

Study of Factors Affecting in Construction Costs

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Abstract -The Construction industry in India has gone through very dramatic fluctuations, since the late 20s due to the near completion of huge infrastructure projects and also due to requirement of development of India in Different manner with a great speed construction. The demand for more construction of all types, coupled with a tight monetary supply, provide the construction industry with a bigger challenge to cut costs.

This research discusses the main factors that affect the construction cost in India. A survey in North India sides was conducted which included 15 contractors, 10 consultants, and 5 owners. This survey resulted in finding out 38 major factors which affect the construction cost in India. The Severity of those factors measured by the level of importance and ranked according to the severity index of the contractors, consultants and owners indicated that material cost, incorrect planning, previous experience of the contract, contract management and poor financial control on site are the most severe factors.

Keywords—Severity index ,Spearman's rank correlation, Relative Index.

INTRODUCTION

In now a day's construction delays are becoming common problems in civil engineering projects. There are some factors which affects construction cost in Tikamgarh district. There are 38 factors which are identified by literature review and direct interview of consultant, contractor and owner/client. These 38 factors are divided into 5 major groups .The 5 major groups are as follows:-

- Environmental factors (A)
- Construction parties related factors (B)
- Construction items related factors (C)
- Cost – Estimating factors (D)
- Financing factors (E)

There are total 38 factors which are considered. The factors have individually given names to avoid confusion. The contractor, consultant and client or owners are involved while ranking all these factors according to severity index.

1. Environmental factors (A) – This is one of the major factors which affects the construction cost. This factor is divided into eleven (11) divisions. The sub-division of environmental factor are as follows.

1. Effects of weather (A1)
2. Number of construction going on at the same time (A2)
3. Social and cultural impacts (A3)

4. Project location (A4)
5. Lack of productivity standard in India (A5)
6. Level of competitors (A6)
7. Number of competitors (A7)
8. Supplier manipulation (A8)
9. Economic Stability (A9)
10. Inadequate production of raw materials by the country (A10)
11. Government policies (law and regulations) (A11)

2. Construction parties related factors (B) –This is a second major factor which affects the construction cost. This factor is divided into six (6) divisions. The subdivision of construction parties related factors are as follows.

1. Incorrect planning (B1)
2. Relationship between management and labor (B2)
3. Lack of coordination between designers and contractors (B3)
4. Poor financial control on site (B4)
5. Previous experience of contract (B5)
6. Disputes on sites (B6)

3. Construction items related factors (C) –This is a third major factor which affects the construction cost. This factor is divided into seven (7) divisions. The subdivisions of this factor are as follows.

1. Fraudulent practices and kickbacks (C1)
2. Contract management (C2)
3. Additional work (C3)
4. Duration of contract period (C4)
5. Contractual procedure (C5)
6. Frequent design changes (C6)
7. Inadequate labor availability (C7)

4. Cost estimating factors (D)-This is a fourth major factor which affects the construction cost. This factor is divided into twelve (12) divisions. The subdivisions of this factor are as follows.

1. Cost of material (D1)
2. Fluctuation of prices (D2)
3. High cost of labor (D3)
4. High cost of machinery (D4)
5. High cost of machinery maintenance (D5)
6. High transportation cost (D6)
7. Insurance cost (D7)
8. High interest rates charged by banks on loans received by contractors (D8)
9. Long period between design and time of tendering (D9)
10. Bureaucracy in tendering method (D10)
11. Waste on site (D11)
12. Wrong estimation method (D12)

5. Financing factors (E)-this is a fifth major factor which affects the construction cost. The factor is divided into two (2) main divisions. The subdivisions of this factor are as follows.

1. Mode of financing, bonds and payment (E1)
2. Inflationary pressure (E2)

OBJECTIVE OF STUDY

The main objective of this study includes the following:

- To identify the factors affecting construction cost in Tikamgarh district.
- To identify severity index (S.I) of the factors affecting in construction cost.
- To identify ranking of the factors on the basis of severity index (S.I).
- To see degree of agreement in the ranking by using Spearman's rank correlation.

LITERATURE REVIEW

Onyelowe Kennedy Chibuzor ^[1] (2011) mentioned index analysis of the causes of vehicular traffic congestion in south-eastern Nigeria. This analysis is carried out in two phases in first phase literature search and interview is carried out and 49 problems were identified. These problems were categories in 5 major groups. Now in second phase questionnaire is prepared and distributed to FRSC (Federal Road Safety Corps) staff, contractors and consultant. The result from survey was analyzed statistically and severity index was found out of every single problem and problems were ranked. The spearman's correlation is calculated to see the rank agreement between FRSC staff, contractors and consultant. Ghanim A.Bekr ^[2] (2014) did study for finding causes and magnitude of wastage of materials on construction sites in Jordan. The study is based on the opinion of contractors, consultants and owners/client. According to theoretical study more than 100 causes of wastage were collected. These 100 causes were categories in six groups. The causes were rank according to severity index (S.I), frequency index (F.I) and important index (II). Mohamed M.Marzouk ^[3] et al. (2013) conducted a survey in analyzing delay causes in Egyptian construction projects. There are 43 causes of delay project which are divided into main 7 groups. The respondents are owners/client, contractors and consultants are used to determine the frequency of occurrence of each cause and severity index (S.I), frequency index (F.I) and important index is calculated and ranking is provided to a delay causes. The statistical analysis is also done to see relationship between ranking of each delay causes. Ibrahim Mahamid ^[4] (2014) did study in micro and macro level of dispute causes in residential building projects in Saudi Arabia. The research was done to identify direct and indirect disputes. The ranking of disputes is done on the basis of severity index and statistical analysis is done. Remon Fayek Aziz ^[5] (2013) conducted a survey in Egypt and found out the ranking of factors which cause delay in construction projects after Egyptian revolution. To achieve objective of the, survey is performed and 99 factors were short listed for the questionnaire survey and it is divided mainly in 9 groups. The data were analyze by using RII (Relative importance index)

