WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Risk Management in Construction Industry

S.Divya Sankar[1], Dr. Kulkarni Shashikanth[2,3]

[1]Research Scholar, Department of Civil Engineering, Lincoln University College, Malaysia
[2] Supervisor, Dr. K. Shashikanth, Lincoln University College, Malaysia
[3]Professor, Department of Civil Engineering, University College of Engineering, Osmania University, Hyderabad, TS, India
divyasankar@lincoln.edu.my
DOI: https://doi.org/10.55248/gengpi.2022.3.5.17

ABSTRACT:

Risks are managed in construction projects mostly through management to realize the construction project objectives in terms of cost, time, quality, environment, safety, design, risks because of crises. In questionnaire, likelihood occurrences and level of impact risk factors are identified using three point Likert scale. Therefore, furthermost research has been concentrated on a number of aspects of risk management in construction by means of an organized and complete approach towards identifying risks, then analyzing the likelihood occurrences and impacts of the risks. The goal of this research is towards identifying and analyzing the risks which are related towards the development of the construction projects. The information is gathered through questionnaires basing on different possibilities of occurrences of likelihood assessment and their level of impacts on the construction project goals too. Questionnaire responses from the construction professionals are gathered from Andhra Pradesh State and Telangana State within Indian construction. In this paper, Cronbach alpha, Kaiser-Meyer-Olkin (KMO) is the Measure of Sampling Adequacy and Component matrix shows the factor loadings for all the factors considered are calculated by using Statistical Package for Social Sciences (SPSS) version 25 software. This research paper is quantitative in nature and the results of the highest rankings of risk factors Cronbach Alpha, KMO and Factor loadings of likelihood occurrences are 0.883, 0.834, 0.779 in Andhra Pradesh and 0.911, 0.850, 0.781 in Telangana State of India. Coming to the results of level of impact, the highest rankings of risk factors of Cronbach Alpha, KMO and Factor loadings are 0.820, 0.773, 0.794 in Andhra Pradesh and 0.911, 0.843 and 0.780 in Telangana State of India. Its scope is limited to Indian context only and few recommendations are also mentioned.

Keywords: Risk management, risk factors, Indian construction, risk, questionnaire survey, SPSS.

INTRODUCTION

For constructional project management, actions towards avoiding hazards involve planning, monitoring and controlling various factors. It is imperative to measure the level of risk for controlling risk and allied hazards. Various researchers have focused on certain phases and advance steps which are not considered to be orderly. Logically, the first step is regarding identification of the type of risks, the second step involves analyzing the identified risk and the third step for minimization of the same. In this study, decisive risk approach for tackling the construction project hazards. The construction of buildings in cities has been growing continuously; hence, various techniques of risk management are necessary depending on the type of construction.

LITERATURE REVIEW OF CONSTRUCTION PROJECTS RISK MANAGEMENT

The review of the literature is revealing a widespread assortment of risks, causes in erecting ventures, managing a number of methods of risk techniques which are employed in managing developments permitted towards controlling possible hazards. Subsequently, certain reviews are well thought-out after many research papers towards demonstrating and then having study information.

Hariharan Subramanyan et al., (2012) observed the risks taken in the Indian construction industry and the procedures of mitigation which are been advised in this paper are very useful, unless implemented in a right procedure and also increases positive outcomes chances.

Patel Ankit Mahendra et al., (2013) proposed an application of the risk management technique which consists of good procedures of documentation for putting a single stop for different varieties of risks that are occurring mostly throughout lifecycle of construction projects.

Renuka et al., (2014) proposed an easy systematic tool for every project task towards assessing hazards in an easy manner and also inspires the practitioners towards implementing risk analysis. This review concluded that risk identification and assessment during the bidding stage of the construction leads towards the better estimation of cost escalation and also time overrun. Therefore, for the completion of the project successfully, risk assessment need to be included in the budget and scheduling.

Alfredo Federico Serpella et al., (2014) recognized an efficient and effective methodology for risk management basing on Chile construction

and also recommended contractors and clients towards approaching risks in a higher manner and by also avoiding loses.

