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Risk Management in Medium Sized Commercial Buildings

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Abstract: *Risk management is the identification, assessment of risk and measures to overcome risks. This study focuses on the risk management in medium-sized commercial building construction in Kerala. Four main objectives of this study were to identify risk factors, identify risk frequency and impact, categorise risk and identify measures to manage these risks. Extensive literature survey followed by a questionnaire survey served as the main source of data for the first 3 objectives. Further, 24 in-depth interviews were conducted with the fourth objective. It was found that owner related risks had high frequency and impact. .The top risks having high-risk exposure level were owner interference, Delay or shortage of materials, labours and equipment & Financial funding problems by owner.Respective management measures were: clearly defined scope of work and use of prequalified subcontractor, keeping a list of possible labour/material supplier who can readily supply in case of shortage, Try to find other sources of a fund like a bank loan, borrow money from financiers etc. Here also, there was also trying to find measures to manage demonetization issue occurred in Indian construction industry during the period of study.*

Keywords- Risk management, medium-sized commercial building and Kerala.

1. INTRODUCTION

Risk management is the identification, assessment, and management of risk.The main objective of the risk management is to find the uncertainties that will create a bad impact on the project and to take measures to overcome it. The risk is the chance of occurring an unpleasant event or threat which cause a loss in a construction project. It also causes a negative impact in one of the project objectives or goals. The chance of occurring a risk event in a different construction project or different geographical areas is different. The risk factor is an associated variable to a risk. For e.g. financial risk is associated with many risk factors like funding problems by owner, unstable bank interest rate etc.

This study was about risk management in commercial building construction of medium-sized up to area 500 m^2. It was also analysed demonetization which occurs in India during the thesis period. (November 2016-May 2017)

The objectives of the project work are.1. To find the main risk factors which affect the commercial building construction. 2. To find the frequency of occurrence and impact of risk factors in construction projects.3. To categorise the risk factors into low, medium, high levels based on frequency and impact.4.To find the various measures to reduce or manage different levels of risk.

The Scope is limited to the construction phase medium sized commercial building construction up to area 500 m^2 in Kerala is considered for study.

2. LITERATURE REVIEW

Some journals studied about risk analysis in commercial building construction as their main objective and some other also given it as the title. They were given as follows:**(Chan et al. 2011)** stated that the risk factors in Target Cost Contracts (TCC) or Guaranteed Maximum Price (GMP) contracts can find out by risk analysis and ranking. T.C.C are those which client and contractors agree to complete the work at a fixed cost before starting work and contractor try to complete the work at or below the fixed cost. Change in scope of work, Insufficient design completion during the tender stage, Unforeseeable design development risks at the tender stage were found as top risk factors affect the construction**(Ur et al. 2010)** analysed time risks or problems causing construction delay in Thailand. They classified risks into risk related to client, labour, consultant, communication, finance etc. And then find its rank in each categor**y. (Gambatese 2012)**studied the severity injury level in the hand over of different construction activities in the commercial building. **(Schneider et al. 2016)** examined and study the handover process in Norwegian construction

industry.**(Azlan et al. 2012)**contractors' perception of factors contributing to project delay: case studies of commercial projects in Klang valley, Malaysia.**(W.J.Fisk 1999)** study the association of ventilation rates and CO_2 concentrations in commercial buildings.

. Some of the journals studied about risk analysis or management in the construction industry in India. Those were given as follows:**(Dey 2006)** said about the risk management in Indian oil pipeline industry by introducing a method called analytic hierarchy process which was a multiple attribute decision-making technique.**(Dey 2010)** said about managing project risk by using combined analytic hierarchy process and risk map in Indian oil industry.**(Dey et al. 1994)** said about planning project control through risk analysis in Indian petroleum industry by combined analytic process.**(Doloi et al. 2012)** analysed risks in Indian construction Industry. They found the main factors were: 1.lack of commitment 2.Ineffecient site management 3. poor site coordination 4.improper planning.(**Iyer and Jha 2005)** studied about the factors affecting cost performance in projects in Indian construction industry. The top factors were: 1. Project manager's competence 2. Top management support 3. Project manager's leadership and coordination skill.**(Jha and Devaya 2010)** studied about risks faced by project managers in Indian construction companies taking international projects.**(Thomas et al. 2010)** studied about risk perception analysis in BOT (Built Operate Transfer) road project participants in India.

