



STUDY OF FACTORS FOR CONSTRUCTION COST MANAGEMENT FOR CONTRACTORS IN AHMEDABAD REGION

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Abstract: The construction sector is currently characterized by intense rivalry and a mostly transparent market, and the conventional enterprise cost management approach has been unable to keep pace with this change. The contractor must figure out how to get the greatest profit possible from the project without compromising the timeline or the highest level of quality in order to thrive in this competitive market and expand at a steady rate. This study aims to identify those factors that can affect the cost management decision-making and importance of those factors. This research uses both qualitative and quantitative approaches. The results of before-and-after analysis of process using various literature related to the topic are reported. With the help of a survey questionnaire, identified viability factors were scaled, and important rankings were noted. Rankings of significance were discovered using the Relative Importance Index Method and Factor Analysis. Factor analysis is the relative approach that focuses on a set of components concurrently, as opposed to RII, which is an absolute method that concentrated on one variable at a time. Preparation of Proper Rate Analysis and Documents, Clarity in Respective Purchase Order / Work Order, Timely Completion of Work & Tracking the Progress, Type of Material, bidding as per Market Rate & Future Analysis are the most important factors that affects cost management for any construction project, according to the analysis done by both the methods.

Index Terms - Cost management, Contractor, Construction Project, Factors affecting Cost

I. INTRODUCTION

This India Construction cost management controls and monitors a construction project's cost from inception to completion. The goal is to ensure that the project is completed within the budget and to minimize any overspending. To achieve this, various tools and technologies are used in construction cost management to provide project teams with the necessary information and insights to make informed decisions and to help mitigate financial risks. A dynamic cost control system that fits the project's scenario is built through the study of its current state. To guarantee that the actual building cost does not differ from the target cost, it is possible to quickly correct cost deviations in the construction process by using a dynamic cost management system. The project's engineering and technical solutions should also undergo a cost analysis. The fundamental labor, material, equipment, and measurement expenses should all be controlled to ensure construction quality and safety.[1]

1.1 NEED FOR STUDY

One of the most rewarding sectors for contractors is the building sector, if the management is sustainable in the methods and techniques used for making profit out of projects. Anyone's first goal as a contractor will be to cut costs as much as they can without compromising the quality of work and their reputation in market. For taking such decisions of cutting cost and making profit from a project, various techniques can be used to maintain some level of financial restrictions. This research will provide a certain understanding of what type of strategy a contractor should apply for better result and greater profit for a particular project, with the help of identified factors.

1.2 OBJECTIVES

- To learn techniques to control the cost overrun of projects
- To understand how to implement the techniques of cost management

1.3 SCOPE OF WORK

The scope of work is restricted to construction companies that are making a profit from bidding tenders and taking work as a contractor in the Ahmedabad region. It will be done to comprehend and define essential viability factors with the aid of professionals in the field. Ranking based on the weighting and factors relevance is determined by data analysis using the established factors.

II. RESEARCH METHODOLOGY

For this thesis, both qualitative and quantitative data were gathered. As a result, the data is divided into primary data and secondary data. The primary data was made up from literature review. The secondary data was gathered using questionnaire survey of construction professionals and stakeholders in order to support the core data's viability. Research papers on different topics related to this study were studied as a part of primary data collection. The questions were divided into various sections as per the topic which were the questions related to. The sections were, Section – 1 “Introduction”, Section – 2 “Background of Participant”, Section – 3 “Factors Related to Preparing / Bidding Tender”, Section – 4 “Factors Related to Material Procurement & Inventory Management” and Section - 5 “Factors Related to Execution Work”. Section – 1 “Introduction” contains a synopsis of the complete study. Section – 2 “Background of Participants” collects the personal details of the person taking the survey such as the name of person, designation, organization details, experience in years, and email address. The respondents were asked to rate factors related to the preparation/bidding tender, factors related to the procurement & inventory management, and factors related to the execution of work in sections 3, 4 & 5, respectively.