Sathish Kumar et al., (2015) proposed a framework towards identifying and assessing risks and also calculating the severity of risks towards personal and property risks for the investors or contractors or developers who need to adopt within the contracting construction works.

Amarsinh (2016) concluded that in the theory it has two dimensions, risk is declared as a negative term and positive term. Moreover, scholars established the knowledge of risk management and risk management process that remains on the edge of zero although, awareness of managing risk remains within construction zone. Therefore, it's necessary to spread alertness and making contemplation amongst people to use risk management techniques in the interior of the construction industries.

Ahsan Nawaz et al. (2019) revealed that the housing industry has many features of managing risks which will be performed by means of interpreting observations and important to outworkers of Pakistan and concluded by identifying risky procedures using in the development of Pakistan construction and also instant modification procedures will be used if hazards occur.

Nasir B. Siraj et al., (2019) recognized routine risks in the field of construction and in this research the highest risks which are identified are errors in design, variation in the rate of inflation, poor engineering, change in government laws & policies affecting outcomes of the project.

Amer Abdullatef Mahmoud al-Mukahalet al.,(2020)stated that, the technique of management of project risk analysis consist of many phases. The primary method is the qualitative risk analysis objectives at studying the variety of consequences by using the following tools, whereas the second is the quantitative chemical analysis purpose is towards supplying a designed quantitative explanation of the risk by using the succeeding tools. The third phase is planning a response to risks and objectives are at illustration of active plans for risk and plans are separated into primary i.e. plan for replying to negative risks and second is plans for response to positive risks. Finally, risk control patterned and it aims to follow up and investigate recent risks.

RESEARCH GAP

This paper aims towards development of construction projects towards identifying and assessing the possibility of occurrences and also the impact level of the factors relating to risk on construction projects. Until now, most of them are calculating the risk factors using relative index RII but in this paper, the ranking is done by using KMO and Factor loadings for the Andhra Pradesh State and Telangana State in view of possibilities of occurrences and an impact level because of different construction methods and procedures on the survey inputs, the comparison results of the risk factors between two States in India are compared.

OBJECTIVE OF THIS RESEARCH STUDY

The objective of this research study is towards identifying and analysing the risks which are related towards the development of construction projects.

RESEARCH METHODOLOGY

Research methodology helps to solve the research problem in a systematic manner. This study is descriptive and primary data has been adopted. For the selection of samples, non-random sampling method is used. In the construction industry, the questionnaire was given to the professionals in residential apartment construction projects. Inorder to have clarity, the pilot study is conducted where the information can be gathered in a detailed manner. In the pilot study and pre-testing, the questionnaire was given to 50 employees for checking the structure and applicability. In the pilot study, Cronbach Alpha reliability value is 0.810. Inorder to verify the contents, again the questionnaire was given to the field experts and all importantmistakes were done. After modification of questionnaire duringpilot study and it's been used for the present study. The formula of the sample size determination of this study is as follows:

$$N = [Z^2 * P * Q] / S.E^2 \quad \text{Eq(1)}$$

Here, N is the sample size

Zisthe confidence interval

P is the occurrenceprobability

Q is the non-occurrenceprobability

In this study, the purposive sampling is a form of nonprobablility sample method which is used for choosing the respondents. Therefore, the

sample size for this study is considered as hundred. A questionnaire was distributed to hundred respondents and their responses are recorded. In the sampling procedure as the population size is unknown, so non- probability sampling method is considered and also purposive sampling technique method is considered. The samples from Andhra Pradesh State and Telangana State are included in this study. From Andhra Pradesh State, fifty responses are gathered and other fifty responses from Telangana State in India were gathered. The total respondents sample size is of 100. The primary data is gathered from the respondents by distributing questionnaires with the Project Managers, Construction Managers, Planner or Schedulers, Builders, Technical Managers, Architects, Quantity Surveyors and Engineers in the construction projects field in the two States.The secondary data is gathered from the literatures published previously in the internet, books and journals.

ANALYSIS AND DISCUSSION

Cronbach's Alpha Reliability is the degree of consistency among the multiple variables measurements and is mainly used when there were multiple questions used in Likert scale. In this study, the questionnaire includes two different data i.e., the possibility of likelihood occurrence as well as its impact level on the goalsof the project. The risks which are considered in this study are risks due to cost, time, quality,environment, design, safety and causing of crises or incidents which are not expected.

