International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 05, May-2019

RISK MANAGEMENT IN HIGH RISE CONSTRUCTION PROJECTS IN SURAT CITY

[1]Gavit Shivamkumar Chandubhai, [2]Dr. Jayeshkumar R. Pitroda, [3]Prof. Ashish H. Makwana

[1]*Construction Engineering and Management, Civil Engineering Department,*
[2]*Associate Professor, PG Coordinator Construction Engineering and Management, Civil Engineering Department*
BVM Engineering College, Vallabh Vidyanagar, Gujarat
[3]*Assistant Professor, Civil Engineering Department, Marwadi Education Foundation's Group of Institutions, Rajkot, Gujarat*

Abstract *– **This paper gives information about identification of risk factors and perceptions of Indian construction practitioners i.e., contractors, owners, project managers and Engineers on the importance of different construction risks and how the risks should be assigned between the different parties of the contract. As the very common project styles, construction projects have so many characteristics likewise time limitation, specific items, financial restrictions and requirements, extraordinary structural and legal situations, complexity features. For this situation every construction project has own complex method. Risks constantly happen at construction projects and frequently cause time overrun or cost overrun. If you don't contemplate these risk factors, or neglect the main factors, these risk factors will affect the damage because of the managerial errors. Risk management is the process which covers to identify the risks, for assessment with the help of qualitatively and quantitatively, to response with appropriate technique for management and controlling. The concept has gain popularity in various industries. Various companies frequently found the method in their projects for upgrading their performance, reducing their losses and increasing their profits. Questionnaire survey among clients, contractors, engineers and architects is analysed using, Relative Importance Index (RII)) method. The focus of this study is to understand what Risk Management is, understand the process of risk management at construction project and have depth knowledge on the use of risk management in high-rise construction projects.***

Keywords – Risk, Risk Management (RM), Risk Assessment (RA), High-Rise Construction, Relative Important Index (RII).

I. INTRODUCTION

High rise construction projects are very major part of construction industry which has an important role for growth of the nation. The risk factors in construction projects are very high. Hence risk involved in high-rise structures also plays a major role in construction industry. Construction project objectives are always unique and built once. Risks are arising from different sources. Risk all the time occurs at construction projects and frequently leads to time overruns or cost overruns. Indian cities perceive huge demographic growth due to migration from surrounding villages. Many citizens all over India migrate to the cities for better jobs and education. In India, a building greater between 35 to 100 meters, generally 12 to 39 stories, is considered as high-rise. Most of the high-rise buildings in India are in the Mumbai. More than 2500 high-rise buildings are previously constructed. Delhi and its nearby area perceive vast construction events with 1500 already constructed high-rises.

Risk management planning is the procedure of determining how to approach and organize the risk events for respective projects. Risk management should apply at the initial phase for project development; Risk management will be very useful in developing an understanding of project uncertainty.

This research shows overall ranking of the risk factors occurs in the high rise construction industry and response was given by the engineers, architects, contractors and owners respectively. After discussion of rankings the recommendations for stakeholders has been discussed and future scope has been made.

II. RISK MANAGEMENT IN HIGH-RISE CONSTRUCTION PROJECTS

It is very important to understand the risk management concept before understanding the risks in high-rise construction industry. In every phase of the projects there are many dimensions of the risks and uncertainties. In projects the objectives are most often related to time, cost, quality and function and client satisfaction**.** Risk can be defined in different ways depending on the risk management focus, different relations between the objectives and the scope of the research.

Risk can be defined as a combination of probability of an event occurs and the consequences befalling to achieve the project objectives. Risk is an exposure to potential loss or damage.

A. High-Rise Structures in India

Indian cities are witnessing immense demographic expansion due to migration from surrounding villages, leading to urban sprawl, housing demand, rise in cost of land. Many citizens all over India migrate to the cities for better jobs and education.

In India, a building greater than 100ft (35 m), generally 12 to 25 stories, is considered as high-rise. Also a building is considered to be high-rise when it extends higher than the maximum reach available to fire fighters. According to the building code of India, Most of the tall buildings in India are in the commercial capital Mumbai. More than 2500 high-rise buildings are already constructed. In addition more than thousand mid-rises exist already in the city. Mumbai is undergoing a massive construction boom, with thousands of tall buildings and about fifteen high-rise structures are under construction. Delhi and its surrounding regions are witnessing huge construction activities with 1500 already constructed high-rises. Figure 1 shows the difference of high rise and low rise buildings.

