STUDY ON PROJECT SCHEDULE AND COST OVERRUNS

Patel Harjinder[1], Patel Saurabh[2]

[1] *Student of Construction Management, Civil Engineering, MIT ADT University, Maharashtra, India*
[2] *Student of Construction Management, Civil Engineering, MIT ADT University, Maharashtra, India*

ABSTRACT

Risk plays an important role in the success of construction project. In managing risk, identification of risk factors is very critical. Hence, this study focused on the investigation of risk factors from contractors' perspective as the contractors are key players in the success of a project. Investigations on the risk factor involved 35 common risk factors classified in five categories and ranking them with the help of questionnaire survey. The data has been Theoretical analysed by following techniques:- Frequency Index, Severity Index, Importance Index and Relative Importance Index. Results found that the five most important risk factors in construction project are escalation in price of material, changes in government regulations and laws, shortages of materials and equipment's, cash flow and financial difficulties. Method developed in this study can help agencies and hence estimation of expected overruns of final cost and delay in completion time for their planned project. The findings of this study would assist in dealing with risks encountered in construction projects.

Keyword: *Risk Factors, overrun, Delay, Cost overrun, Construction projects, Time overrun*.

1. INTRODUCTION

Construction industry is usually riskier as compared to other business activity because of the complexity in coordinating various activities. Furthermore, each project is unique and often incorporated with new techniques and procedures. The core element of project success is to meet the time, cost, and quality as targeted. In order to achieve these targets, risk may appear in many ways and could result in time overrun, budget overrun, financial losses, loss of life, environmental damage, and many more failures. Therefore, project can be positively success by considering the risks where it normally tends to give positive and negative effect on the project. The project time overrun and cost overrun problem is faced by numerous countries and the study on the causes of these problems is also conducted such as India. In most construction projects, best possible performance is unachievable with poor productivity resulting in time overrun and consequently cost escalation of the projects. The occurrence of delay is may concurrently with other delays and all of them can impact the project completion date. In delay project experiences delays in construction period where different gaps occurred between the actual progress on site work and scheduled work. Hence, projects are failed to complete in construction period as per contract and this failure to achieve targeted time, budgeted cost and specified quality results in various negative effects. Services provided by infrastructure projects serve as input for other sectors, and cost overruns in these projects lead to an increase in the capital-output ratio for the entire economy.
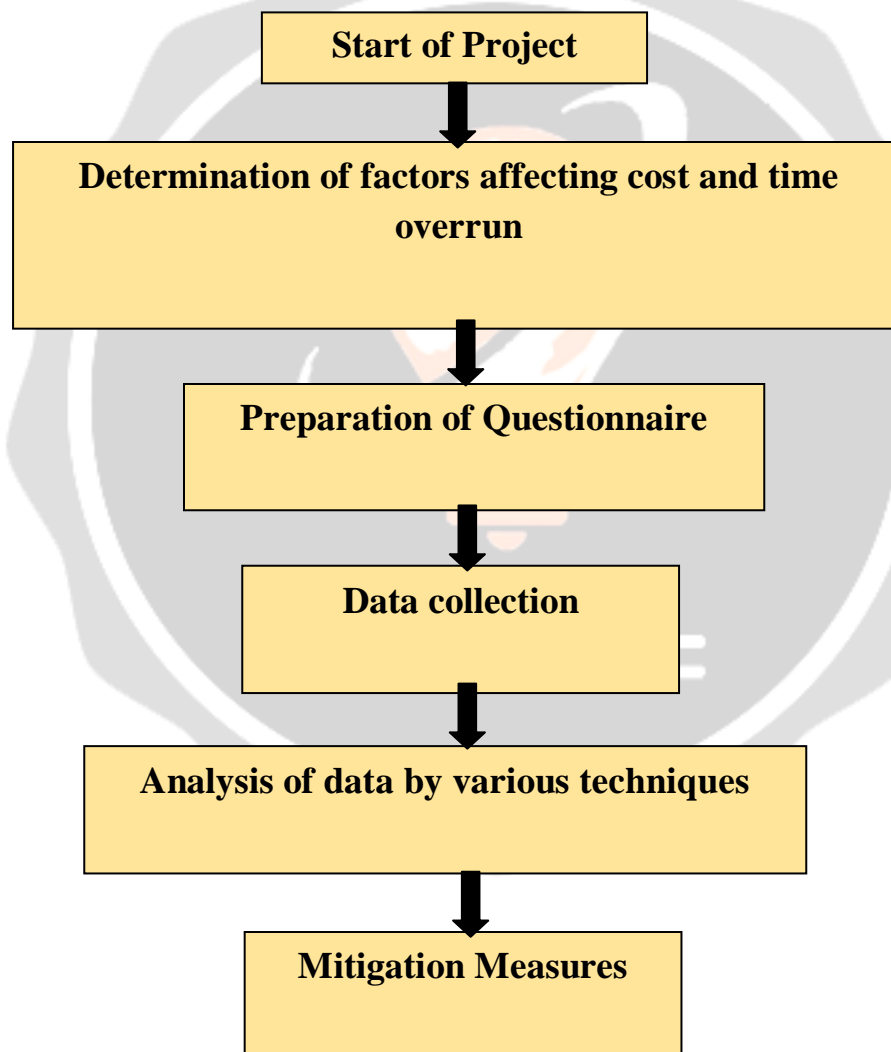
The construction industry plays an important role in achieving fully developed nation status. Completing projects on time are an indicator of efficient construction industry. In fact, a project is considered 'successful' if it is completed on time, within budget and to the specified quality. Normally, when the projects are delayed, they are either extended or accelerated and therefore, incur additional cost. To the dislike of owners, contractors and consultants many projects experience extensive delays and thereby exceed initial time and cost estimates. The construction process is subject to many variables and unpredictable factors. Delivering a project on time does not occur by hoping that the required completion date will be met. To plan and manage a successful project, the three parameters of time, cost and quality should be considered. The clients in the construction industry are primarily concerned with quality, time and cost. But majority of construction projects are procured on the basis of the

