representation of risk ratings can be made by plotting graph between probability and seriousness Figure-2 explains this

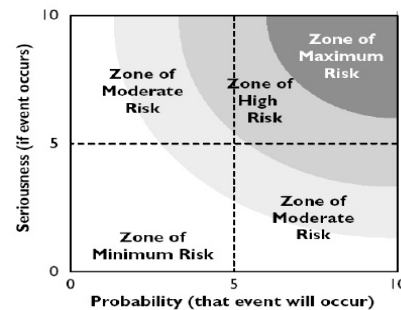


Figure-2. Graphical representations of risk rating.

#### b) General types of risks

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



long term. A short-term risk has an immediate impact, such as changing the requirements for a deliverable. A long-term risk has an impact sometime in the distant future, such as releasing a product without adequate testing. Risks are members. Finally, risks are either internal or external. An internal risk is peculiar to a project, such as the inability to get the parts of a product to work. An external risk originates from outside the scope of the project, such as when senior management arbitrarily cuts funding by 20 percent.

**1) Delivery/operation risk:** The ability to overcome the risk of delivering and operating the project as conceived. This risk factor involves issues or concerns associated with actual engineering, procurement, construction execution, and operation of the project, including non-traditional approaches such as a public owner's use of design-build contracts.

**2) Technology risk:** The ability to overcome the technological risks of the project. This risk factor involves issues or concerns associated with the technologies involved in the execution methods and operational technology of the project.

**3) Financial risk:** The ability to overcome the financial risk of the project through to final completion and operation. This risk factor involves issues or concerns associated with the financing of the project, including the execution period and operations or equity financing.

**4) Procurement-contractual risk:** The ability to overcome the risks associated with the procurement of, or contracting for, the execution and operation of the project. This risk factor involves issues or concerns associated with the contractual and procurement approaches-systems-processes used for both project execution and operation.

**5) Political risk:** The ability to overcome the political risk of the project, including local, state, and national political opposition and code and regulatory impediments. This risk factor involves issues or concerns associated with the local, regional, and national political and regulatory situation confronting the project.

**6) Environmental risk:** The ability to overcome the environmental risks of the project. This risk factor involves issues or concerns associated with the environmental problems, concerns, and activities confronting the project during the project execution and the project operation.

**7) Social risk:** The ability to overcome the social risks of the project. This risk factor involves issues or concerns associated with the social and cultural impacts of the project to the community and region within which it is to be located.

**8) Economic risk:** The ability to overcome the economic impact risks of the project. This risk factor involves issues or concerns associated with the macroeconomic impact of the project to the community and region within which it is to be located.

**9) Reserves risk:** an operations risk factor addresses the extent of reserves and contingency to be transported, and not only the anchor field, but also reserve

risk associated with the prospects and discoveries in the area.

**10) Credit risk:** a financial risk factor Customer credit risk is a new risk issue stemming from the large inflow of small capital independents and the formation of many Limited Liability Corporations without any real assets.

**11) Engineering risk:** a technology risk factor: The exploration and production requirements are continuously pushing the deep water envelope. A large risk consideration is that the meteorological-ocean data current and waves is empirical and is changing with new measurement information becoming available every year.

**12) Materials risks:** a procurement risk factor: The huge costs of projects are driving the search for the cheapest material that meets specifications which is to be fabricated in a location that has the least cost-often in different countries.

**13) Weather risks:** an environmental risk factor: Wave currents (storm risks) are plaguing many off-shore projects, yet are increasingly uninsurable.

**14) Insurance risks:** an economic risk factor: The global reinsurance market currently has severe capital restrictions that are restricting access to project insurance.

**15) People risks:** social risk factor Changing social relationships and forced cultural changes of linear projects, like pipe- lines, are destabilizing local support and long term operability conditions.

#### 4. ANALYSIS AND DISCUSSION ON IDENTIFICATION AND ASSESSMENT OF DIFFERENT RISK FACTORS

For easy understanding the survey analysis is divided into two part (i.e.) one for the project costing below fifty crores and the other for projects costing above fifty crores. In each category only the first three risks is identified and taken for analysis, since analysing each and early risk will be laborious process. The factors a in the overall survey shortage of skill workers is the main shortage risk faced by the construction firms. Since a large number of cheap unskilled labours are available for work who have migrated to construction industry from various other industries. But as far as the skilled labour is concerned only, few people are available and thus cost of them is very high. To increase the skilled work force the government and the industry people should setup training institutes across the country. Time constraint is also one of the major risks since construction firms are given a short notice in construction and even penalty is imposed on the construction firms if the project is extended beyond the completion date. Certain Information Technology parks are completed within a very short time, ranging from 8 months to 14 months, which are made in a fast track construction mode. Sub contractor related problems prevail everywhere in the construction industry and in each project. Quality and time are the main reasons for the project delay; this is mainly due to the behaviour of sub – contractors. Competition from other companies is also a major threat faced by smaller firms, since large construction companies project with its financial and



technical strength. Planning and budgeting problems is faced both in larger and smaller construction companies, and this risk depends on other factors sub risks. Fluctuation in inflation and a steep rise in the interest rate by banks are current main problems faced by all the sectors of the industry, particularly the construction sector. Communication gap is also a major problem between the clients, since improper communication leads to a bad situation which could have been easily avoided.