3. RESEARCH METHODOLOGY

3.1Risk Identification

In this project, it was found out the risk factors which affect the medium commercial building construction by literature review. The journals concerning risk management in commercial building construction was found through Google scholar search and risk factors will be listed out after reading it. The list so developed would be universal in nature and not restricted to the scope of the project. To find the factors that are relevant to Kerala conditions, discussion with experts from Kerala construction industry were conducted.

3.2 Finding Risk Frequency and Impact

For the questionnaire survey, 2 modes were selected: interview and electronic questionnaire survey. Interview must do by got their response by seeing them in their working place. Questionnaire in the form of Gmail word file was also prepared & send it to far respondents.

The questionnaire had a maximum of 4 pages in 2 parts. In 1st part, there were risk factors, its frequency and risk impact options columns to be filled by respondents. The 2nd part consists of respondent's background information such as their name, current position, experience, company, phone no and also comments about demonetization. After the questionnaire survey and analysis, It was found that the risk frequency and impact by giving weight age to low/medium /high-risk frequency and impact and take its average.

4 point Likert scale (forced choice method) for finding risk frequency and 3 point Likert scale (forced choice method) for finding risk impact (forced choice method) by avoiding neutral option was selected as rating scale for the survey analysis. More specifically saying, here frequency or likelihood scale (for finding frequency or indirectly probability of risk occurrence) and severity or impact scale (for finding impact) which can be considered subcategories of Likert scale were used. Forced choice method by avoiding neutral option (In the questionnaire, frequency neutral may be represented by 'never in project schedule' option in likelihood scale and impact neutral may be represented by 'no impact' option in severity scale) in the Likert scale because of following reasons: a) neutral option provides easy choice for the respondents. They always have a tendency to save company reputation by choosing the neutral option for an item (risk factor). b) Risk occurrence and their impact must be predicted from the survey respondents.

For frequency, the different options provided were: 1. Once in project schedule (Low Frequency- rating was 1) 2. Several times/year (Low frequency-rating was 2) 3.Several times /month (Medium frequency- rating was 2) 4. Several times /week (High frequency-rating was 3).For impact, different parameters were given as Low, medium and high (rating was 1, 2, 3 respectively).

There was also selected some people for pilot questionnaire survey to know that the questionnaire had enough clarity in their question pattern or setting. It's also helped that whether the questions had any difficult terms to understand by respondents. From their opinion, it can be go forward with the survey or if any change, it must be done in the questionnaire format.

*3.*3Risk Categorisation

Risk can be categorised on the basis of probability and impact of event or risk. Risk exposure = Frequency x Impact.

As per the questionnaire, the risks was categorised and provided the following risk exposure value range: Low risks- < 3, Medium risks- between 3 and 6, High Risks - >6.After these risks were categorised measures must be taken by giving priority.

1. High risks-Avoid / accept the risks by taking measures when the project commences. The fund must be definitely permitted to accept the risks.2. Medium risks- Reduce/accept the risks by taking measures when the project commences. The fund must be permitted to accept the risks.3. Low Risks- Monitor the risks continuously & measures to be taken to reduce the risk exposure level during project execution or in the development stage. Funds can be permitted if possible.

3.4Finding Measures to Manage Risks

Here measures were found to reduce risk exposure level and to find the risk cost allowance to meet the various risk events and uncertainties in the project. It should be done with the help of expert interview and ask their opinion after the questionnaire survey

4. RISK IDENTIFICATION AND PILOT STUDY

It was done by selecting 30 risk factors from the literature review and listing of risk factors for questionnaire preparation after the expert interview. Experts' interviews were conducted to know which of the risk factors affect the commercial building construction in Kerala region.

After pilot study in 5 respondents, some factors were included by their opinion and some others were eliminated. Some others factors which were obtained from journal review and expert opinion will cause dislike to the respondent (e.g. project fraud or corruption).So that type of risk factors in the questionnaire in an indirect manner.