constraints time and cost. Cost escalation and time overruns are typically associated with poor management practices.

1.1 Objectives

- To study and establish the reason affecting project schedule and cost overruns in construction projects.
- To assist contractors in dealing with risks encountered in construction projects and give appropriate mitigation measures.

2. RESEARCH METHODOLOGY

```
            ┌─────────────────────────────┐
            │      Start of Project        │
            └─────────────────────────────┘
                          │
                          ▼
    ┌──────────────────────────────────────────────┐
    │   Determination of factors affecting cost     │
    │                and time overrun                │
    └──────────────────────────────────────────────┘
                          │
                          ▼
        ┌──────────────────────────────────────┐
        │     Preparation of Questionnaire      │
        └──────────────────────────────────────┘
                          │
                          ▼
            ┌─────────────────────────────┐
            │       Data collection        │
            └─────────────────────────────┘
                          │
                          ▼
    ┌──────────────────────────────────────────────┐
    │    Analysis of data by various techniques     │
    └──────────────────────────────────────────────┘
                          │
                          ▼
            ┌─────────────────────────────┐
            │      Mitigation Measures     │
            └─────────────────────────────┘
```

2.1 Identification of Factors

The research methodology for present study contains two phases. The first includes a literature search. The literature review was conducted through books, conference proceedings, internet and international project

management journals. As the outcome of this phase, 35 causes of cost and time overrun in construction projects were identified. These causes were categorised in five main groups as:-

- Owner
- Contractor
- Consultant
- Resource
- External

2.2 Questionnaire Design

The questionnaire will be designed based on above factors and the respodents will give the ranking based on following five terms-

A: Strongly Agree
B: Agree
C: Neither Agree nor Disagree
D: Disagree
E: Strongly Disagree

1. Personal Information:

Name :
Company :
Address :
City :
Email Address :

2. Designation:

3. Industrial Experience:

4. Please identify whether following factors have caused delays or cost overrun, % Cost Overrun and % Time Overrun in various construction projects:
(Please tick against the best option which you think has maximum effect)

1] For factors:

A: Strongly Agree.

B: Agree.

C: Neither Agree Nor Disagree.

D: Disagree.

E: Strongly Disagree.

2] For % Cost and Time Overrun:

A: 0-5%

B: 5-10%

C: 10-50%

D: 50-100%

Group	Factors						% Cost Overrun				% Time Overrun			
		A	B	C	D	E	A	B	C	D	A	B	C	D
Owner	1. Change in scope of project.													
	2. Delay in progress payment.		`											
	3. Poor communication and co-ordination by owner with parties.													
	4. Financial Difficulties of owner.													
	5. Decision making (delay).													
	6. Unrealistic Contract Duration													
Contractor	1. Cash flow and financial difficulties.													
	2. Rework due to errors during construction													
	3. Delay in site mobilisation.													
	4. Lack of experience.													
	5. Poor site management and supervision.													
	6. Inadequate planning and scheduling.													
	7. Conflicts between contractor and other parties.													

Group	Factors						% Cost Overrun				% Time Overrun			
		A	B	C	D	E	A	B	C	D	A	B	C	D
Consultant	1. Mistakes and errors in design.													
	2. Delay in preparation and approval of drawing.		`											
	3. Inflexibility of consultant.													
	4. Delay in Inspection and approval of completed works.													
	5. Inadequate experience.													
	6. Incomplete design at time of tenders.													
	7. Complexity of project design													
	8. Inadequate and unclear details in drawing.													
	9. Misunderstanding of owner's requirements by Design Engineer.													
	10. Misunderstanding between Architect and Structural Engg.													

Group	Factors	A	B	C	D	E	% Cost Overrun A	B	C	D	% Time Overrun A	B	C	D
Resource	1. Shortage of materials and equipments.													
	2. Late delivery of material and equipment.		`											
	3. Escalation in prices of material.													
	4. Late Procurement.													
	5. Labour Productivity													
	6. Shortage of site workers.													
	7. Personal conflicts among workers.													
	8. Equipment breakdown.													
External	1. Political and social issues.													
	2. Delay in permission from local authority.													
	3. Accidents on sites.													
	4. Different weather and site conditions.													
	5. Delay in providing services from utilities.													
	6. Changes in government regulations and laws.													

