

# Risk Management on Small Construction Projects

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**Abstract**— The bigger projects in public sector and most of the private sector projects enhance the efficiency of construction phase by construction management programmes, the small projects lack this. The project deals with the identification of risks, rank risks or uncertainties based on probability of occurrence, severity of impact and its Importance in small projects. Then assess the impact of risks or uncertainties on cost, time and quality and finally recommend Systematic Risk Management (mainly to highly ranked risks) in Small Construction Projects. The Systematic risk management can be considered as not only problem preventing tool but also problem solving tool.

**Keywords**—Risk, severity, impact, occurrence, Systematic Risk Management.

## I. INTRODUCTION

Risk is the exposure to the chance of occurrence of uncertainty. Uncertainty represents the probability that an event will occur. Risks and other uncertainties can cause losses that lead to increased costs, time delays and lack of quality during the progression of the projects and at their end.

A construction project is plagued with various risks in all the stages of the life cycle of the project. Management systems including risk management are widely used in the construction projects to mitigate these risks

Literature review shows that large projects use the technique extensively while the small projects sometimes never use it which can be attributed to lack of time for proper planning. For smaller projects, site managers may deal with two projects simultaneously, leaving little time to follow the management systems' routines and guidelines. This might not be a problem, but could lead to the smaller project making shortcuts that are fatal to the risk outbreak in the project. Risk management is about thinking ahead and calculating the risks and uncertainties involved in a project.

## II. SCOPE AND OBJECTIVE

The main aim of the research is to uncover how risk management is carried out in small size construction projects. The contribution of the study is to reach an understanding of the risk process. If a greater understanding about the issues in small sized projects is achieved, a systematic risk management technique could be formulated.

The objective of the project are listed below.

1. The various risks or uncertainties associated with the small scale projects in Kerala will be investigated.

2. To analyze the risks or uncertainties identified. To rank the risks on the basis of their probability of occurrence and severity of impact.
3. To test the strength of association between the rankings of the respondent groups.
4. To assess the impact of these risks on cost, time and quality.
5. Recommendations to incorporate the Systematic Risk Management will be done.
6. Attain all the above process by interview survey with contractors, site managers and clients and site investigation in small construction projects at Kerala.

## III. METHODOLOGY

The strategy followed in this research was first started with problem identification (risk identification) which has been done through unstructured literature review, archival study and informal discussion with colleagues and professionals in the construction sector and then the research design was formulated. The methods adopted are site investigation, interview survey and questionnaire survey.

## IV. RESEARCH DESIGN

The strategy followed in this research was first started with problem identification (risk identification) which has been done through unstructured literature review, archival study and informal discussion with colleagues and professionals in the construction sector and then the research design was formulated. Then data and information sources were determined based on the prepared research design. On the basis of the data and information sources the research instruments were decided; and available documentary sources relevant to the research were reviewed. The review include journals, internet sources and other documents.

After an in-depth literature review and site visit a questionnaire listing the various risks and uncertainties were distributed to reputed construction contractors site managers and clients to get their professional opinion based on experience. Questionnaire is prepared on the basis of risk matrix implies the probability of occurrence, impact and importance of risks.

Questionnaire consisted of three sections, Section A, Section B and Section C. In Section A information regarding the building was asked. Section B was aimed to obtain information about risks facing in construction works in small construction projects. Section C was aimed to

obtain information about the factors affected by these risks and uncertainties. The answers for the structured part (Section B) of the questionnaire were based on Likert's scale of five ordinal measures of agreement for each statement (from 0 to 4) as explained in the following sections.

## V. PILOT STUDY

### A. Details Of Projects Used For Pilot Study

Twenty small projects of project cost range 1-2 crores were visited for the pilot study. Data collection would thus be based on approximately 20 interviews.

Interview with contractors site managers and clients had been done. After going through the Site Visit and interview with professionals, 30 important risks identified are listed for use in the questionnaire. They are:

1. Accidents
2. Unexpected site conditions
3. Bad weather
4. Rule changes by government
5. Disputes on site
6. Strikes by personnel
7. Inadequate site investigation
8. Delay in providing design or poor design
9. Rework due to wrong work
10. Complex designs provided by professionals which are not Constructable
11. Limited time for construction work
12. Unexpected supply of poor quality materials
13. Unskilled labours
14. Frequent breakdown of equipments in between work
15. Increase in material/machine prices
16. Lack of proper training and experience of workers
17. Low experience of contractor in line of work
18. Inadequate specification
19. Poor Contract Management
20. Lack of knowledge of clients and consultants
21. Non performance of sub contractors
22. Poor monitoring and control (inefficient supervisors)
23. Wrong estimation
24. Poor material management
25. Lack of coordination
26. Unfavourable political situation
27. Lack of safety measures
28. Lack of communication
29. Unexpected increment in labour charge
30. Frequent changes to work/scope

## VI. DATA ANALYSIS AND INTERPRETATION

### A. Reliability Test

The reliability statistics was obtained by using SPSS software. The Cronbach's alpha reliability test performed in SPSS obtained a value of 0.953. As per the rule of thumb, the values obtained point to the data having excellent internal consistency and is therefore highly reliable.