5. FINDING RISK FREQUENCY AND IMPACT

5.1 Questionnaire Survey Response

Questions were widely distributed in Kerala and got a response rate of 78.57% (Got 55 responses out of 70 respondents.).Some respondents had a previous experience of working in Kerala. Now they are working outside Kerala or now they are working in foreign countries.

5.2 Respondents Position

The respondents were in 17 wide range category of designation or their position. From site supervisor who has poly diploma qualification to General Manager in a company who had B-tech with MBA qualification. Out of total respondents, about 20% respondents were site supervisors, 27 % respondents were site engineers. After them, Project Control Engineer dominated about 16 %.Other types were almost equally distributed their contribution in the survey

*5.*3Respondents Organization

Respondents who gave a response to the questionnaire survey were from 6 different types of organisation. Private Construction Company 58%, Development builders 13%, Public sector 11%, Multinational Company 9%, Private consultancy 7% and Real estate 2%.Real estate company represent client group and Development builders itself represent client group and contractor group, Private Construction group itself represent both contractor and consultant group.

5.4 Validation of Survey Results

After the 25th and 55th survey response analysis (at the mid and the end of survey), It was found that their opinion and survey results were almost similar. So analysis results of 100 or 1000 survey results will be never show no high variation and it will show similar results.So it was decided to conclude the survey in 55 respondents (logical validation were done).

5.5 Risk Frequency Analysis

Here risk frequency averages obtained by survey analysis were ranked the risks in the order of largest to smallest average frequency. It was found that owner interference has a top frequency (2.16).The risk factor which has least average frequency is Typhoon or flood risk (1.01).In the top 10 risk factors, there is mostly client and contractor involved risk factors.

Table-1: Risk Frequency Analysis & Ranking

Risk Rank	Risk Factors	Average Frequency
1	Owner interference	2.163636364
2	Low productivity of labour, equipment.	1.563636364
3	Delay /Shortage in availability of labour, material, equipment	1.545454545
4	Lack of communication of client	1.418181818
5	Design information delay	1.381818182
6	Complexity of work	1.363636364
7	Unrealistic client's requirements	1.345454545
8	late approval of result of a test sample of materials	1.345454545
9	Selection of subcontractor with unsatisfactory performance	1.327272727
10	Lack of proper training and exercise of labours and employees.	1.309090909
11	Labor dispute	1.309090909
12	Drunkard labours making issues	1.309090909
13	Poor quality work	1.290909091
14	Financial funding problems by owner	1.290909091
15	Change in material types or specification	1.236363636
16	Inflation of prices beyond expectation	1.236363636
17	Inaccurate estimate	1.2
18	Delay in sanction from Govt. for building permits and infrastructure	1.181818182
19	Design Changes by owner or his agent during construction	1.163636364
20	Errors in tender document	1.145454545
21	Safety risk in different activities like formwork of columns etc	1.145454545
22	Exchange rate variations	1.109090909
23	Late approval of drawings	1.072727273
24	Change in scope of work	1.054545455
25	Change in government regulations	1.054545455
26	Unforeseeable ground condition	1.054545455
27	Labor strike	1.036363636
28	Heavy rain, heavy snow	1.036363636

29	Unstable bank interest rate	1.036363636
30	Typhoon or flood risk	1.018181818
Total		**37.74545455**

5.6 Risk Impact Analysis

It was found that owner related risk factors had high impact (Financial Funding Problems by owner and Design Changes by owner during construction- Average Impact 2.64 and 2.51

respectively. Drunkard labours making issue has the lowest impact (Average impact-1.73)

Table -2: Risk Impact Analysis & Ranking

Risk Rank	Risk Factors	Average Impact
1	Financial funding problems by owner	2.642857143
2	Design Changes by owner or his agent during construction	2.517857143
3	Inflation of prices beyond expectation	2.446428571
4	Typhoon or flood risk	2.392857143
5	Unforeseeable ground condition	2.392857143
6	Delay /Shortage in availability of labour, material, equipment	2.285714286
7	Change in government regulations	2.267857143
8	Poor quality work	2.232142857
9	Delay in sanction from Govt. for building permits and infrastructure	2.232142857
10	Design information delay	2.214285714
11	Safety risk in different activities like formwork of columns etc	2.214285714
12	Change in scope of work	2.196428571
13	Selection of subcontractor with unsatisfactory performance	2.163636364
14	Late approval of drawings	2.160714286
15	Low productivity of labour, equipment.	2.107142857
16	Errors in tender document	2.107142857
17	Heavy rain, heavy snow	2.107142857
18	Unrealistic client's requirements	2.089285714
19	Lack of communication of client	2.089285714
20	Complexity of work	2.053571429
21	Inaccurate estimate	2.053571429