Remark:

Rating:

- Not Good   (   )
- Good   (   )
- Very Good   (   )

Stamp and Signature

2.3 Data Analysis Methods

After consideration of factors and ranking them with the help of questionnaire survey, the data can be analysed by any of these following techniques:-

A] Theoretical Analysis:-

- Frequency Index
- Severity Index
- Importance Index
- Relative Importance Index

1. Frequency Index:

A formula is used to rank causes of delay based on frequency of occurrence as identified by the respondents.

Frequency Index = $(\Sigma \, (a \, n) \div N)* (100 \div 4)$

Where a is the constant expressing weighting given to each response (ranges from 1 for rarely up to 4 for always), n is the frequency of the responses, and N is the total number of responses.

GROUP	FACTORS	1	2	3	4	5	FI
OWNER	1	7.857	17.143	10.714	0.000	0.000	35.714
	2	7.857	22.857	0.000	2.857	0.000	33.571
	3	2.857	17.143	21.429	2.857	0.000	44.286
	4	12.143	15.714	0.000	0.000	0.000	27.857
	5	7.857	20.000	6.429	0.000	0.000	34.286
	6	4.286	22.857	6.429	8.571	0.000	42.143
CONTRACTOR	7	14.286	7.143	4.286	2.857	0.000	28.571
	8	0.714	21.429	21.429	5.714	0.000	49.286
	9	1.429	14.286	17.143	20.000	0.000	52.857
	10	6.429	11.429	15.000	11.429	0.000	44.286
	11	7.143	17.143	4.286	2.857	10.714	42.143
	12	9.286	17.143	4.286	2.857	0.000	33.571
	13	5.000	14.286	21.429	2.857	0.000	43.571
CONSULTANT	14	5.000	22.857	6.429	5.714	0.000	40.000
	15	6.429	18.571	4.286	8.571	0.000	37.857
	16	5.714	15.714	10.714	2.857	10.714	45.714
	17	7.143	14.286	12.857	5.714	0.000	40.000
	18	2.143	14.286	10.714	28.571	0.000	55.714
	19	7.857	11.429	4.286	11.429	10.714	45.714
	20	3.571	12.857	21.429	5.714	7.143	50.714
	21	2.143	21.429	8.571	8.571	10.714	51.429
	22	6.429	12.857	12.857	8.571	3.571	44.286
	23	5.000	15.714	17.143	2.857	3.571	44.286
RESOURCE	24	7.857	17.143	2.143	11.429	0.000	38.571
	25	4.286	25.714	0.000	2.857	10.714	43.571
	26	5.000	18.571	8.571	11.429	0.000	43.571
	27	6.429	22.857	2.143	5.714	0.000	37.143
	28	4.286	18.571	12.857	8.571	0.000	44.286
	29	5.714	18.571	6.429	11.429	0.000	42.143
	30	1.429	7.143	30.000	17.143	3.571	59.286
	31	2.857	17.143	19.286	2.857	7.143	49.286
EXTERNAL	32	3.571	14.286	21.429	8.571	0.000	47.857
	33	8.571	14.286	10.714	2.857	0.000	36.429
	34	1.429	15.714	32.143	0.000	0.000	49.286
	35	2.143	20.000	17.143	2.857	7.143	49.286
	36	1.429	28.571	8.571	5.714	0.000	44.286
	37	5.714	20.000	12.857	0.000	0.000	38.571

Table 1- Frequency Index For Overall Overrun

2.   Severity Index:

A formula is used to rank causes of delay based on severity of occurrence as identified by the participants.

Severity Index = (Σ (a n) ÷ N)* (100 ÷ 4)

Where a is the constant expressing weighting given to each response (ranges from 1 for little up to 4 for severe), n is the frequency of the responses, and N is the total number of responses.