### B. Analysis of Risks or Uncertainties

In the analysis, the 'mean score' method was adopted for the structured part of the questionnaire, to establish the

relative importance of risks or uncertainties based on frequencies of occurrence and their impact.

The data are processed through three pattern of mean scores given below;

- Mean Score Occurrence: This index expresses occurrence frequency of factor responsible for risks or uncertainties. It is computed as per following formula:

$$MSO = \frac{\sum a_i \times n_i}{N} \dots\dots\dots(i)$$

Where:

a = constant expressing the weight assigned to each responses (ranges from 0 for Not at all to 4 for Certain).

n = frequency of each response.

N = total number of responses.

- Mean Score Impact: This index expresses severity of risks or uncertainties. It is determined as per following formula:

$$MSI = \frac{\sum a_i \times n_i}{N} \dots\dots\dots(ii)$$

Where:

a = constant expressing the weight assigned to each responses (ranges from 0 for Not at all to 4 for Certain).

n = frequency of each response.

N = total number of responses.

- Cumulative Mean Score Importance: This index expresses the overview of factor based on both their occurrence and impact. It is computed as per following formula:

$$CMS = MSO \times MSI \dots\dots\dots(iii)$$

### C. Contractors' Response on Questionnaire Survey

According to the contractor's point of view, the risk related to Unexpected Increment in Labour Charge, uncertainties due to bad weather conditions, poor material management, lack of safety measures and uncertainties due to unskilled labourers comes out to be the major concerns.

Out of this five, three of them is related with the labour problems. The risk related to the labour can be attributed to lack of specific contractual agreement with labours. In most of these small projects subcontractors does not come into picture as in the case of large projects. Moreover, migrant workers are the main labour force nowadays. Until some years before, the local workers were the main labour force and there was no much problem because of the proper trade unions. So if any problem arises with contractor and laborers, it could be solved out with head of labour unions. There was proper communication with the labour unions and the contractors. There was no untimely labor charge increment.

Since, migrant workers has no such authority, had caused these problems. The skill of these workers also cannot be assessed as they frequently change one site to other. It is necessary to have a proper authority looking after them and proper agreement with them has to be made. Migrant workers also cause problem with the safety issue.

### D. Site Managers' Response on Questionnaire Survey

According to the site manager Uncertainties in weather and lack of safety measures ranked as first and second in probability of occurrence and in severity of impact. Due to

these risks site managers conveyed that they are facing such a mental stress on showing irresponsibility by labours on doing work during rain and accidents occurred due to lack of safety measures. Poor material management by labours leading to wastage of materials and hence losses occur. Managing unskilled labours is tiresome duty by site managers.

Poor material management and unskilled labours ranked as third and fourth based on occurrence of probability, severity of impact. For site managers also rules changes by government is ranked as lowest and is least affected by site managers.

#### E. Clients' Response on Questionnaire Survey

According to Clients, delay in rules changes by the government and Uncertainties in weather (Bad weather) ranked as first and second on probability of occurrence.

As the clients stated that due to these reasons delay occurs in starting the projects. This is mainly due to the irregular structure of our political scenario. By means of Impact and importance, lack of safety measures shares an important role. Non performance of sub contractors and inadequate specification indirectly affects clients. Most of the clients stated that due to lack of proper planning of contractors, most of these risks obtaining.

#### F. Correlation

To identify the degree of agreement or disagreement among the respondent groups, Spearman's coefficient of rank correlation is done. The Spearman (rho) rank correlation coefficient for any two groups of ranking is given by the formula given below:

$$\text{Rho} = 1 - \frac{6 \times (\sum d_i^2)}{N \times (N^2 - 1)} \dots \dots \dots (\text{iv})$$

Where:

Rho = Spearman rank correlation coefficient

$d_i$  = The difference in ranking between each pair of causes

N = Number of causes (variables)

The categories tested using SPSS software in this section have high degree of correlation. This means that respondents mostly have the same perception on probability of the occurrences of risks or uncertainties, impact and overall importance of risks or uncertainties. This means that the data can be utilized as a whole.

#### G. Recommendation of Systematic Risk Management

1. After questionnaire survey weather risk ranked high on the basis of importance for both contractors and site managers. The following recommendations can be followed to mitigate the risks due to weather and reduce its impact from extreme to high or medium or low. The weather risk is affecting small projects mainly due to lack of planning.