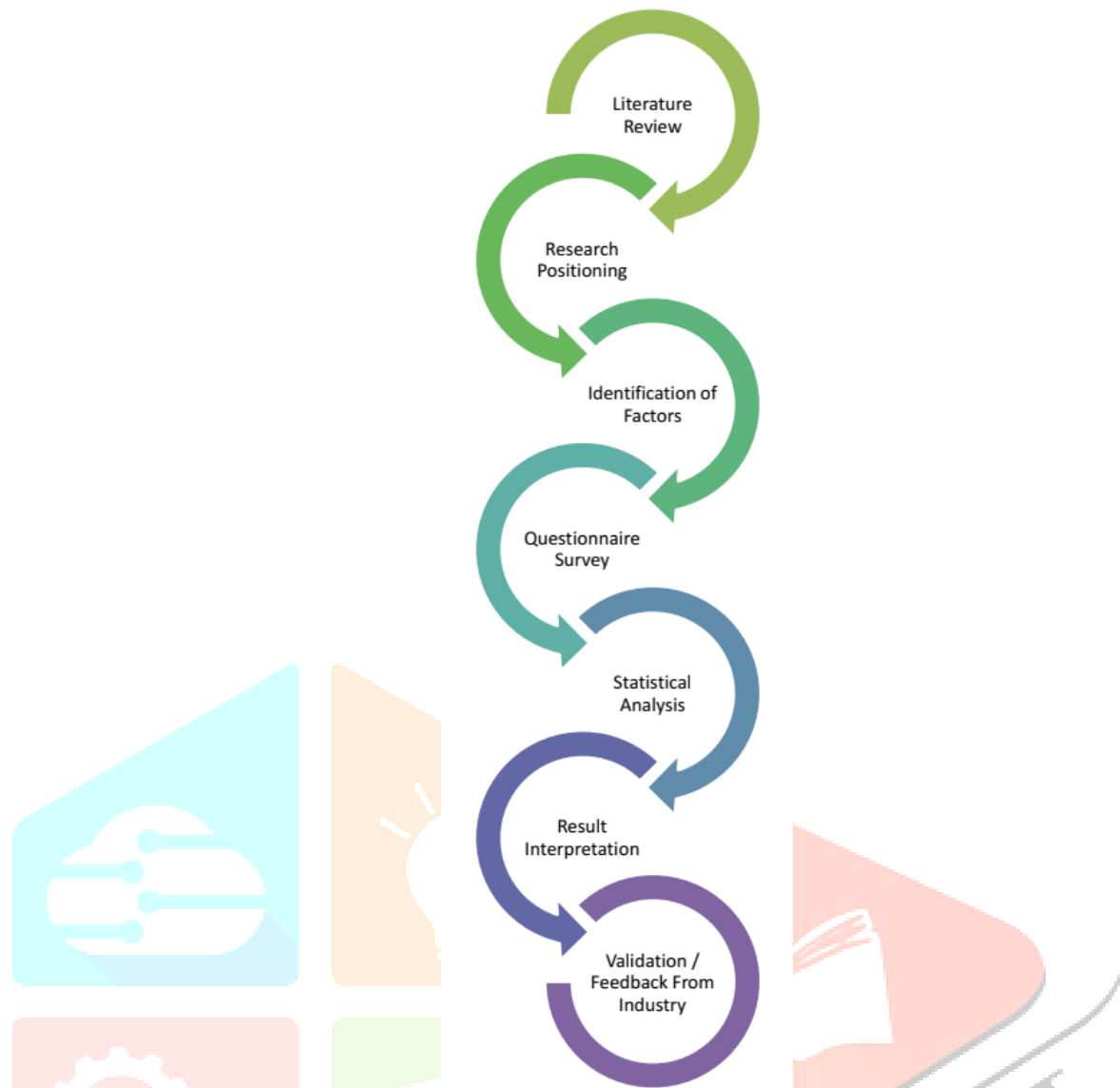


Fig-1: Research Methodology

III. LITERATURE REVIEW

Various research papers connected to “Factors Affecting Cost Management”, “Material Management”, “Cost Management Practices”, “Effectiveness of Cost & Time Management”, “Cost Overrun in Construction Projects”, “Success Factors for Cost Management” were studied for literature analysis.