22	Labor strike	2
23	Lack of proper training and exercise of labours and employees.	2
24	Exchange rate variations	1.964285714
25	Owner interference	1.928571429
26	late approval of result of a test sample of materials	1.875
27	Labor dispute	1.857142857
28	Change in material types or specification	1.839285714
29	Unstable bank interest rate	1.839285714
30	Drunkard labours making issues	1.732142857
Total		**64.00292208**

6. RISK CATEGORISATION

Risk factors were categorised on the basis of risk exposure value. Out of 30 factors, 24 factors were found to be as low risks (80%) and 6 factors were found to be as medium risks (20%). Risk factors having rank 1 to 6 were categorised as medium risks and risks having rank 7 to 30 were categorised as low risks. So the measures must be implemented on the basis of priority.

Table-3: Risk Exposure Value of Risk Factors

Risk Rank	Risk Factors	F X I (Risk Exposure)
1	Owner interference	4.172727273
2	Delay /Shortage in availability of labour, material, equipment	3.532467532
3	Financial funding problems by owner	3.411688312
4	Low productivity of labour, equipment.	3.294805195
5	Design information delay	3.05974026
6	Inflation of prices beyond expectation	3.024675325
7	Lack of communication of client	2.962987013
8	Design Changes by owner or his agent during construction	2.92987013
9	Poor quality work	2.881493506
10	Selection of subcontractor with unsatisfactory performance	2.871735537
11	Unrealistic client's requirements	2.811038961
12	Complexity of work	2.800324675
13	Delay in sanction from Govt. for building permits and infrastructure	2.637987013
14	Lack of proper training and exercise of labours and employees.	2.618181818
15	Labor dispute	2.618181818
16	Safety risk in different activities like formwork of columns etc	2.536363636

17	Unforeseeable ground condition	2.523376623,
18	late approval of result of a test sample of materials	2.522727273
19	Inaccurate estimate	2.464285714
20	Typhoon or flood risk	2.436363636
21	Errors in tender document	2.413636364
22	Change in government regulations	2.391558442
23	Late approval of drawings	2.317857143
24	Change in scope of work	2.316233766
25	Change in material types or specification	2.274025974
26	Drunkard labours making issues	2.267532468
27	Heavy rain, heavy snow	2.183766234
28	Exchange rate variations	2.178571429L
29	Labor strike	2.072727273
30	Unstable bank interest rate	1.906168831
Total		**=∑F x I=80.43309917**

7. MEASURES TO MANAGE DIFFERENT LEVELS OF RISK

7.1 Measures to manage different risk factors

The measures to manage different levels of risk were found out by interview with the respondents. Questionnaire survey and interview with respondents were done simultaneously.

Table-4: Measures to manage different Risk Factors (Obtained from Interview)

Risk factor	Measures
Owner interference	Scope will be clearly defined in contract.
Delay /Shortage in availability of labour, material, equipment	Keep a list of possible labour/material supplier who can readily supply in case of shortage.
Financial funding problems by owner	Try to find other sources of a fund like a bank loan, borrow money from financier
Low productivity of labour, equipment.	Keep track /monitor the progress of work. If low productivity replace it
Design information delay	There must be coordinator from contractor side to ensure information flow