Likelihood occurrence: [1] Less likely [2] Likely [3] Highly Likely

Level of Impact: [1] Less likely [2] Likely [3] Highly Likely

KMO full form is Kaiser-Meyer-Olkin [Kaiser et al., 1974] measure of sample adequacy (MSA). In KMO, if the value is nearby to 1 then the extraction factors are better and if the value 0.86 then its good correlation matrix factors. The minimum value of KMO should be 0.6.

***Factor loadings* signify the correlation between a variable and a factor.**

The Likelihood Occurrences of Andhra Pradesh State, the highest Cronbach Alpha value is 0.883 for Risks due to unexpected incidents or crises; Highest KMO value is 0.834 for Quality related risks and highest Factor loading is 0.779 for environmental risks as referred below to Table 1.

Table1:Reliability measures for the study of Likelihood occurrence Andhra Pradesh

S.No.	Risks	No. of items	Cronbach's Alpha	KMO	Factor Loadings
1	Cost related risks	10	0.822	0.737	0.689
2	Time related risks	10	0.764	0.696	0.738
3	Quality related risks	10	0.867	0.834	0.763
4	Environmentalrelated risks	9	0.803	0.757	0.779
5	Design related risks	8	0.804	0.698	0.744
6	Safety related risks	7	0.846	0.678	0.763
7	Risks due to unexpected incidents or crises	7	0.883	0.811	0.765
	Overall reliability of the study of occurrence	70			

The Level of impact of Andhra Pradesh State, the highest Cronbach Alpha value is 0.820 for Safety related risks; Highest KMO value is

0.773 for Cost related risks and highest Factor loading is 0.794 for Design related risks as referred below to Table 2.

Table 2:Reliability measures for the study of Level of impact Andhra Pradesh

S.No.	Risks	No. of items	Cronbach's Alpha	KMO	Factor Loadings
1	Cost related risks	10	0.789	0.773	0.654
2	Time related risks	10	0.732	0.647	0.689
3	Quality related risks	10	0.793	0.746	0.705
4	Environmental related risks	9	0.700	0.608	0.717
5	Design related risks	8	0.806	0.687	0.794
6	Safety related risks	7	0.820	0.725	0.779
7	Risks due to unexpected incidents or crises	7	0.805	0.728	0.725
	Overall reliability of the study of impact	70			

The Likelihood Occurrences of Telangana State, the highest Cronbach Alpha value is 0.911 for Cost related risks; Highest KMO value is 0.850 for Risks due to unexpected incidents or crises and highest Factor loading is 0.781 for Safety related risks as referred to below Table 3.

Table 3.Reliability measures for the study of Likelihood occurrence Telangana State

S.No.	Risks	No. of items	Cronbach's Alpha	KMO	Factor Loadings
1	Cost related risks	10	0.911	0.843	0.701
2	Time related risks	10	0.738	0.749	0.758
3	Quality related risks	10	0.727	0.634	0.711
4	Environmental Related Risk	9	0.735	0.689	0.765
5	Design related risks	8	0.814	0.792	0.710
6	Safety related risks			0.843	

Table 3.Reliability measures for the study of Likelihood occurrence Telangana State

S.No.	Risks	No. of items	Cronbach's Alpha	KMO	Factor Loadings
1	Cost related risks	10	0.911	0.843	0.701
2	Time related risks	10	0.738	0.749	0.758
3	Quality related risks	10	0.727	0.634	0.711
4	Environmental Related Risk	9	0.735	0.689	0.765
5	Design related risks	8	0.814	0.792	0.710
6	Safety related risks	7	0.647	0.843	0.781
7	Risks due to unexpected incidents or crises	7	0.887	0.850	0.760
	Overall reliability of the study of occurrence	70			

The Level of impact of Telangana State, the highest Cronbach Alpha value is 0.911 for Quality related risks, Highest KMO value is 0.843 for Quality related risks and highest Factor loading is 0.780 for Time related risks as referred to below Table 4.