GROUP	FACTORS	1	2	3	4	5	SI
OWNER	1	39.29	34.29	10.71	0.00	0.00	84.29
	2	39.29	45.71	0.00	2.86	0.00	87.86
	3	17.86	34.29	21.43	2.86	0.00	76.43
	4	60.71	31.43	0.00	0.00	0.00	92.14
	5	39.29	40.00	6.43	0.00	0.00	85.71
	6	21.43	45.71	6.43	8.57	0.00	82.14
CONTRACTOR	7	71.43	14.29	4.29	2.86	0.00	92.86
	8	3.57	42.86	21.43	5.71	0.00	73.57
	9	7.14	28.57	19.29	20.00	0.00	75.00
	10	32.14	22.86	15.00	11.43	0.00	81.43
	11	35.71	34.29	4.29	2.86	10.71	87.86
	12	46.43	34.29	4.29	2.86	0.00	87.86
	13	25.00	28.57	21.43	2.86	0.00	77.86
CONSULTANT	14	25.00	45.71	6.43	5.71	0.00	82.86
	15	35.71	37.14	4.29	8.57	0.00	85.71
	16	28.57	31.43	10.71	2.86	10.71	84.29
	17	35.71	28.57	12.86	5.71	0.00	82.86
	18	10.71	28.57	10.71	28.57	0.00	78.57
	19	39.29	22.86	4.29	11.43	10.71	88.57
	20	17.86	25.71	21.43	5.71	7.14	77.86
	21	10.71	42.86	8.57	8.57	10.71	81.43
	22	32.14	25.71	12.86	8.57	3.57	82.86
	23	25.00	31.43	17.14	2.86	3.57	80.00
RESOURCE	24	39.29	34.29	2.14	2.86	0.00	78.57
	25	21.43	51.43	0.00	2.86	10.71	86.43
	26	25.00	37.14	8.57	11.43	0.00	82.14
	27	32.14	45.71	2.14	5.71	0.00	85.71
	28	21.43	37.14	12.86	8.57	0.00	80.00
	29	28.57	37.14	6.43	11.43	0.00	83.57
	30	7.14	14.29	30.00	17.14	3.57	72.14
	31	14.29	34.29	19.29	2.86	7.14	77.86
EXTERNAL	32	17.86	28.57	21.43	8.57	0.00	76.43
	33	42.86	28.57	10.71	2.86	0.00	85.00
	34	7.14	31.43	32.14	0.00	0.00	70.71
	35	10.71	40.00	17.14	2.86	7.14	77.86
	36	7.14	57.14	8.57	5.71	0.00	78.57
	37	28.57	40.00	12.86	0.00	0.00	81.43

**Table 2-** Severity Index For Overrun

3. Importance Index:

The importance index of cause is calculated as a function of both frequency and severity indices, as follows:

Importance Index (I.I %) = (Frequency Index% * Severity Index %) ÷ 100

Sr. No.	FACTORS	FI	SI	II	Overall Rank
1	Change in scope of project.	35.714	84.286	30.102	6
2	Delay in progress payment.	33.571	87.857	29.495	4
3	Poor communication and co-ordination by owner with parties.	44.286	76.429	33.847	14
4	Financial Difficulties of owner.	27.857	92.143	25.668	1
5	Decision making (delay).	34.286	85.714	29.388	3
6	Unrealistic Contract Duration	42.143	82.143	34.617	16
7	Cash flow and financial difficulties.	28.571	92.857	26.531	2
8	Rework due to errors during construction	49.286	73.571	36.260	24
9	Delay in site mobilisation.	52.857	75.000	39.643	33
10	Lack of experience.	44.286	81.429	36.061	23
11	Poor site management and supervision.	42.143	87.857	37.026	27
12	Inadequate planning and scheduling.	33.571	87.857	29.495	5
13	Conflicts between contractor and other parties.	43.571	77.857	33.923	15
14	Mistakes and errors in design.	40.000	82.857	33.143	12
15	Delay in preparation and approval of drawing.	37.857	85.714	32.449	11
16	Inflexibility of consultant.	45.714	84.286	38.531	31
17	Delay in Inspection and approval of completed works.	40.000	82.857	33.143	13
18	Inadequate experience.	55.714	78.571	43.776	37
19	Incomplete design at time of tenders.	45.714	88.571	40.490	34
20	Complexity of project design	50.714	77.857	39.485	32
21	Inadequate and unclear details in drawing.	51.429	81.429	41.878	35
22	Misunderstanding of owner's requirements by Design Engineer.	44.286	82.857	36.694	26
23	Misunderstanding between Architect and Structural Engg.	44.286	80.000	35.429	20
24	Shortage of materials and equipments.	38.571	78.571	30.306	7
25	Late delivery of material and equipment.	43.571	86.429	37.658	28
26	Escalation in prices of material.	43.571	82.143	35.791	22
27	Late Procurement.	37.143	85.714	31.837	10
28	Labour Productivity	44.286	80.000	35.429	20
29	Shortage of site workers.	42.143	83.571	35.219	19
30	Personal conflicts among workers.	59.286	72.143	42.770	36
31	Equipment breakdown.	49.286	77.857	38.372	29
32	Political and social issues.	47.857	76.429	36.577	25
33	Delay in permission from local authority.	36.429	85.000	30.964	8
34	Accidents on sites.	49.286	70.714	34.852	18
35	Different weather and site conditions.	49.286	77.857	38.372	29
36	Delay in providing services from utilities.	44.286	78.571	34.796	17
37	Changes in government regulations and laws.	38.571	81.429	31.408	9