#### 4.1 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.

#### 4.2 demographical analysis and results of survey

The questionnaire survey will be collected from the various construction projects by mail or by personnel meeting. 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 thirteen categories, namely: Technical Risk, Time Risk,

Construction Risk, Design Risk, Legal Risk, Market Risk, Management Risk, Financial Risk, Policy and Political Risk, Environmental Risk, Social Risk, Safety Risk, and Physical Risk. Questionnaires are valuable method of collecting a wide range of information from a large number of individuals often referred to as respondents. The questionnaires will be designed based on the knowledge obtained from the relevant literature reviews and discussions. The questionnaire will be designed to review comprehensively all major risks that are likely to be encountered in construction projects. Totally for two hundred companies the questionnaires were sent out of which one hundred and fifty five had an effective reply. Thus the response rate is 80% which is considered a good response in this type of survey.

All the questionnaire survey was done from General Manager, Project Manager, Project Engineer, Site Engineers of the project. Even email reply was accepted since it was difficult to get the direct one to one meeting with the project managers. The demographical analysis is as shown in the Table based on the Designation, Qualification, Experience, and Organization. Totally for two hundred companies the questionnaire were given, out of which one hundred and fifty five had an effective reply. Thus the response rate is 80% which is considered a good response in this type of survey. All the questionnaire survey was done from General Manager, Project Manager, Project Engineer, Site Engineers of the project. Even email reply was accepted since it was difficult to get the direct one to one meeting with the project managers. For the construction companies, Financial Risk, Time Risk, and Construction Risk has the maximum risk rating.

The typical risk factors are shown in the Table-1.

**Table-1.** Overall risk factors.

S. No.	Description of risk	Mean	Std. deviation
1	Incomplete Design	3.019	1.00
2	Inadequate site investigation	3.0129	1.00
3	Improper project planning and budgeting	3.0645	1.01
4	Inadequate specification	2.8839	0.93
5	Excessive approval procedures in administrative government departments	2.7871	0.86
6	The contractor does not pay worker wages in due time	2.8581	0.84
7	Tight Project Schedule	3.0065	.71
8	Inappropriate time allocation	2.8774	.76
9	Insufficient time to prepare bid	2.8645	.81
10	Unsuitable construction program planning	2.8516	0.87
11	The worker does not abide by regular work-hours	2.7806	0.75
12	Plans of design are incompatible with execution.	2.9355	0.88
13	Many modifications on designs are made during execution.	2.9484	0.76



14	The designer does not follow up designs and changes made on them.	3.0000	0.89
15	Inability to execute the project within specified timetable.	2.8710	0.94
16	Necessary technical skills are not available	3.2065	0.87
17	Low productive efficiency of the worker.	3.0774	0.80
18	Some materials do not arrive at the assigned site.	3.1290	0.86
19	Absence of trained manpower.	3.0065	0.86
20	Selection of material and equipments	2.8323	0.91
21	Equipment failure	3.0452	1.00
22	Shortage of labours	3.0516	0.89
23	Shortage of equipment	3.0710	0.95
24	Quality variations by the labours	2.9097	0.84
25	New technology implemented	2.8129	0.98
26	Changes in material types and specifications during construction	2.9742	1.10
27	Undocumented change orders	3.0710	1.01
28	Labour disputes	3.0774	0.93
29	Designs are changed by the engineers	3.1806	0.89
30	Actual quantities differ from the contract quantities	3.1290	0.96
31	Defective design (incorrect)	3.2387	1.34
32	Not coordinated design (structural, mechanical, electrical, etc.)	3.2000	1.29
33	Inaccurate quantities	3.1355	1.23
34	Lack of consistency between bill of quantities, drawings and specifications	3.1806	1.25
35	Rush design	3.3290	1.11
36	Awarding the design to unqualified designers	3.2968	1.25
37	Breach of contract by project partner	2.9355	0.97
38	Improper verification of contract documents	3.0581	0.97
39	Lack of enforcement of legal judgment	2.9677	1.05
40	Uncertainty and unfairness of court justice	3.0581	1.06
41	Competition from other similar projects	3.0774	.96
42	Increase of Labour costs	3.2129	.83
43	Increase of Material price	3.1548	1.01
44	Unfairness in tendering	3.0645	1.00
45	Unrealistic price variation in material	3.2000	1.06
46	Inadequate forecast about market demand	3.1742	1.09
47	Change of top management	2.9548	0.88
48	No past experience in similar projects	3.2258	0.95
49	Internal management problems	3.0774	0.92
50	Improper project feasibility study	3.1161	0.90
51	Poor relation and disputes with partner	3.2129	0.95
52	Project delay by the management problems	3.1613	0.99
53	Loss due to fluctuation of interest rate	3.1419	0.78