Inflation of prices beyond expectation	Adopt inflation sharing clause in contract
Lack of communication of client	Good communication must be developed, Ego clash must be avoided.
Design Changes by owner or his agent during construction	Think how to modify the existing structure
Poor quality work	Quality assurance and proper inspection must be provided.
Selection of subcontractor with unsatisfactory performance	Regularly evaluate the subcontractor And replace them who have poor performance
Unrealistic client's requirements	Owner first to decide what to do
Complexity of work	Unique design must be adopted Work suitable for the present condition
Delay in sanction from Govt. for building permits and infrastructure	proper follow-up of rules and regulation
Lack of proper training and exercise of labours and employees.	The contractor must place them under skilled labours.
Labor dispute	Accept-Provide contingency
Safety risk in different activities like formwork of columns etc	Adopt Safety Precautions in the site
Unforeseeable ground condition	Prepare a detailed ground study about underground condition
late approval of result of a test sample of materials	Go to labs which are not usually busy
Inaccurate estimate	Prepare revised estimate
Typhoon or flood risk	Accept-Provide contingency
Errors in tender document	Retender must be done
Change in government regulations	Accept-Provide contingency
Late approval of drawings	Proper follow up to the authorities.
Change in scope of work	Owner first to decide what to do
Change in material types or specification	If it's a fixed contract then late Change will lead to claims
Drunkard labours making issues	Accept-Provide contingency
Heavy rain, heavy snow	Accept-Provide contingency
Exchange rate variations	Accept-Provide contingency

Labor strike	Accept-Provide contingency
Unstable bank interest rate	Accept-Provide contingency

7.2 Mitigation Measures Can Be Adopted To Manage Demonetization Issue

The difference of managing the risk and issue (happened risk) was also found out. During the project period, demonetization was also affecting the construction industry in India (Arose in November 8, 2016). In November 8, 2016, Central Government of India suddenly withdraws 86 % of currency from the economy to control the black money transaction. This produced a high impact in different sectors in the country including realty sector. Daily wages of workers , material purchase etc were affected according to news reports **(Dhanorkar 2016) (Financial 2016).**Its remedial measures must be taken to manage demonetization issue was found by interview.

For Project Involving Large Companies and Clients

- Adopt digitalization of transaction (through bank, e-wallet, Aadhar linked payment etc) for payment of labours, material purchase etc**.**
- Daily wage scheme of specialist labours can be changed to monthly wage scheme after taking the opinion from them.
- The company should have the capacity and tie up with shop owners to meet labours daily needs during work. Later this money can be taken from their weekly wage.
- Adopt more machinery by reducing the labours. For e.g. adopt Berger's Express painting which is 40% faster than traditional painting. The training for operating the machinery is given by Paint Company itself. So the days of painting activity and daily wages to workers is considerably reduced.

For Project Involving Contractors and Labors

- Make tie up with shop owners to give materials for work and labours daily needs in terms of debt. Change the wage scheme so that the payment can be given in multiples of Rs 2000 or Rs 500 instead of Rs 100.

8. CONCLUSIONS

1. Owner related risks had more frequency and Impact. Owner Interference had a top average frequency (2.16). Funding problems by owner have a top high impact (2.64). Typhoon or flood risk had the least average frequency (1.01) and Drunkard labours making issues had the least average impact (1.73).

2. Owner interference had highest risk exposure value (4.1). It was also categorised as medium risk.

3. Owner interference can be avoided by the clearly defined scope of work and use of prequalified subcontractor. Financial funding problems from the owner which had 3rd rank having higher risk exposure value can be avoided by finding sources of other money by the client (private works) or contractor (during public works).

4. There was no high category of risks which affect the medium – sized commercial building construction. It does not mean that medium and low category risks have only a mild effect in the medium sized commercial building construction. It just means that measures must be given on priority basis. For low risks, it should be continuously monitored and for medium risk provide contingency to manage it during medium commercial building construction Kerala.

5. Top 6 major risk factors which were found from the survey results having highest risk exposure value were owner interference (4.1), delay in shortage of labour , material and equipment (3.53), financial funding problems by owner (3.41) , Low productivity

of labour and equipment (3.29), Design information delay (3.05) , Inflation of prices beyond expectation (3.02). These factors affect the medium commercial building construction.

6. Risks which have least risk exposure value in the descending order were drunkard labours making an issue on the site (2.26), heavy rain and snow (2.18), exchange rate variations (2.17), labour strike (2.07) and unstable bank interest rate (1.09).

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