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A Study of Risk Response Technique Associated With Occupational Hazards on Residential Construction Sites

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Abstract: **Construction industry in India is 2nd largest employer and contributor to economic activity, after agriculture sector. However ignorance towards safety practices, time management and quality made this industry loose its credibility. India is emerging as a bright spot for world with immense scope for infrastructural development and mega projects in construction. The objective of this study is to identify critical risk events and their consequences. Data from 55 residential construction sites with respect to the occupational hazards occurring frequently was used for the analysis. Mis-operation of machinery is found to be Intolerable risk. Only Collapse of temporary structures is acceptable risk, all the other risk events are Undesirable in terms of the occurrence frequency and the consequences.**

Keywords: **Construction Industry, India, Risk, Risk events, Risk management.**

I. INTRODUCTION

The construction sector accounts for second highest inflow of FDI after the services sector and employs more than 35 Million people. 50% of the demand for construction activity in India comes from the infrastructure sector, the rest comes from industrial activities, residential and commercial development etc. The Indian construction industry is valued at over USD 126 Billion. USD 1 Trillion investments for infrastructure sector projected during 2012-17. Present levels of urban infrastructure are inadequate to meet the demands of the existing urban population. There is need for re-generation of urban areas in existing cities and the creation of new, inclusive smart cities to meet the demands of increasing population and migration from rural to urban areas. Future cities of India will require smart real estate and urban infrastructure. [1] * (http://www.makeinindia.com)

The construction industry is often considered as a risky business due to its complexity and strategic nature. It incurs a numerous project stakeholders, internal and external factors which will lead to enormous risks. (S. M. Renuka et al, 2014) [2]. Risk is an integral part of any activity. In early days, the risk was not considered that seriously as it should have been, because of which many consequences were required to be faced. Managing risks in construction projects has been recognized as a very important management process in order to achieve the project objectives. There are particularly in the context of various factors which affect the risk on a construction project.

In this study 'Risk Response Technique' is used for identification risk mitigation ways and 'Risk Assessment Tables' [2] are used for analysis of data collected from construction sites. The tables help to determine the action required to be taken based on category of impact of risk.

II. LITERATURE REVIEW

Alone et al [3] describe, there are four main ways in which risks can be mitigated. These are

a. Reduced or Eliminated,

b. Transferred,

c. Avoided,

d. Absorbed or pooled

Risk assessment tables are very useful in the risk mitigation strategy.

Chris Chapman and Stephen Ward (2003) [4], says the scope for uncertainty in any project is considerable, and most project management activities are concerned with managing uncertainty from the earliest stages of the Project Life Cycle (PLC), clarifying what can be done, deciding what is to be done, and ensuring that it gets done.

Kolhatkar & Dutta (2013) [5], observe that risks are the integral part of a construction project. But skilful handling of the risk is very important. For that identification of risk is very important. There are following types of risks- Financial Risk, Business Risk, Technology Risk, Political Risk and Project Risk. This paper includes overview on all possible risks occurring in a construction project, common sources of risk in a construction project and possible ways to mitigate the risks.

Nguyen, Bhagavatulya, Jacobs (2014) [6], mention that the primary intent of their research study is to focus on the India construction transportation sector with an emphasis on multiple project risk factors. A data collection questionnaire was administered to Indian construction companies with a 66% response rate. Respondents were asked to rate among 30 identified industry risk factors. The study results indicated that several of the risks highlighted have a high impact even if the probability of occurrence is low. It is also understood that project management teams are not effective in terms of communication with project stakeholders, and are incapable of formulating the correct strategies when projects are not in good health. The research outcome suggests that the Indian construction transportation sector needs to employ innovative technologies and better contract management strategies to overcome project risk factors.

Considering the above aspects, this study focuses on the following objectives: -

i) Identification of risk scenario with respect to the occupational hazards occurring on residential construction site.

ii) Suggest a risk response action plan so as to decide a better way for risk mitigation out of four risk mitigation ways available.

III. RESEARCH METHODOLOGY

The four ways of risk mitigation were taken into consideration. The Risk Assessment table helps to classify scenarios and provide Scale Values separately. Probability of occurrence for each risk event was necessary requirement for analysis. A questionnaire survey was prepared and given to many experts for the response on description of consequences of risk event occurrence. So accordingly data was collected from 55 various residential construction sites in Pune & Pimpri - Chinchwad area. The estimated cost of the projects ranges from 50 Cr to 150 Cr. Most of the projects were of 3 – 4 years of duration.