54	Change in bank formalities and lenders	3.0387	0.68
55	Loss due to rises in fuel prices	3.1161	0.81
56	Late payment by clients	3.2645	0.81
57	Cash flow problem	3.1613	0.79
58	Price fluctuation	3.3806	0.79
59	Tax rate increase	3.1290	0.77
60	Foreign currency exchange rate fluctuation	3.1548	0.81
61	Inflation	3.2710	0.82
62	Funding / Payment shortage	3.3226	0.70
63	Cancellation in giving loan	3.3161	0.86
64	The owner lags behind in paying the contractor.	3.2258	0.87
65	Construction prices are low.	3.1806	0.91
66	Competition in pricing projects.	3.0774	0.73
67	Large number of Construction companies	3.2516	0.74
68	Specialists in project financial analysis are not employed	3.0258	0.80
69	Inexperience when pricing tenders	3.2516	1.02
70	Changes in laws and regulations	3.0903	0.88
71	Changes in laws and regulations	3.1484	0.92
72	Requirement for permit and late approvals	2.9935	0.94
73	Loss incurred due to Corruption and Bribery	3.1742	0.97
74	Natural Disaster (Floods, earthquakes, etc.)	3.3484	1.20
75	Difficulty to access the Site (Very far, settlements)	3.2645	1.08
76	Adverse weather conditions	3.1355	0.88
77	Pollution and Safety rules	3.2968	1.17
78	Problems from near project	3.0194	1.08
79	Local People support for project	2.8129	1.04
80	Accidents on workers	2.9613	1.30
81	Unexpectedly falls of the floors	3.3419	1.31
82	Electrical fires occurred	3.1161	1.29
83	Vehicle crashes on workers	3.0968	1.32
84	Being struck on the equipment	3.1290	1.15
85	Poor quality of materials procured due to damaged in structure	3.0516	1.27
86	Damage to equipment	3.1935	1.16
87	Labour injuries	3.2258	1.10
88	Wastage of materials by workers	3.4645	1.11
89	Equipment and material fire	3.3161	1.16
90	Theft of materials at site	2.9484	1.19

#### 4.3. Ranking of risk factors

The overall risk factors are calculated by using SPSS tools (Statistical Packages of Social Studies). This is one of the management tool helps to analyse the 5-scale likert factor analysis. The Mean value is to be find out for

the various risk factors and to determine the ranking of the risk factors.

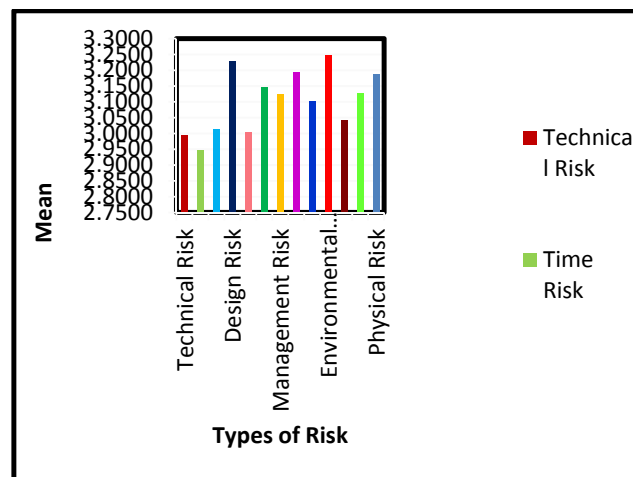
This questionnaire survey will shown the ranking of risk factors involved in the construction industries.



Environmental Risk, Design Risk, Financial Risk, Physical Risk, and Market Risk has the maximum risk rating.

**Table-2.** Ranking of risks factors.

S. No.	Types of risk factors	Mean	Ranking
1	Technical Risk	2.9952	12
2	Time Risk	2.9467	13
3	Construction Risk	3.0141	10
4	Design Risk	3.2301	2
5	Legal Risk	3.0048	11
6	Market Risk	3.1473	5
7	Management Risk	3.1247	7
8	Financial Risk	3.1947	3
9	Policy and Political Risk	3.1016	8
10	Environmental Risk	3.2495	1
11	Social Risk	3.0430	9
12	Safety Risk	3.1290	6
13	Physical Risk	3.1889	4



**Figure-3.**

## 5. CONCLUSIONS

As far as India is concerned risk management is still a new word in the construction sector and this should be changed as soon as possible. Currently the Government of India has proposed a risk rating system will help the developers to develop projects at a faster pace by taking quick decisions. Each rating agency will have its own methodology to rate projects. The system will help government to develop a strategy to mitigating risk. This will encourage more response from developers and investors for public-private partnerships projects. It could make the bidding projects more competitive. The system will enable bankers to take quick decisions for lending finances, which could lead to the financial closure of the project at a faster pace. Third party risk rating would

certainly raise critical points, which are not normally raised during finalisation of project.

This study should assist management in identifying activities where there is a risk of Financial, Time and Construction 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. 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, General Manager, Project managers,



Project Engineers and Site Engineers which was then analyzed by using the software of SPSS.

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