3.1 Content of Literature

Asapuri and Payghan did research to determine how the present material administration application affected the building sector. They determined that the three most frequent root causes of ineffective material administration were matching pricing to competitor’s price, spending time investigating reliable sources, and material accessibility. After adding up the overall construction costs, the worth of the building materials in a design may be between 60 and 70 percent. This research paper's main goal is to examine how the present material management policies impact the construction sector.[2]

Another study was carried out to find out all the problems that arise in the company due to the improper application of materials management. Materials are key components of construction projects. Therefore, if the management of materials is not reasonable, it will create a difference in construction cost. The primary ingredient in building project is material. As a result, poor material handling will result in a cost variance for the job. By correcting the cost difference, project costs can be kept under control.[3]

Okereke, Zakariyau & Eze spoke about the performance of projects and the strategic performance of construction organisations are both enhanced by effective cost management. The purpose of the study is to evaluate how cost management practices affect Nigerian construction businesses' strategic performance.[4]

The use of big data technologies for cost management and control in building projects was investigated in one research conducted in China. Construction businesses must embrace technicalization, information, and digitalization in cost management to better manage costs and increase benefits.[5]

Huang investigated how the advancement of technology has led to project cost management becoming more sophisticated in the age of big data. In order to lower project management expenses and increase project value, BIM technology increases the frequency of employing big data in project cost management. [6]

Guo's research is based on dynamic cost management during the construction of real estate project construction stage. From the perspective of real estate enterprise construction units, this paper will analyze the cost management problems in the construction process, and propose corresponding measures and improvement methods. A dynamic cost management system that fits the project's circumstance is created through the study of its current state. To ensure that the real building cost does not deviate from the goal cost, a dynamic cost control system can be established and the cost deviation in the construction process can be promptly corrected.[7]

A bidding agency plays a significant role in the development of construction project bidding by offering services and giving the development of construction project bidding a diversified characteristic, as Heyan Fu discussed in his study. [8]

Another study conducted in India looked at the constraints that increase project management complexity. When a customer is a large organization, like public sector or a corporation, the needs are differentiated. The purpose of this study is to identify the limitations that exist in the working conditions of a construction business project and to use the Theory of Limitations (TOC). [9]

Albtoush, Doh, and Rahman talked about the elements influencing cost control in building projects. Construction projects require cost management in the first stage to complete the project within the required cost, time, and quality. Cost management is regarded as the most important factor affecting the success of construction projects in all developing and developed countries.[10]

IV. DATA COLLECTION

As mentioned above, the data collection was done in two stages: Qualitative and Quantitative.

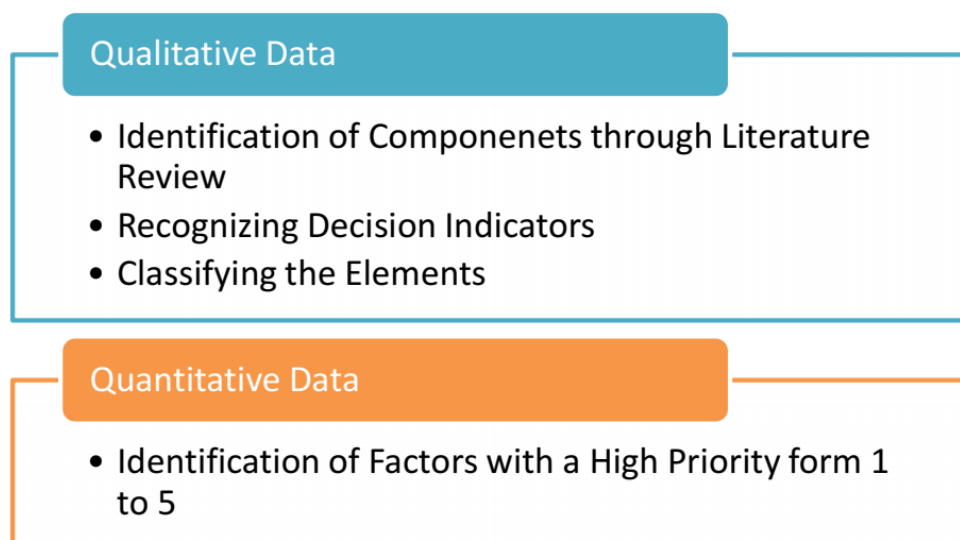


Fig-2: Type of Data Collection

The questionnaire was approved and verified by 5 personnel from the industry, they indicated some changes and modifications. After making the necessary changes, the questionnaire was disseminated. The questionnaire was divided into major 4 sections.