Figure 1. High Rise and Low Rise

B. Risks in Construction Projects

Risks frequently occur in construction projects are the following:

1. Occurrence of accidents to operatives on site causing physical injury.
2. Failure to complete within the stipulated design and construction time.
3. Failure to obtain the expected outline planning, detailed planning or building code/regulation approvals within the time allowed in the design program.
4. Unforeseen adverse ground conditions delaying the project.
5. Failure to complete the project within the client's budget allowance.
6. Loss of the contractor caused by the late production.

C. Risk Management Process

The risk management process may consist of elements more or less closely connected. The risk management process consists of four phases.

1. Risk Identification
2. Risk Analysis
3. Risk Response
4. Risk Control

1. Risk Identification

Risk management always starts with risk identification, which may be considered the most important phase of the risk management process. Its purpose is to compile a list of risks important for a particular project. To form this list, it is first necessary to research the potential sources of risk, adverse events that include risk, and the unfavourable effects of an undesirable scenario.

2. Risk Analysis

Risk analysis, the second stage of the risk management process, deals with the causes and effects of events which cause harm. The aim behind such analysis is a precise and objective calculation of risk. The essence of risk analysis is that it attempts to capture all feasible options and to analyse the various outcomes of any decision.

3. Risk Response

Risk Response process is the third stage in the risk management process. The most common responses that are used to deal with risks are:

1. Risk Avoidance
2. Risk Transfer
3. Risk Mitigation
4. Risk Share
5. Risk Acceptance
6. Contingency

4. Risk Control

This is the last process of risk management and it involves the implementation of risk response to the risk.

1. All responses that are made to risks must be monitored and reviewed to ensure they are effective.
2. Responses taken to risks should also be fully documented for future reference and project plans need to be updated accordingly. Any changes required in schedule, budget etc. due to the risk should be documented and updated in the project plans.
3. Risk Control should be an on-going process in which the impact of the risk is again evaluated and assessed.

D. Benefits of Risk Management

The following are the benefits of the risk management:

1. Risk management contributes to a better view of possible consequences resulting from unmanaged risks and how to avoid them.
2. Another benefit of working with risk management is increased level of control over the whole project and more efficient problem solving processes.
3. The risk management also provides a procedure which can reduce possible and sudden surprises.

III. RESEARCH METHODOLOGY

A. Questionnaire Design

The work included a literature search and interviews. The literature review was conducted through book, internet and journals. As the outcome of this, 38 risk factors for building construction projects were identified. These factors were categorized in eleven main groups such as: design, physical, logistics, legal, environmental, management, cultural, financial, construction, policies and safety. Content validity was conducted by three experts to evaluate the content validity of questionnaire, to check readability, offensiveness of the language and to add more factors and information if needed. As a result, good comments regarding the factors were taken into consideration and 5 additional factors were added to reflect the nature of construction industry in Gujarat. These factors were combined with the original factors and the required modifications have been introduced to the final questionnaire. A total of 38 factors were distributed into eleven groups.

B. Data Analysis Methods

Questionnaire survey among owners, contractors, engineers and architects will be analysed using Relative Importance Index (RII) method.

1. Ranking Methods

In this research, ordinal scales were used. An ordinal scale, as shown in the table 1 is a ranking or a rating of data that normally uses integers in ascending or descending order. The numbers assigned 1, 2, 3, 4, 5 are simply numerical labels.

Table 1: Ordinal Scale Used for Measuring of the level of Effect

ITEM	CRITICAL EFFECT	HIGH EFFECT	MEDIUM EFFECT	LOW EFFECT	NO EFFECT
Scale	5	4	3	2	1

For analysing data by ordinal scale, a Relative Importance Index (RII) was used for each factor by the following equation:

$$\text{Relative Importance Index} = \frac{5n_1 + 4n_2 + 3n_3 + 2n_4 + n_5}{5(n_1 + n_2 + n_3 + n_4 + n_5)} \quad \ldots. (1)$$

Where, n_1 = number of respondents who answered "Critical effect"
n_2 = number of respondents who answered "High effect"
n_3 = number of respondents who answered "Medium effect"
n_4 = number of respondents who answered "Low effect"
n_5 = number of respondents who answered "No effect"

2. Spearman's Rank Correlation Coefficient

A correlation is simply defined as a relationship between two variables. In order to test the relative agreement/disagreement between the responses from different groups engineers, architects, contractors, owners the ranks, derived from the ratings given by respondents corresponding to the risk factors affecting in High-rise construction projects, are to be analysed using the Spearman's rank correlation coefficient.

$$R = 1 - \frac{6\sum d^2}{n(n^2 - 1)} \quad \ldots (2)$$

Where, d = difference between ranks

n = number of parameter being ranked

IV. DATA ANALYSIS AND RESULTS

A. Stakeholder Details

Four types of stakeholders are targeted:

1. Engineers
2. Architects
3. Contractors
4. Owners

Total 70 questionnaires were distributed to different respondents in Surat. Total 69 respondents provided their response for this research work. Table 2 shows the number of respondents.