Table 4.Reliability measures for the study of Level of impact Telangana State

S.No.	Risks	No.of items	Cronbach's Alpha	KMO	Factor Loadings
					0.689
1	Cost related risks	10	0.732	0.647	
2	Time related risks				0.780
		10	0.705	0.692	
3	Quality related risks				0.701
		10	0.911	0.843	
4	Environmental Related Risk				0.692
		9	0.780	0.772	
5	Design related risks				0.776
		8	0.809	0.731	
6	Safety related risks				0.779
		7	0.820	0.725	
7	Risks due to unexpected				0.698
	incidents or crises	7	0.658	0.683	
Overall reliability of the					
study of impact		70			

Frequency Figures of Andhra Pradesh State in India

In the Frequency of designation of Andhra Pradesh, the responses are gathered from Assistant General Manager, Architects, Construction Manager, Contract Manager, Contractor, Construction Engineer, Planner/Scheduler, Quanitity Surveyor, Project Manager and Technical Manager. Among all of the respondents, the highest responses are given by the Construction Engineers (13%) as referred below to Fig.1.

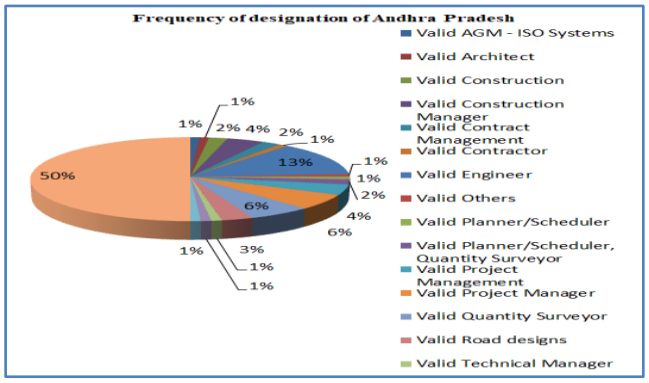

Fig. 1. Frequency of designation of Andhra Pradesh

In the Frequency of Qualification of Education of Andhra Pradesh, the qualification of respondents is B.Com, B.Sc/B.Tech, M.Sc/M.Tech, PhD and others too. Among all theses respondents, the highest responses are given by M.Sc/M.Tech (24%) respondents as referred below to Fig. 2.

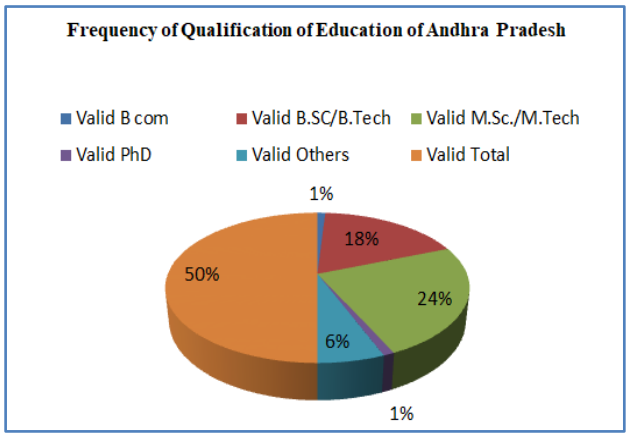

Fig. 2. Frequency of Qualification of Education of Andhra Pradesh

In the Frequency of Experience of Years of Andhra Pradesh, the respondents experience is lying between 5-10,11-20 and 21-30 years of experience respondents are working in the construction industry of residential apartments. Among all the respondents, the highest frequency of responses are gathered from (27%) respondents belonging to 5-10 years, (20%) respondents belonging to 11-20 years and (3%) respondents are belonging to 21-30 years of experience. Therefore, the highest responses 27% are gathered from 5-10 years of experience respondents in construction field as referred below to Fig. 3.