- I. Background of Participant
- II. Factors Related to Preparing / Bidding Tender
- III. Factors Related to Material Procurement & Inventory Management
- IV. Factors Related to Execution Work

The parameters are measured using a scale that alluded to the factor's criticality. A score of 5 denotes a high degree of relevance for the parameter, while a score of 1 denotes a low degree of importance. These variables are rated by respondents in an online survey conducted using a Google Form. Email and WhatsApp (Personal & Group), and in-person interaction were the contact method.

Table -1: Rating Scale of Factors

1	2	3	4	5
Not Important	Slightly Important	Moderately Important	Important	Very Important

V. DATA ANALYSIS

The data gathered from the questionnaire survey was analyzed using two of the standard methods. Basic analysis and advanced analysis are the two main sections of the analysis. Analysis based on the rating and its applicability to indirect factors like Experience, Type of organization, Experience & Designation. The advanced analysis includes factor analysis with RII Method analysis and using SPSS software.

5.1 Analysis Based on Type of Organization

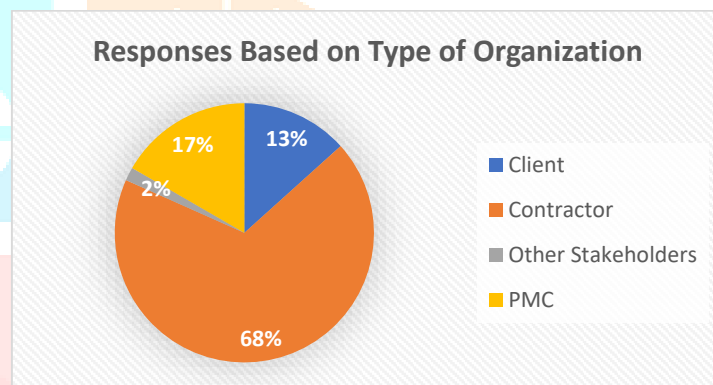


Fig-3: Analysis Based on Type of Organization

The chart describes that 68% of respondents were from a contracting firm. 17% and 13% of the respondents were from PMC and Client firm respectively, and 2% respondents were from other stakeholders.

5.2 Analysis Based on Experience of Respondents

The questionnaire's key three parts for experience as a variable are mentioned below:

- Less than 5 Years
- 5 to 15 Years
- Above 15 Years

The chart below represents that the majority of respondents are having experience between 5 to 15 years, followed by respondents with less than 5 years of experience and respondents having experience more than 15 years of experience. The chart and table show the number of responses in their respective group of age.

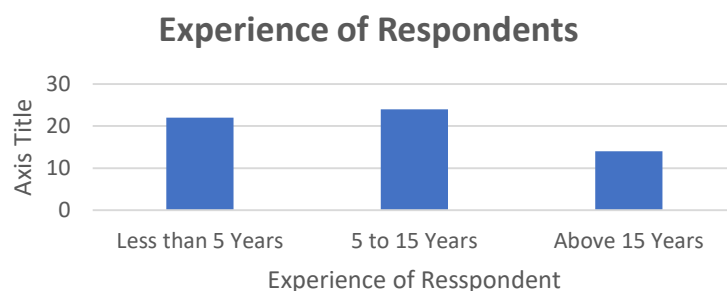


Fig-4: Analysis Based on Experience of Respondents

5.3 Analysis Based On Designation Of Respondents

The highest number of respondents are having the position of assistant engineer, which is 23%. Followed by junior engineer at 22%, senior engineer at 20% and project manager at 13%. There are 2% of respondents with the designation of director and 9% of respondents are having the designation of assistant project manager.