Table 2: Distribution of Respondents

STAKEHOLDERS	TOTAL
Engineer	29
Architect	14
Contractor	12
Owner	14
TOTAL	**69**

B. Data Analysis by Relative Important Index (RII) Method

The primary data collected from the questionnaire survey were analysed using Relative Importance Index method for ranking each factor from the perspective of engineer, architect, contractors and owner. Table 3 shows the ranking of overall response by RII method for risk factors.

Table 1 Ranking of Overall Response by RII Method for Risk Factors

ID	FACTORS	RII	RANK
A	**DESIGN**		
A1	Defective Design	0.705	6
A2	Awarding the Design to Inexperience Designer	0.675	11
A3	Inaccurate Quantities	0.657	15
A4	Design Changes	0.673	12
B	**PHYSICAL**		
B1	Occurrence Of Accidents Because Of Poor Safety Procedures	0.649	18
B2	Supplies Of Defective Materials	0.625	22
B3	Security Of Material And Equipment	0.596	29
B4	Varied Labour And Equipment Productivity	0.652	16
C	**LOGISTICS**		
C1	Improper Site Investigation	0.636	21
C2	High Competition in Bids	0.712	5
C3	Poor Communications Between the Site and Head Offices	0.689	9
D	**LEGAL**		
D1	Ambiguity of Work Legislations	0.327	35
D2	Difficulty to Get Permits	0.586	31
D3	Disputes Among the Parties of Contract	0.625	22
E	**ENVIRONMENTAL**		
E1	Adverse Weather Conditions	0.622	25
E2	Difficulty to Access the Site	0.689	10
E3	Natural Calamities (Floods, Earthquakes, Fire, etc.)	0.723	4
F	**MANAGEMENT**		
F1	Poor Communication Between Involved Parties	0.689	8
F2	Improper Planning	0.692	7
F3	Changes in Management Ways	0.651	17
F4	Information Unavailability	0.617	26
F5	Material Management	0.746	3
F6	Equipment Management	0.668	13
G	**CULTURAL**		
G1	Religion	0.222	38
H	**FINANCIAL**		
H1	Delayed Payments on Contract	0.779	2
H2	Unmanaged Cash Flow	0.591	30
H3	Inflation	0.485	33
H4	Financial Failure of the Contractor	0.791	1
I	**CONSTRUCTION**		
I1	Gaps Between the Implementation and the Specifications.	0.638	20
I2	Actual Quantities Differ from the Contract Quantities	0.361	34
I3	Lower Work Quality in Presence of Time Constraints	0.604	28
I4	Undocumented Change Work Orders	0.662	14

J	**POLICIES**		
J1	New Governmental Acts or Legislations	0.320	36
K	**SAFETY**		
K1	Fire Safety	0.641	19
K2	Use of Defective Equipment	0.623	24
K3	Improper Guarding of Equipment or Platform.	0.614	27
K4	Failure to Use Personal Protective Equipment	0.570	32
K5	Unsafe Material Handling	0.298	37

The top ten risk factors affecting in high-rise construction projects with their level of effect as rated by considering all responses are listed below.

1. Financial failure of the contractor with a value of RII=0.791
2. Delayed payments on contract with a value of RII =0.779
3. Material management with a value of RII=0.746
4. Natural calamities (floods, earthquakes, fire, etc.) with a value of RII=0.723
5. High competition in bids with a value of RII=0.712
6. Defective design with a value of RII=0.705
7. Improper planning with a value of RII=0.692
8. Poor communication between involved parties with a value of RII=0.689
9. Poor communication between the site and head office with a value of RII=0.689
10. Difficulty to access the site with a value of RII=0.689

C. Spearman's Rank Correlation Coefficient

The spearman's correlation coefficient was used to find out the correlation between the rankings given by engineers, architects, contractors and owners. These correlation coefficient values show the amount of correlation between these stakeholders for ranking the risk factors affecting in high-rise construction projects using RII method. Table 4 shows the spearman's correlation coefficient between stakeholders.