Table Error! No text of specified style in document.- Importance Index For Overall Factors.
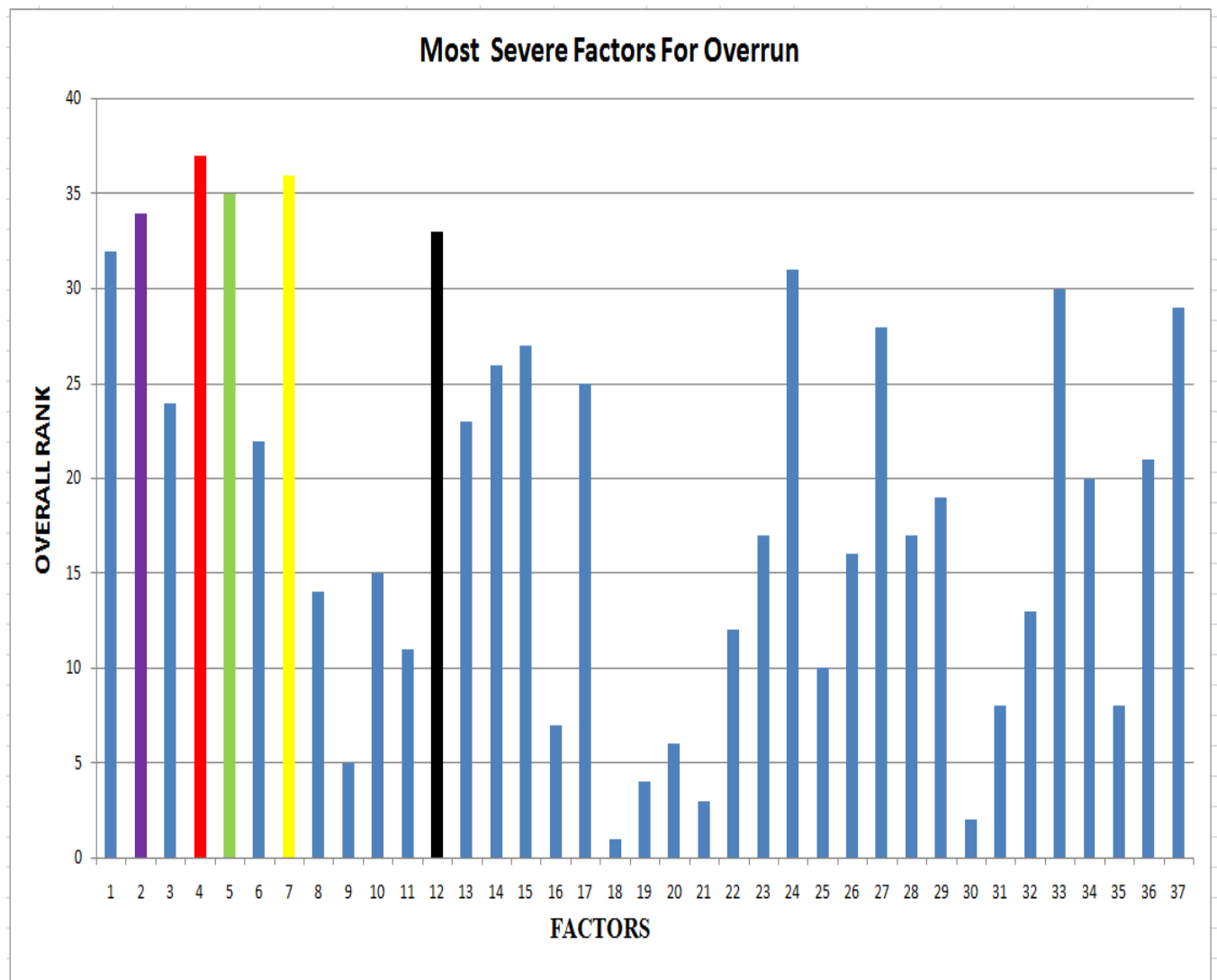
Graph 1- Most Severe Factors For Overrun

Following colors indicates the severity of the factors affecting overrun:

■	**Extremely Severe**
■	**Very Severe**
■	**Severe**
■	**Moderately Severe**
■	**Less Severe**

4. Relative Importance Index technique:

Relative Importance Index is the method to determine the relative importance of the various causes and effects of delays. The same method is going to adopted in this study within various groups (i.e. owner, consultant, contractor, resource and external). The five-point scale ranged from 1 (strongly agree) to 5 (strongly disagree) is adopted and transformed to relative importance indices (RII) for each factor as follows:

$$RII = \frac{\sum W}{A * N}$$

Where, W is the weighting given to each factor by the respondents (ranging from 1 to 5), A is the highest weight (i.e.5 in this case), and N is the total number of respondents. The RII value had a range from 0 to 5 (0 not inclusive), higher the value of RII, more important was the cause of delays.

The RII was used to rank (R) the different causes. These rankings made it possible to cross-compare the relative importance of the factors as perceived by the 5 groups of respondents (i.e. owner, consultant, contractor, resource and external). Each individual cause's RII perceived by all respondents should be used to assess the general and overall rankings in order to give an overall picture of the causes of construction delays in

Indian construction industry.