IV. RISK RESPONSE TECHNIQUE

There are four basic forms of risk response, as

a. Risk Reduction,

b. Risk Transfer,

c. Risk Avoidance,

d. Risk Absorption.

a. Risk Reduction: Sharing risk exposure with other parties. e.g. Security deposit.

b. Risk Transfer: Transferring risk does not reduce the criticality of risk, it is just pushed to another party. e.g. insurance cost.

c. Risk Avoidance: Risk avoidance is associated with refusal for acceptance of risk. e.g. use of exemption clauses.

d. Risk Absorption: Risks responsible for repetitive losses can be retained. e.g. likely cost of paying for loss, if uninsured. (Roger Flanagan & George Norman, 1993) [7].

The respondents from 55 construction sites detail about the probability of occurrence of various risk events. With reference to data collected from sites, the data was analysed using Various Risk Assessment tables. Risk assessment tables are very useful in the risk mitigation strategy.

Calculation Procedure:

- Table 4.1, gives Scale value-I with reference to probability of risk event occurrence.
- Table 4.2, gives Scale Value-II.
- Scale Value-I & Scale Value-II together gives us points of the consequences given in table 4.3.
- Based on the points, category of the risk can be defined which gives risk response action.

Table 4.1: Risk Assessment Table – Likelihood

Description	Scenario	Probability	Scale Value-I
Highly Likely	Very Frequent occurrence	Over 85%	16
Likely	More than even chance	50 - 85%	12
Fairly Likely	Quite often occurs	21 - 49%	8
Unlikely	Small likelihood but could well happen	1 - 20%	4
Very Unlikely	Not expected to happen	Less than 1%	2
Extremely Unlikely	Just possible but very surprising	Less than 0.01%	1

Source: RAMP Handbook [8]

Table 4.2: Risk assessment Table- Consequence

Description	Scenario	Scale Value-II
Disastrous	Business investment could not be sustained (e.g. Death, Bankruptcy)	1000
Severe	Serious threat to business or investment	100
Substantial	Reduces profit significantly	20
Marginal	Small effect on profit	3
Negligible	Trivial effect on profit	1

Source: RAMP Handbook [8]

Table 4.3: Risk Assessment Table- Acceptance of Risk

Likelihood	Consequence				
	Disastrous (1000)	Severe (100)	Substantial (20)	Marginal (3)	Negligible (1)
Highly Likely (16)	16000	1600	320	48	16
Likely (12)	12000	1200	240	36	12
Fairly Likely (8)	8000	800	160	24	8
Unlikely (4)	4000	400	80	12	4
Very Unlikely (2)	2000	200	40	6	2
Extremely Unlikely (1)	1000	100	20	3	1

Source: RAMP Handbook [8]

Table 4.4: Key to Acceptance of Risk

Points	Category	Action Required
Over 1000	Intolerable	Must be Eliminated
101 - 1000	Undesirable	Attempt to avoid or transfer Risk
21 - 100	Acceptable	Retain & manage risk
Up to 20	Negligible	Can be ignored

Source: RAMP Handbook [8]

V. DISSCUSSION OF RESULT

Because there are so many factors affecting the occurrence of accidents on a construction site, it is necessary to construct a process that reduces the amount to a manageable few. (Hyun-Soo Lee et al) [9].

Table 5.1 is the summary of data analyzed using Risk Assessment Tables. It shows that, on an average 'Collapse of temporary structure' falls into Acceptable Category, whereas all the other but one are Undesirable. Mis-operation of machinery/ equipment/ tools is an Intolerable event.

Example of calculation:

Probability of occurrence of Risk Event: 60%

As per Table 4.1, Scale Value-I = 12.

As per Table 4.2, Scale Value-II = 100 (ref. to expert response)

With ref. to Table 4.3, Points of consequences = 1200.

As per Table 4.4, with points over 1000 falls into Intolerable Category.

Table 5.1: Summary

Risk Event	Score	Category
Drops (Object/tool falls on person from height)	160	Undesirable
Collapse of temporary structure	24	**Acceptable**
Person falling from height	160	Undesirable
Object slips on floor (Impact on stable objects, hits by moving objects)	800	Undesirable
Squeezing (Caught in between two objects)	400	Undesirable
Contact with electric current/shock	800	Undesirable
Mis-operation of machinery/equipment/tools	1200	**Intolerable**
Traffic accidents	160	Undesirable
Overworking	-	
Other reasons of accident	-	

VI. CONCLUSION

- Risk Reduction mitigates the impact of adverse risk event, it depends on time and money available.
- Risk Transfer can be done with payment of insurance premium & cost effectiveness.
- Risks can be avoided by removing the causes of risk.
- Risk absorption can also be called as acceptance of risk. For adoption of this strategy, there should be preparation of contingency plan since initiation.

The risk assessment with the help of Risk Response Technique is easy way to understand and implement. After thorough analysis of risk events and causes of their occurrence, it is important to select appropriate way for mitigation of risk out of the four suggested.

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