Table 4: Spearman's Correlation Coefficient between Stakeholders

SR. NO.	GROUPS		SPEARMAN'S CORRELATION COEFFICIENT	AGREEMENT/ DISAGREEMENT
RISK FACTORS				
1	Engineer	Architect	0.846	Agreement
2	Engineer	Contractor	0.791	Agreement
3	Engineer	owner	0.902	Agreement
4	Architect	Contractor	0.758	Agreement
5	Architect	Owner	0.911	Agreement
6	Contractor	Owner	0.792	Agreement

V. CONCLUSIONS

This research is intended to identify the risk factors affecting in high-rise construction projects. This study investigates all possible risk factors affecting in high-rise construction projects through a structured questionnaire distributed in Surat city of Gujarat. The survey results are subjected to analysis, and the ranking of factors is calculated using the Relative Important Index (RII) Method.

From this research studies following recommendation are given to prevent the risk factors in high-rise construction projects.

1. Special attention should be given by the engineers on the issues related to material management, improper planning, and communication between involved parties in order to minimize their impacts on High-rise construction projects.
2. Special attention should be given by the architects on the issues related to defective design and communication between involved parties in order to minimize the impact on affecting in High-rise construction projects.
3. Special attention should be given by the contractors on the issues related to financial failure of contractor, high competition in bids, communication between site and head office in order to minimize their impacts on affecting in High-rise construction projects.
4. Engineers and contractors are advised to give serious attention in material management, proper planning and communication between involved parties.
5. Special attention should be given by owner on issues related on issues related to delayed payments, awarding the design to inexperience designer, awarding contract to the financially incapable contractor, communication between involved parties.
6. The stakeholders should plan in advance to handle the effect of the identified critical factors by taking into consideration the ranks as listed in this study.

ACKNOWLEDGEMENT

I thankful to Prof. (Dr.) I. N. Patel, Principal, BVM Engineering College, Vallabh Vidhyanagar, Gujarat. Dr. Jayeshkumar R. Pitroda, Associate Professor, PG Coordinator, Construction Engineering and Management, Civil Engineering Department, BVM Engineering College Vallabh Vidhyanagar, Gujarat. Prof. Ashish H. Makwana, Assistant Professor, Civil Engineering Department, Marwadi Education foundation's Group of Institutions, Rajkot, Gujarat for their motivation and support for research work.

REFRENCES

1 Arati Chougule, Ashish Waghmare (2015) "Risk Management in High-Rise Building Construction" International Journal for Scientific Research and Development (IJSRD) Vol. 3, Issue 06, ISSN (Online): 2321-0613.

2 Bhandari M.G. (2014) "Management of Risk in Construction Projects in Maharashtra," International Journal of Engineering Science Invention Vol.3 (1), Pp.14-17.

3 Boris Titarenko, Amir Hasnaoui, Roman Titarenko, and Liliya Buzuk (2018) "Project Risk Management in the Construction of High-Rise Buildings" E3S Web of Conferences Vol. 33, 03074.

4 Danish Ali, Alvin Harison (2016) "Risk Management Strategies in Construction Companies in India" International Journal for Innovative Research in Science and Technology (IJIRST) Vol. 2, Issue 10.

5 Dr. Nadeem Ehsan (2010) "Risk Management in Construction Industry", IEEE, Vol. 4, Issue-6.

6 Edmundas Kazimieras Zavadskas, Zenonas Turskis (2013) "Multi-Criteria Risk Assessment of a Construction Project", Science Direct, Procedia Computer Science Vol. 17, 129 – 133.

7 Eldemery Ibrahim (2007) "High- Rise Buildings – Needs and Impacts" CIB, Vol. 269.

8 Fellows, R. And Liu, A. (1997) "Research Methods for Construction" Blackwell Science, Vol. 3.

9 Flanagan, R. And Norman, G. (1993) "Risk Management and Construction" Victoria: Blackwell Science Pty Ltd, Australia, Vol. 2.

10 Ger Maas (2005) "Technical Developments in High-Rise Building" 22nd International Symposium on Automation and Robotics in Construction (ISARC), Ferrara (Italy), Vol. 4.

11 Hanish Verma, Neha Verma (2017) "A Study on Risk Assessment and Safety Management in the Construction of High-Rise Buildings" IJEDR, Vol. 5, Issue 1, ISSN: 2321-9939.

12 Imayanti Basari (2017) "Estimation Risk of High Rise Building on Contractor" IPTEK, Journal Of Engineering, Vol. 3, No. 2, Eissn: 2337-8557.

13 Junying Liu, Qunxia Xie, Bo Xia, and Adrian J. Bridge (2017) "Impact of Design Risk on the Performance of Design-Build Projects" American Society of Civil Engineers, Vol.6.

14 Manlian Ronald. A. Simanjuntak, Hannah Achmadi (2017) "Important Risk Identification on High-Rise School Building in Eastern Part of Indonesia" Imperial Journal Of Interdisciplinary Research (IJIR) ,Vol-3, Issue-4, ISSN: 2454-1362.