1	2	3	4	5	6	7	8	RII	RANK
2	2	3	1	1	1	1	3	0.357	6
1	1	2	2	2	2	2	1	0.336	3
2	1	2	2	3	1	2	3	0.450	25
1	2	1	1	2	1	2	2	0.279	1
2	1	2	1	2	1	1	3	0.343	5
4	2	1	2	2	2	2	1	0.421	14
2	1	1	1	1	1	1	2	0.286	2
3	2	3	2	3	2	2	2	0.493	29
4	2	4	3	3	2	3	2	0.550	35
4	1	1	3	2	1	2	4	0.443	20
2	1	5	2	2	1	1	2	0.421	14
2	1	1	1	2	2	2	2	0.336	3
2	2	3	1	3	3	3	1	0.436	17
1	2	3	2	2	2	4	1	0.400	12
1	1	4	1	2	1	3	2	0.386	9
2	3	5	2	1	1	3	2	0.457	26
2	2	3	2	1	1	4	2	0.400	12
4	2	4	3	2	2	4	4	0.557	36
4	1	5	2	1	1	3	3	0.457	26
2	3	5	2	3	1	3	3	0.507	33
2	2	5	1	2	2	4	3	0.514	34
5	2	2	3	1	1	4	3	0.443	20
5	1	3	1	1	3	3	2	0.443	20
2	1	4	2	2	2	1	3	0.386	9
1	2	5	2	2	1	2	2	0.436	17
1	2	4	2	2	1	2	4	0.436	17
2	2	1	2	2	2	2	4	0.371	8
2	3	3	2	2	2	2	2	0.443	20
2	2	1	2	2	1	2	2	0.421	14
3	3	4	3	2	3	3	3	0.593	37
2	2	5	1	3	2	3	3	0.493	29
3	3	4	1	2	3	3	4	0.479	28
1	1	3	1	2	2	1	4	0.364	7
3	2	3	3	2	2	3	3	0.493	29
2	2	5	2	2	1	3	3	0.493	29
2	3	2	2	2	2	2	2	0.443	20
3	3	2	1	2	1	2	3	0.386	9