and ranking of factors was done on the basis of RII. The priority rule formula is used as ERII (Equivalent weighted average percentage, DC (Delay Coefficient), PAD (Predicted actual duration and PSD (Planned schedule duration) was calculated. G.N.Ezeh ^[6] et al. (2013) in South Eastern Nigeria did study on the severity index analysis of the problems of optical fiber communication in Nigeria. The survey was conducted and 17 problems were observed and it is divided into 4 major groups. The severity index of each problem was calculated and ranking is done of all the problems. Aswathi R ^[7] et al. (2013) mentioned a delay causes in railway construction project in India and their impact. A case study is done on the doubling track project between Chengannur and Mavelikkara. The survey was performed and delay factors are considered and ranking them according to S.I (severity index), F.I (frequency index and II (important index). Shadab Motamedi ^[8] (2014) in Iran conducted a survey on time delay risk in construction project. There were 26 delay factors which are recognized by literature review. These factors are ranked according to S.I (severity index), F.I (frequency index), II (important index) and correlation is found out between a rank given by contractor, consultant and owner. Desai Megha ^[9] et al. (2013) provided a methodology for ranking of causes of delay for residential construction projects in India. On the basis of survey and literature review there are 59 factors of cost delay which are divided in 7 main groups. The S.I (severity index), F.I (frequency index), II (important index) of delay factors was calculated and ranking provided and Spearman's rank correlation is also calculated for best rank agreement between different groups. Megha Desai ^[10] et al. (2013) mentioned critical causes of delay in residential construction projects in central Gujarat region. A case study was identified of 59 causes in 7 major groups and 50 respondent's views are considered. The severity index (S.I), frequency index (F.I), important index (II) of factors are calculated and ranking is done. To see the best rank agreement between parties' spearman's correlations was calculated.

RESEARCH METHODOLOGY

The indices comes under the research methodology, actually there are two stages of methodology at present scenario.

1. In first stage this includes literature review and practical interviews. The literature was taken from internet, book of particular subject, articles, conference etc. In this paper outcome of this phase is 38 factors which affect the construction cost at Tikamgarh district. These 38 factors are divided into 5 major groups.
 - Environmental factors (A)
 - Construction parties related factors (B)
 - Construction items related factors (C)
 - Cost – Estimating factors (D)
 - Financing factors (E)

2. The second stage includes in which two types of questionnaire will be prepared on two different approaches, which will be used for giving ranking to factors affecting construction cost in Tikamgarh district.

There are two different methods for ranking the factors affecting in construction cost are as follows:-

- In first method Relative importance index (RII) of each factor can be calculated.
- In second method important index is calculated as a function of frequency and severity indices.

Importance index technique:-

This is a technique in which for each factor two questions were asked:

1. What is the frequency of occurrence for this factor?
2. What is the degree of severity of this factor affecting construction cost?

Analysis using severity index: Severity index: A formula is used to rank factors affecting construction cost based on severity as indicated by the participants (contractors, consultants and owner/client).

Total no. of respondents =20

Where, Total no. of consultant = 5, Total no. of contractor =10 and Total no. of owner =5.

The respondents (20) were given four (4) rating options are as follows:

1. Strongly severe
2. Moderately severe
3. Slightly severe
4. Non severe

From above four (4) options, respondents have to select one option based on their judgment of the severity of the problem. The severity index (S.I) of each of the problem was calculated as (Mendenhall et al., 2009).

$$\text{Severity Index} = \frac{\sum_{i=1}^{i=4} (a_i x_i)}{3 \sum_{i=1}^{i=4} x_i} \times 100\%$$

Where, a_i = constant expressing the weight given to the i th response, and $a_i = 0, 1, 2, 3$ for $i = 1, 2, 3, 4$.

- $a_1 = 0$ is equivalent to "non severe".
- $a_2 = 1$ is equivalent to "slightly Severe".
- $a_3 = 2$ is equivalent to "moderately severe"
- $a_4 = 3$ is equivalent to "most severe".

X_i = variable expressing the percentage frequency for the degree of importance of each factor where,

- X_1 = percentage of frequency of "non severe" responses.
- X_2 = percentage of frequency of "slightly severe" responses.
- X_3 = percentage of frequency of "moderately severe" responses.
- X_4 = percentage of frequency of "most severe" responses.