The construction crew should have contact with the weather related authorities of the region of construction to know the climatic variations of that particular region. This helps in Planning the future works.

- Every construction site should keep atleast one tarpaulin for avoiding the problems due to unexpected variations such as unexpected rain etc.
2. After questionnaire survey Increment in labour charge ranked second high on the basis of importance for contractors and Lack of safety measures ranked second high on the basis of importance for site managers.
    - For Increment in labour charge, Contractors or sub contractor should enter into an agreement with labours on fixed salary throughout the life of the project. The professionals involved in the project make sure that all the workers involved in the project signed in the agreement.
    - For Lack of Safety Measures, All the workers should wear safety measures such as helmets, safetybelts, and safety glass in small construction projects too. Site managers should be responsible on checking weather the workers wearing the safety belts or not. If they are wearing penalty should be imposed on the worker without safety measures.
  3. Poor Material Management is also highly ranked risk on the basis of importance for both contractors and site managers.
    - Keep daily report in construction site, which includes name of workers, Total quantity of materials procured in the site, Quantity of materials utilized per day and work executed (in terms of cu.m for concreting and earth work excavation and sq.m for others ).
    - Penalty should be imposed on workers for the improper usage of materials which cause wastage of materials.
  4. Non performance of sub-Contractors and unskilled labours are also highly considerable risks.
    - Contractors and Client should enter into an agreement that includes the terms and conditions such that Subcontractor should use qualified individuals with suitable training, experience and capabilities, sub contractor only use materials having good quality and subcontractor should give compensation to the contractor or client on the losses occurring due to his non performance.
    - Give more preference to experienced labours and provide training to unskilled labours by these experienced labours until they become experts. Time limit should be provided for the training period of unskilled labours.
  5. Inefficient supervising, Lack of coordination, disputes on site and lack of communication is intermediately considerable risk. This leads to poor monitoring and control of the project.
    - Experienced site supervisors should be appointed by construction crew.
    - Strict working hours should be provided in the construction site and site manager is responsible for ensuring that the workers are punctual more than that site manager should be punctual.
    - Lack of communication occurs in between clients and contractors because of the client settled abroad or due to busy contractor or due to both. Now a days social

medias will help a lot to solve this problem. This makes communication easier even though the two parties are far away.

7. Frequent changes in scope of the project, Wrong estimation, Inadequate specification, Poor design or delay in providing design, Complex designs provided by professionals, Lack of soil investigation, unexpected site condition and Rework due to wrong work are also considerable risk.
  - Well-defined Specification will help to reduce both the above stated risks.
  - Detailed Site Survey.
  - Completing design before execution
  - Contractor is responsible to make sure the above recommendations had done during the construction work.
  - Soil investigation should be done by experienced authorities in construction site even if it is small or large projects.
  - Detailed Site Survey helps to rectify unexpected site conditions.
9. Unfavorable political condition, strikes by personnel, DeLay in sanctioning, rules changes by government and Poor contract management according to client the last two risks are leading to extreme impact on time.
  - Allow an extension to the contractor for extra time in solving the above risks.
  - Handing over these risks by contractor or client to private agencies who is more capable of dealing with such problems.
  - Lump-sum contract can be used when the design is complete, duration is known and quality, quantity and type of work is fully known.

## VII CONCLUSION

### A. Main Observations and Conclusions

Risk is the exposure to the chance of occurrence of uncertainty. Uncertainty represents the probability that an event will occur. In this thesis, Risks identification had done on the basis of literature review, site visit and interview survey and on the basis of risk identified and risk matrix, questionnaire had prepared.

Questionnaire survey had done for contractors, site managers and clients. The analysis of questionnaire survey had been done by using SPSS software. Reliability of questionnaire and correlation had also been done by software analysis. As a result of survey, risks had been ranked using mean score method. Weather risk is highly ranked and due to proper planning and scheduling we can rectify the losses arises due to this risk. Lack of safety measures, Increment in labour charge, Non performance of sub contractors, Poor material management and unskilled laboures are other highly ranked risks. Rules changes by government are the least ranked risks and the only way is to allow an extension to the contractor for extra time. This Thesis is concluding that by adopting systematic risk management in small construction projects, reduce the

extreme risks to high, high risks to medium and medium risks to low and thus we can achieve the basic goal of a construction industry such as completing the project at right time.

### B. Future Scope

The thesis revealed many important risks or uncertainties prevalent in the construction industry. Based on the findings of this thesis, the following have scope for future research:

1. Detailed studies can be done on highly ranked risks and improved measures can be adopted based on software and upcoming technologies.
2. Modelling can be done using BIM (Building Information Modelling) software by including AutoCADD drawing and risks incorporated in Navis work software.

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