Table 4- RII for Most Severe Overall Factors
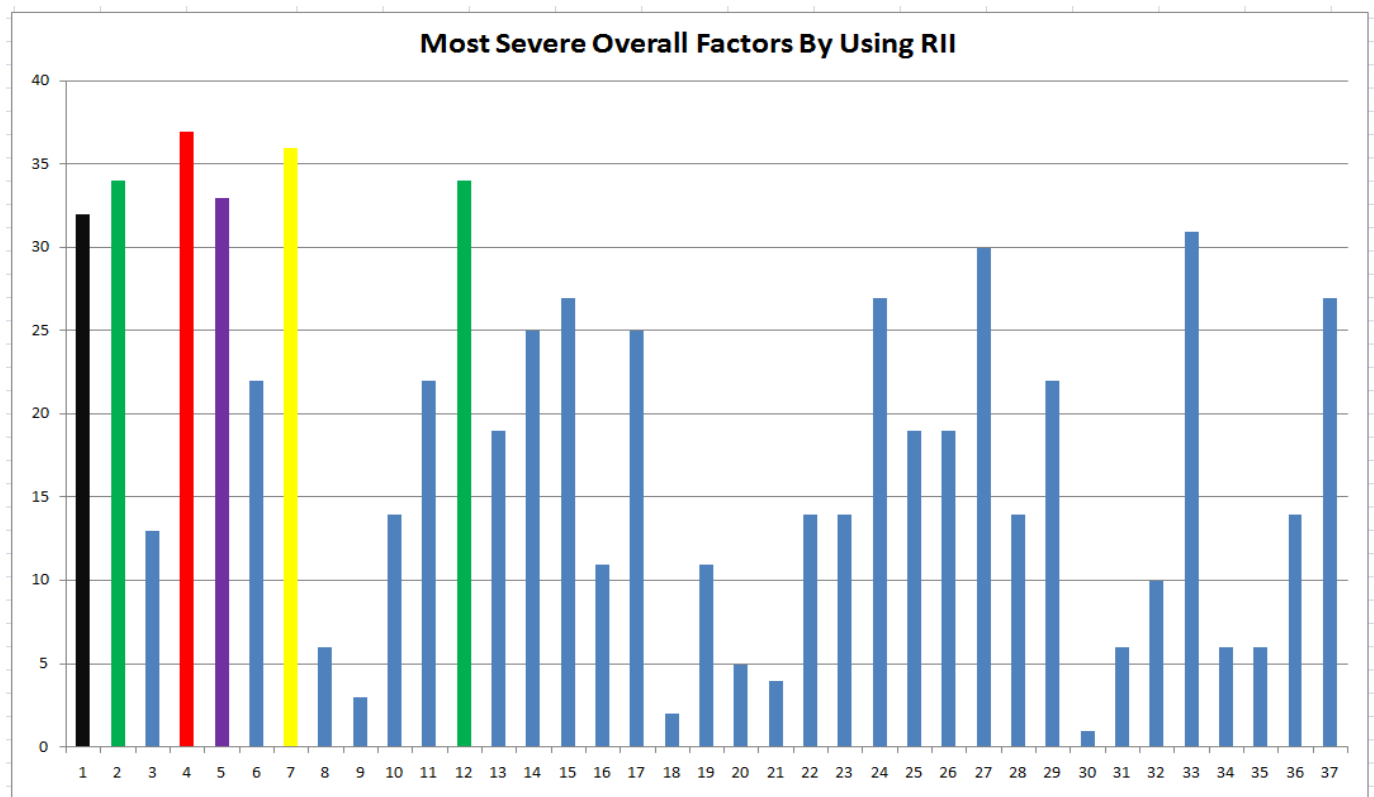
Graph 2- Most Severe Overall Factors by Using RII
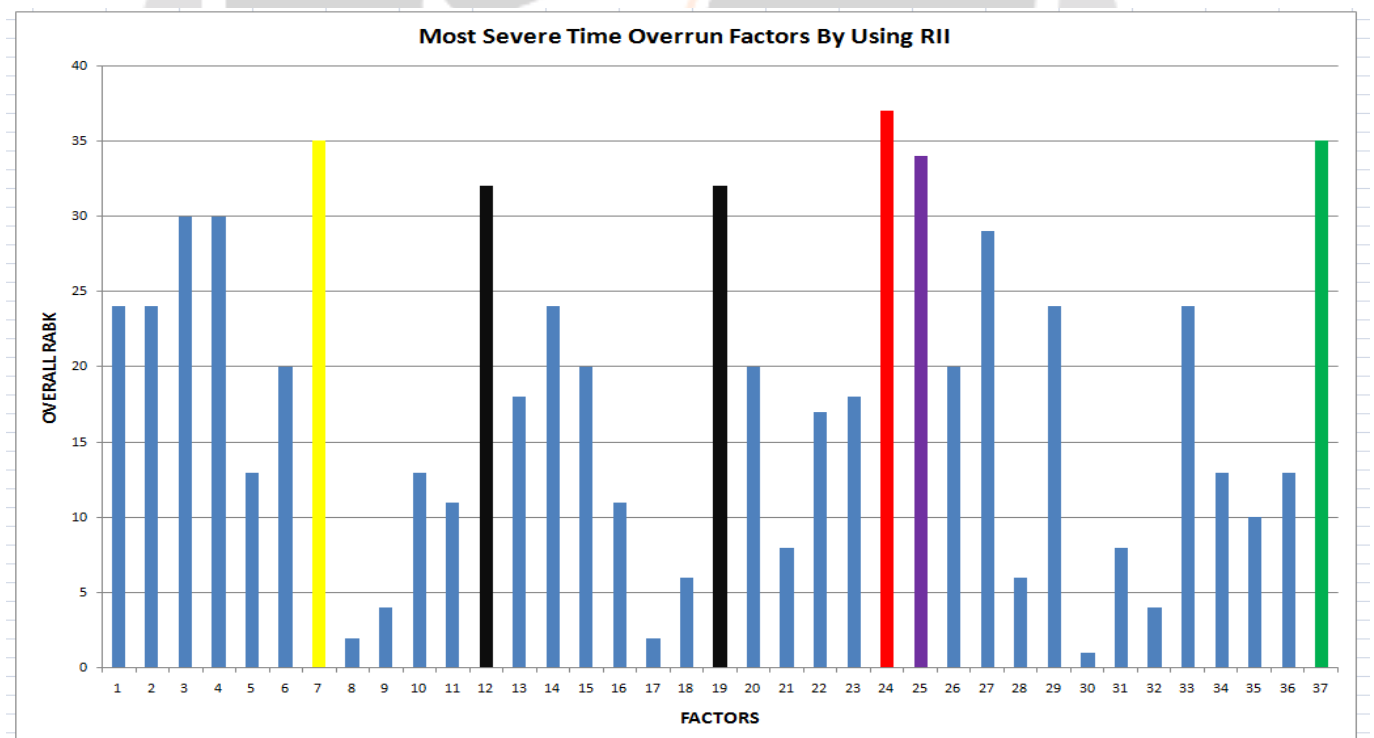
Graph 3- Most Severe Time Overrun Factors By Using RII

3. RESULT AND DISCUSSION

After consideration of factors and ranking them with the help of questionnaire survey, the data has been Theoretically analysed by following techniques:- Frequency Index, Severity Index, Importance Index and Relative Importance Index.

It was found that in theoretical analysis done by frequency index, severity index, importance index for overall overrun the financial difficulties of the owner was found to be extremely severe followed by cash flow and financial difficulties to be very severe and decision making to be severe. Similarly for cost overrun, escalation in prices of material, changes in government regulations and laws and financial difficulties of owner was found to be extremely severe, very severe, severe respectively. Also for time overrun, financial difficulties of owner, shortage of materials and equipments, cash flow and financial difficulties was found to be extremely severe, very severe, severe respectively.

In RII method, it was found that for overall overrun the financial difficulties of the owner was found to be extremely severe followed by cash flow and financial difficulties to be very severe and inadequate planning and scheduling to be severe. Similarly for cost overrun, escalation in prices of material, changes in government regulations and laws and financial difficulties of owner was found to be extremely severe, very severe, severe respectively. Also for time overrun, financial difficulties of owner, cash flow and financial difficulties, inadequate planning and scheduling was found to be extremely severe, very severe, severe respectively.