SPEARMAN'S RANK CORRELATION COEFFICIENT

Professor Charles Spearman developed a method to find the correlation. This method is much easier as compared with Karl's Pearson method. This method is called Spearman's Rank Difference Method. In this method the knowledge of values of different terms of a series is not necessary but the method is applicable if we only know the ranks of different terms corresponding to their values. The top value is assigned rank 1, the second rank 2, and the third rank 3 and so on.

$$\text{It is given by } r = 1 - \frac{6 \sum d^2}{n(n^2-1)} \quad \text{or } r = 1 - \frac{\sum d^2}{n(n^2-1)}$$

Where d_i = difference in ranks of i th paired items in two series.

n = number of individuals.

In the above formula 'r' is called Spearman's Coefficient of rank correlation or simply rank correlation coefficient.

Remark 1. If two individual values are equal i.e. if ties occur, and then they are assigned the average of the ranks they would have received if they had differed slightly. Therefore, if two items are tied for the 5th rank, each will be assigned the rank $\frac{1}{2}(5+6) = 5.5$.

Remark 2. Rank correlation coefficient lies between -1 and +1 including both the values.

Results Analysis:

1. Close to -1 = negative correlation
2. Close to 0 = no linear correlation
3. Close to +1 = positive correlation

Here,

R_1 = consultant

R_2 = contractor

R_3 = owner/client

RESULT

$$r_{1,2} = 0.891$$

$$r_{2,3} = 0.93$$

$$r_{3,1} = 0.835$$

$r_{1,2} = 0.891$, shows there is a positive correlation between consultant and contractor.

$r_{2,3} = 0.93$, shows there is a positive correlation between contractor and owner/client.

$r_{3,1} = 0.835$, shows there is a positive correlation between owner/client and consultant.

Table No.1_Representing severity index (S.I) (%) of factors affecting in construction cost.

Consultant		Contractor		Client/Owner	
Factors	S.I (%)	Factors	S.I (%)	Factors	S.I (%)
A1	55	A1	63.33	A1	80
A2	20	A2	30	A2	33.33
A3	5	A3	16.66	A3	6.66
A4	45	A4	33.33	A4	33.33
A5	40	A5	30	A5	16.66
A6	40	A6	30	A6	16.66
A7	50	A7	33.33	A7	16.66
A8	55	A8	33.33	A8	16.66
A9	70	A9	90	A9	80
A10	50	A10	43.33	A10	26.66
A11	75	A11	66.66	A11	86.66
B1	85	B1	93.33	B1	93.33
B2	70	B2	83.33	B2	93.33
B3	60	B3	80	B3	93.33
B4	75	B4	43.33	B4	40
B5	95	B5	90	B5	86.66
B6	45	B6	36.66	B6	33.33
C1	35	C1	23.33	C1	13.33
C2	75	C2	63.33	C2	66.66
C3	25	C3	30	C3	33.33
C4	75	C4	56.66	C4	60
C5	70	C5	60	C5	66.66
C6	80	C6	76.66	C6	73.33
C7	50	C7	53.33	C7	33.33
D1	100	D1	96.66	D1	100
D2	75	D2	80	D2	93.33
D3	60	D3	63.33	D3	53.33
D4	55	D4	63.33	D4	53.33
D5	55	D5	63.33	D5	53.33
D6	50	D6	63.33	D6	53.33
D7	20	D7	10	D7	13.33
D8	60	D8	46.66	D8	26.66
D9	80	D9	83.33	D9	66.66
D10	50	D10	30	D10	33.33
D11	10	D11	6.66	D11	13.33
D12	95	D12	93.33	D12	86.66
E1	45	E1	26.66	E1	20
E2	35	E2	23.33	E2	20

Table No.2 Representing ranking of factors affecting in construction cost.

Factors	Consultant		Contractor		Client/Owner	
	S.I (%)	Rank	S.I (%)	Rank	S.I (%)	Rank
A1	55	18	63.33	12	80	9
A2	20	36	30	28	33.33	21
A3	5	38	16.66	36	6.66	38
A4	45	28	33.33	25	33.33	22
A5	40	31	30	29	16.66	31
A6	40	30	30	30	16.66	32
A7	50	26	33.33	26	16.66	33
A8	55	21	33.33	27	16.66	34
A9	70	14	90	4	80	10
A10	50	25	43.33	22	26.66	27
A11	75	10	66.66	11	86.66	6
B1	85	4	93.33	2	93.33	2
B2	70	13	83.33	6	93.33	3
B3	60	17	80	8	93.33	4
B4	75	11	43.33	23	40	20
B5	95	3	90	5	86.66	7
B6	45	27	36.66	24	33.33	23
C1	35	32	23.33	35	13.33	35
C2	75	9	63.33	13	66.66	12
C3	25	34	30	32	33.33	24
C4	75	8	56.66	19	60	15
C5	70	12	60	18	66.66	13
C6	80	5	76.66	10	73.33	11
C7	50	24	53.33	20	33.33	25
D1	100	1	96.66	1	100	1

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