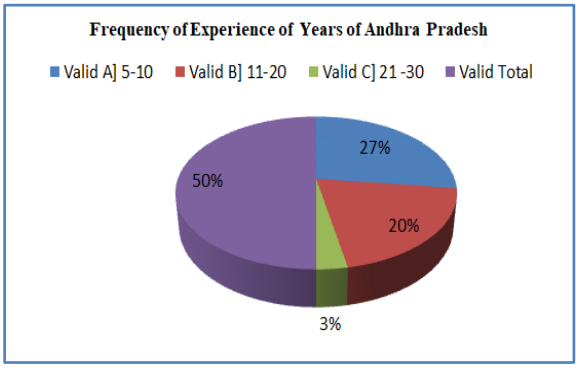

Fig. 3. Frequency of Experience of Years of Andhra Pradesh

Frequency Tables of Telangana State in India

In the Frequency table of designation of Telangana State, the responses are gathered from Construction Manager, Construction Engineers, Assistant Executive Engineers, Planning/ Scheduling Engineer, Quantity Surveyor, Project Manager, Technical Manager, Utility Survey Engineer and finally from a Vice President in Project Management. Among all of these respondents, the highest responses are given by the Construction Engineers (26%) as referred below to Fig.4.

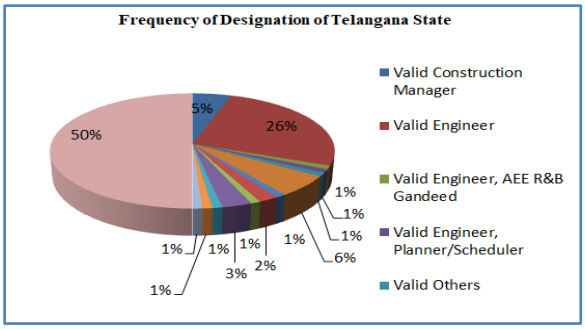

Fig. 4. Frequency of Designation of Telangana State

In the Frequency of Qualification of Education of Telangana State, the qualification of respondents is B.Sc/B.Tech, M.Sc/M.Tech, PhD and others too. Among all theses respondents, the highest responses are given by M.Sc/M.Tech (28%) respondents as referred below to Fig. 5.

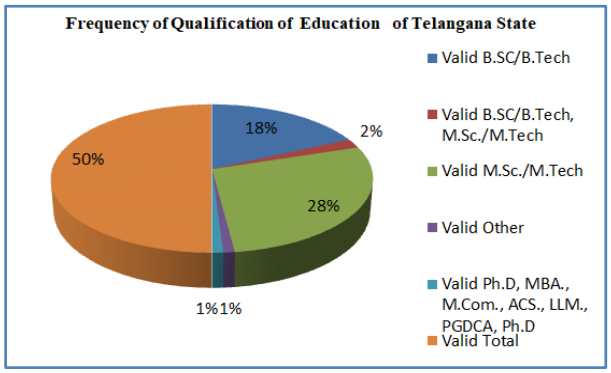

Fig. 5. Frequency of Qualification of Education of Telangana State

In the Frequency of Experience of Years of Telangana State, the respondents experience is between 5-10, 11-20, 21-30, 31-40 and above 41 years of experience respondents, responses are gathered. Therefore, the highest responses 34% are gathered from 5-10 years of experience respondents in construction field as referred below to Fig. 6.

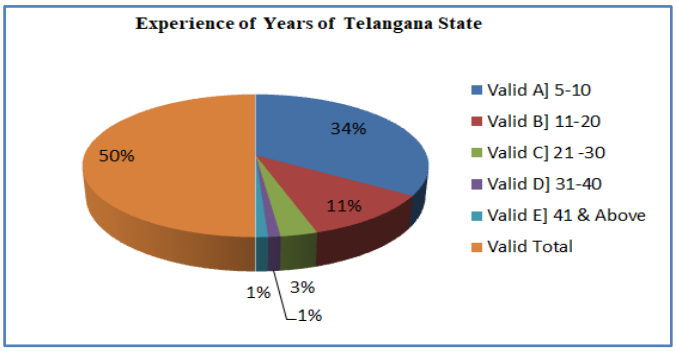

Fig. 6. Experience of Years of Telangana State

Relative Important Index: **RII = ΣW / (A*N)**

w = Weighting given to each factor by respondents and it ranges from 1 to 3. x = Frequency of it response given for each cause

A = Highest weight (i.e. 3 in this case)