Analysis has shown a comparison of cost overruns trends among the different classification of construction organizations. The result of the study will be helpful in indicating the trend of cost and time overruns; moreover, these results can be useful for the owners in the selection of organizations for their upcoming projects with better control over cost and time overrun. This indicated that for achieving better cost performance and time performance contractors, project managers, owners are required to improve their management related to these identified factors. Besides that, these findings will benefit parties involved in managing cost performance of construction projects. It is recommended that more emphasis should be given on cost estimating, availability of materials on site, quick response, and clearance of legal aspects before commencement of project work.

4. CONCLUSIONS AND RECOMMENDATIONS

Construction companies are profit seeking organizations and their ultimate goal is to earn money and achieve the targeted profit margin at the end of each undertaken project. Achievement of this goal mainly depends on completing projects within the anticipated budget and time. However, in most construction projects, severe cost overruns, delays occur. There are several reasons behind these deviations. Every construction company is negatively affected by cost overruns. However, construction companies are enormously influenced by these cost overruns because they have limited capitals and thereby they are more vulnerable to risks. Therefore, they should thoroughly analyze the factors that may bring about cost overruns before they submit their bids for the construction projects.

This study aims to investigate the importance level of factors that may cause cost overruns in construction projects undertaken by construction companies. For this purpose, the relevant literature on cost overruns in construction projects was reviewed, a questionnaire survey was designed based on information gathered from the literature review, the questionnaire survey was conducted among 35 respondents, and the reliability and ranking analysis were carried out on the collected data in order to test the reliability of the questionnaire and find the relative importance levels of these factors, respectively.

The following are the mitigation measures to control Project delay and cost overrun:-

1. Cost estimating.

2. Owners emphasis on quality.

3. Proper formulation and Appraisal of construction projects.

4. Proper planning and advance action.

5. Adaptation of quality control and accuracy system.

5. REFERENCES

1. N. Hamzah, M. A. Khoiry, I. Arshad, N. M. Tawil, and A. I. Che Ani, "Cause of construction delay - Theoretical framework," Procedia Eng., vol. 20, no. Kpkt 2010, pp. 490–495, 2011.

2. P. Eik-Andresen, A. D. Landmark, and A. Johansen, "Managing Cost and Time in a Large Portfolio of Projects," Procedia Econ. Financ., vol. 21, no. 2212, pp. 502–509, 2015.

3. R. Chidambaram and N. S. Potty, "Qualitative analysis of Time delay and Cost overrun in Multiple Design and Build Projects," Int. Conf. Data Mining, Civ. Mech. Eng., pp. 2–6, 2014.

4. A. Shebob, N. Dawood, and Q. Xu, "Analysing Construction Delay Factors: A Case Study Of Building Construction Project In Libya," Procs 27th Annu. ARCOM Conf., no. September, pp. 1005–1012, 2011.

5. Y. Olawale, "COST AND TIME CONTROL OF CONSTRUCTION PROJECTS: INHIBITING FACTORS AND MITIGATING MEASURES IN PRACTICE Yakubu Adisa Olawale, Ph.D., MCIOB and Ming Sun, Ph.D. (Professor)," Int. J. Proj. Manag., vol. 28, no. 5, pp. 509–526, 2010.

6. S. Morris, "Sector Projects *," Time, vol. XXV, no. 47, 1990.

7. R. Singh, "Delays and Cost Overruns in Infrastructure Projects : Extent , Causes and Remedies," Econ. Polit. Wkly., vol. xlv, no. 181, pp. 43–54, 2010.

8. O. Ameh and E. Osegbo, "Study of relationship between time overrun and productivity on construction sites," Int. J. Constr. Supply Chain Manag., vol. 1, no. 1, pp. 56–67, 2011.

9. N. Alkaf, A. Karim, I. A. Rahman, A. H. Memmon, and N. Jamil, "Significant Risk Factors in Construction Projects : Contractor ' s Perception," IEEE Colloqium Humanit. Sci. Eng. Res., no. Chuser, pp. 351–354, 2012.

10. K. Venema and A. Gueniche, "Study on project schedule and cost overruns," Benef. Microbes, vol. 5, no. 2, pp. 97–8, 2014.

11. E. E. Rwakarehe and D. A. Mfinanga, "Effect of Inadequate Design on Cost and Time Overrun of Road Construction Projects in Tanzania," 2014.

12. M. M. Hossen, S. Kang, and J. Kim, "Construction schedule delay risk assessment by using combined AHP-RII methodology for an international NPP project," Nucl. Eng. Technol., vol. 47, no. 3, pp. 362–379, 2015.

13. H. Jones, F. Moura, and T. Domingos, "Transport Infrastructure Project Evaluation Using Cost-benefit Analysis," Procedia - Soc. Behav. Sci., vol. 111, pp. 400–409, 2014.