15 Mostafa H. Kotb, Abdullah K. Murtaja (2015) "Risk Analysis in Construction Projects in Gaza Strip (Contractor's Perspective)" IUG Journal of Natural and Engineering Studies, Vol 23, No 1, ISSN 2409-4587.

16 Prof. Shakil S. Malek (2013) "Risk Management in Construction Industry", IJAR, Vol.3, Issue-2.

17 Rupali Kavilkar And Shweta Patil (2014) "Study of High Rise Residential Buildings in Indian Cities (A Case Study –Pune City)" International Journal of Engineering and Technology (IACSIT), Vol. 6, No.

18 Said Ali El-Quliti, Refat Basarwan, Hasan Alzahrani, Saeedalzahrani, Farisbadr (2016) "Project Risk Management in High Rise Buildings in Saudi Arabia" AARJSH Vol. 3 Issue 6,ISSN : 2278 – 859X.

19 Terry Lyons, Martin Skitmore (2004) "Project Risk Management in the Queensland Engineering Construction Industry: A Survey" International Journal Of Project Management. Vol.22.

20 Xiao-Qian Suna, Ming-Chun Luob (2014) "Fire Risk Assessment for Super High-Rise Buildings" Procedia Engineering, Vol. 71.

AUTHORS BIOGRAPHY

Gavit Shivamkumar Chandubhai received Bachelor of Engineering degree (Civil Engineering) from Sarvajanik College of Engineering and Technology, Gujarat Technological University in 2017. At present, he is final year student of Master of Technology in Construction Engineering & Management from Birla Vishwakarma Mahavidhyalaya, Guajarat Technological University.

Dr. Jayeshkumar Pitroda received his Bachelor of Engineering Degree in Civil Engineering from Birla Vishwakarma Mahavidyalaya Engineering College, Sardar Patel University (Vallabh Vidyanagar, Gujarat-India) in 2000. In 2009 he received his master's degree in Construction Engineering and Management form Birla Vishwakarma Mahavidyalaya Sardar Patel University (Vallabh Vidyanagar, Gujarat-India). In 2015 he received his Doctor of Philosophy (Ph.D.) Degree in Civil Engineering from Sardar Patel University (Vallabh Vidyanagar, Gujarat-India). He has joined Birla Vishwakarma Mahavidyalaya Engineering College as a faculty in 2009, where he is lecturer of Civil Engineering Department and at present working as Associate Professor from February 2018 having total experience of 19 years in the field of Research, Designing and Education. At present holding charge of PG Coordinator Construction Engineering and Management. He is guiding M.E. / M. Tech (Construction Engineering and Management/ Construction Project Management/ Environmental Engineering) thesis work in the field of Civil / Construction Engineering/ Environmental Engineering. He is also guiding Ph.D. students (Civil Engineering). He has published many papers in National / International Conferences and Journals. He has published nine Research Books in the field of Civil Engineering, Rural Road Construction, National Highways Construction, Utilization of Industrial Waste, Fly Ash Bricks, Construction Engineering and Management, Eco-friendly Construction.

Prof. Ashish Harendrabhai Makwana was born in 1988 in Jamnagar district, Gujarat-India. In 2012, he received Bachelor of Engineering degree (Civil Engineering) from Charotar Institute of Science and Technology (Changa, Gujarat-India) which is affiliated to Gujarat Technological University (Ahmedabad, Gujarat-India). Gujarat Technological University. In 2014, he received Masters of Engineering degree (Construction Engineering & Management) from Birla Vishvakarma Mahavidyalaya Engineering College (Vallabh Vidyanagar, Gujarat-India) which is affiliated to Gujarat Technological University (Ahmedabad, Gujarat-India). Currently, he is working as Assistant Professor in Civil Engineering Department of Marwadi University, Rajkot. At present (2018), he has teaching and research experience of 4.4 years in Marwadi University (Rajkot, Gujarat-India) and 1.3 year of experience as Site Engineer at M/S Deepak B. Pala Consultancy (Jamnagar, Gujarat-India). His research interests include Construction Project Management application through various management techniques. He has diversified teaching experience in subjects of Infrastructure Engineering and Management, Construction Management, Advanced Construction & Equipment, Concrete Technology, Professional Practices & Valuation, Surveying, Civil Engineering Materials, Elements of Civil Engineering, Hydrology & Water Resources Engineering. He is guiding for M.E. (Construction Engineering and Management) thesis research work in the field of Civil / Construction Engineering. He has published many research papers in various International Journals as well as International / National Conferences. Also, he has published three Research Books in Lap Lambert Academic Publication, Germany.