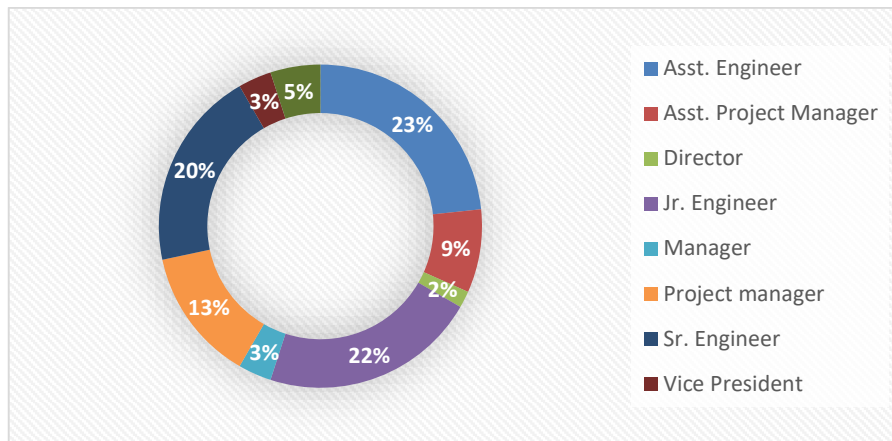


Fig-5: Analysis Based on Designation of Respondents

5.4 Analysis Based On Mean Value of the Responses

For each identified factor, mean values were calculated, and top five mean values were used to determine which factors were of the most significance. The top 5 factors, based on mean values are shown in the table below.

Table -2: Mean Value of Top 5 Factors

Ranking	Code	Category	Factors	Mean Value
1	E9	Execution	Inter-Staff Coordination & Communication	4.6667
2	T5	Tender	Preparation of Proper Rate Analysis and Documents	4.5833
3	T2	Tender	Studying and Understanding Tender Documents	4.5667
4	P9	Procurement	Clarity in Respective Purchase Order / Work Order	4.4000
5	E4	Execution	Executing Work as per Specification	4.3833

5.5 Analysis Based On Mean Value of Sections

The parameters were divided into major three sections:

- Factors related to Preparing / Bidding Tender
- Factors related to Material Procurement & Inventory Management
- Factors related to Execution Work

Means of all sections have been carried out which is shown in the table below.

Table -3: Mean Value of Each Section

Ranking	Sections	Mean Value
1	Preparing / Bidding Tender	4.2111
2	Material Procurement & Inventory Management	4.1000
3	Execution Work	4.1444

5.6 Analysis Based On Importance Rating

Each feature is evaluated and characterized based on the response “Very Important”. According to the response “Very Important”, the ranking of viability characteristics is shown in the table below.

Table -4: Ranking Based on Importance Ranking (Very important)

Ranking	Code	Factor	Number of “Very Important” Responses
1	E9	Inter-Staff Coordination & Communication	47
2	T2	Studying and Understanding Tender Documents	44
3	T5	Preparation of Proper Rate Analysis and Documents	41
4	E1	Timely Completion of Work & Tracking the Progress	35
5	P9	Clarity in Respective Purchase Order / Work Order	33

5.7 Analysis Based On Importance Rating – Section Wise

In preparation for tender and bidding section, analyzing and studying of the documents of tender is the most important factor to take into consideration while bidding for any tender. In the material purchase and inventory management section, clarity in the order for the purchase or work order has the highest “Very important” ratings from the respondents. In the execution of work section, inter-staff coordination and communication have been rated “Very important” most times by the respondents in this survey.

Table -5: Ranking Based on Importance Ranking-Section Wise

Code	Factors	Number of “Very Important” Responses
T2	Studying and Understanding Tender Documents	44
T5	Preparation of Proper Rate Analysis and Documents	41
P9	Clarity in Respective Purchase Order / Work Order	33
P2	Type of Material	29
E9	Inter-Staff Coordination & Communication	47
E1	Timely Completion of Work & Tracking the Progress	35

5.8 Analysis Using Relative Important Index Method

Two approaches were used to analyze the data, with the RII method serving as the starting method. The relative relevance of different factors, as well as their causes and delays, are determined using this method. Only when the samples are gathered using a Likert scale is this approach employed. The responses given by the respondents are then converted into relative important index with the use of the equation below.