N = Total number of participants

Likelihood occurrence: [1] Less likely [2] Likely [3] Highly Likely

Level of Impact: [1] Less likely [2] Likely [3] Highly Likely

CONCLUSIONS

The study is on identification and assessment of likely occurrences and impact level of factors related to risk in residential apartments in A.P and Telangana. Based on the highest KMO, the risk factors are listed. Comparison of various risk factors of construction companies have been considered. The factors are Tight Project Schedule, design variation, variation by customer, improper programming, disputes, price expansion, rigid endorsement techniques in govt./consultant level, incomplete approach, inaccurate quote, insufficient program scheduling. The first position is for Tight Project Schedule (R II value is 0.760). For price expansion of materials and excessive endorsement, the rank is second (R II is 0.707). The third position goes to Design variation due to design changes and uncertainty as well as disputes (R II = 0.667)
Regarding variable of time related risks, the factors are

a) Variation of construction & development b) Government related

c) Inadequate program scheduling d) High expectation

e) Unsuitable plans& changes by customer f) Improper endorsement techniques

g) Tight schedule h) Design changes and i) Improper approval. The first rank is given to High execution or quality expectation (R II = 0.778)
Price expansion & design changes are in second rank (R II = 0.707) The third rank is for government procedures (R II = 0.713)
For quality related risks, the factors are low competence of sub contractual workers, lack of labour, lack of coordination, high execution or quality expectation, changes in construction programs, lack of proper scheduling, inaccurate cost. The first rank is for High execution or quality expectation (R II is 0.773). The second rank is for Tight project schedule (R II = 0.713). The third rank is for inaccurate cost estimate (R II is 0.7).

LIMITATIONS OF THE STUDY

In this paper, the study is limited only to two states of Andhra Pradesh and Telangana State in India.

Due to this COVID – 19 pandemic, only 100 questionnaire responses are gathered from the people working in the construction projects.

SCOPE FOR FUTURE STUDY

- Many different construction projects can be performed for any construction projects.
- By using Fuzzy logic different model parameters, linguistic variables, membership functions, fuzzy rules, weights of rules, aggregation and by defuzzification methods can be designed.
- Compulsory construction project teams need to be registered for training courses related to risk management.

REFERENCES

[1] Hariharan Subramanyan, Priyadarshi H. Sawant, Vandana Bhatt, Construction project risk assessment: development of model based on investigation of opinion of construction project experts from India, Journal of Construction Engineering and Management 138, no.3 (2012) 409-421.

[2] Patel Ankit Mahendra, Jayeshkumar R. Pitroda and J. J. Bhavsar, A Study of Risk Management Techniques for Construction Projects in Developing Countries, International Journal of Innovative Technology and Exploring Engineering (IJITEE), (2013) Volume-3, Issue-5.

[3] S. M. Renuka, C. Umarani, S. Kamal, A Review on Critical Risk Factors in the Life Cycle of Construction Projects, Journal of Civil Engineering Research (2014), 4(2A): 31-36.

[4] Alfredo Federico Serpella, Ximena Ferrada, Rodolfo Howard, Larissa Rubio, Risk management in construction projects: a knowledge-based approach, Procedia-Social and Behavioral Sciences 119: (2014) 653-662.

[5] V. Sathish Kumar, P.N. Raghunath, K. Suguna,Critical Factors Influencing to Management Risk in Construction Projects, The International Journal Of Engineering And Science (IJES) Volume 4, Issue 1 (2015) 37-46.

[6] Amarsinh B. Landage, Risk Management in Construction Industry, Article in International Journal of Engineering Research, Vol-5, Issue 1 (2016) 153-155.

[7] Ahsan Nawaz, Ahsan Waqar, Syyed Adnan Raheel Shah, Muhammad Sajid, Muhammad Irslan Khalid, An Innovative

Framework for Risk Management in Construction Projects in Developing Countries, (2019), 7, 24.

[8] Nasir B. Siraj, Aminah Robinson Fayek, Risk Identification and Common Risks in Construction: Literature Review and Content Analysis, Journal of Construction Engineering and Management, Vol-145, Issue-9 (2019).

[9] Amer Abdullatef Mahmoud Al-Mukahal, Risk Management of Construction Projects Engineering Management Research, Vol-9, Issue-1 (2020)