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

Where,

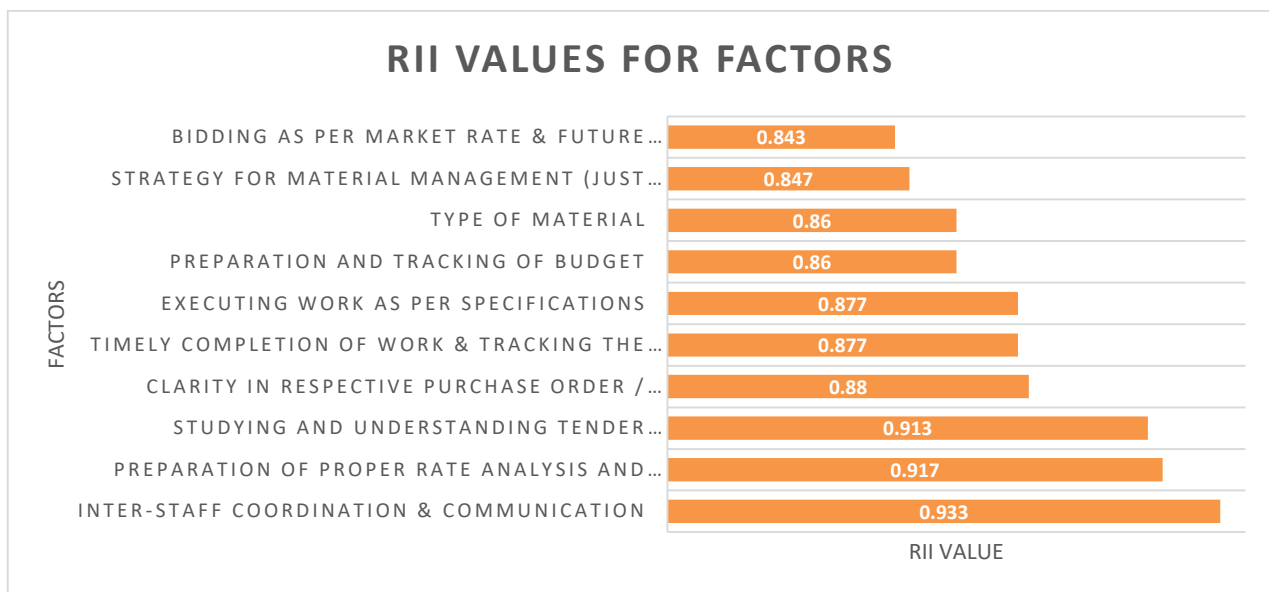
W = Weightage given by the responders (1 to 5)

A = Highest Weightage (5)

N = Number of Responder (60)

Table -6: Top 10 Factors as per RII Value

Ranking	Code	Section	Factors	RII Value
1	E9	Execution	Inter-Staff Coordination & Communication	0.933
2	T5	Tender	Preparation of Proper Rate Analysis and Documents	0.917
3	T2	Tender	Studying and Understanding Tender Documents	0.913
4	P9	Procurement	Clarity in Respective Purchase Order / Work Order	0.88
5	E4	Execution	Timely Completion of Work & Tracking the Progress	0.877
6	P2	Procurement	Executing work as per Specifications	0.877
7	E1	Execution	Preparation and Tracking of Budget	0.86
8	E5	Execution	Type of Material	0.86
9	E6	Execution	Strategy for Material Management (Just in Time)	0.847
10	T3	Tender	Bidding as per Market Rate & Future Analysis	0.843

**Fig-6: RII Values of top 10 Characteristics**

5.9 Reliability Testing Of Questionnaire Results

Cronbach's Alpha scale was utilized for reliability testing, and SPSS software was used for validation.

Table -7: Reliability Testing Results

Cronbach's Alpha	Cronbach's Alpha based on Standardized Items	N of Items
0.905	0.902	25

Here reliability test shows that Cronbach's alpha value is above 0.7, with 0.905 indicating each factor's adequate internal consistency.

5.10 Factor Analysis (Principal Component Method)

Table -8: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.762
Bartlett's Test of Sphericity	Approx. Chi-Square	859.445
	df	300
	Sig.	.000

According to the outcome, the Kaiser-Meyer-Olkin measure of sample adequacy is appropriate because it is greater than 0.5 and stands at 0.762. In this case, the significant of Bartlett's Test of

significance is 000, which is less than 0.5, which indicates that the variables are sufficiently linked to allow for component analysis.

5.11 Total Variance Between Factors Extracted

Table -9: Total Variance Explained

Component	Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.737	34.950	34.950	6.674	26.695	26.695
2	2.413	9.653	44.603	2.790	11.161	37.856
3	1.785	7.141	51.744	2.114	8.457	46.313
4	1.358	5.432	57.176	1.926	7.704	54.016
5	1.311	5.242	62.418	1.746	6.982	60.999
6	1.141	4.564	66.982	1.496	5.983	66.982

Extraction Method: Principal Component Analysis.

Through the use of SPSS software, a total of 6 components are derived from the factor analysis. These six elements are the grouping of viability criteria. Every component has a single group of characters, and each parameter inside a component affects the outcomes equally. The variation is broken down into 25 factor criteria in this overall variance table. Please take note that all 6 components have eigenvalues larger than 1, indicating that they all have a bigger influence on the result. The research shows that the detected factors, which were divided into 90 components, have a good influence with a cumulative loading variance of 66.98%, which is above 60%.

5.12 Rotated Component Matrix

Table -10: Rotated Component Matrix

Code	Name of Factors	Component					
		1	2	3	4	5	6
T1	Strategy of Bidding	.631			-.143	.413	.253
T2	Studying and Understanding Tender Documents	.658	.396	.132	.298	-.133	
T3	Preparation and Tracking of Budget	.170	.609	.206	.267	-.458	-.154
T4	Talent Support in Bidding Process	-.367	.501	.470		.262	-.125
T5	Preparation of Proper Rate Analysis and Documents	.711	.412				.128
T6	Bidding as per Market Rate & Future Analysis	.301	.705	-.102			
P1	Procurement Method for Type of Material	.653	.126	.352			.385
P2	Type of Material	.867			.183		
P3	Terms with the Vendor	.112		-.118	.806		
P4	Strategy for Material Management (Just in Time)	.600	.488			.166	
P5	Negotiation	.633	.168			-.325	-.258
P6	Reputation in Market	.324	.154		.646	-.172	
P7	Inventory Cost of Material		.121	.108		.618	-.158
P8	Material with Probability of Inflation		-.261	.308	.112	.662	.317
P9	Clarity in Respective Purchase Order / Work Order	.725	.154		.362		
P10	Tracking of Available & Required Material	.456	.443	.166	.268	-.143	.120

E1	Timely Completion of Work & Tracking the Progress	.824	.215	.137	.184	-	.113	
E3	Minimizing the Overheads	.506	.375	-.338	.111	.369	.154	
E2	Rates of Sub-Contractors / Agencies	.477	.581	.102			.212	
E4	Executing work as per Specifications	.625			.377		-	.121
E5	Managing the Resources while Execution	.283		.743	-.197		-	.114
E6	Minimizing Wastage of Material	.601	.116	.226	.348	.245		
E7	Use of Value Engineering			.814		.145	.177	
E8	Tracking Earned Value	.333	.317	.242		.105	.667	
E9	Inter-Staff Coordination & Communication	.419	.273	.233	.197		-	.651
Extraction Method: Principal Component Analysis.								
Rotation Method: Varimax with Kaiser Normalization.								
a. Rotation converged in 24 iterations.								

With 0.7 as the cut-off, the rotated component matrix displayed in the table above was utilized. As a general thumb rule, 0.7 or higher factor loading in the SEM (Structural Equation Modelling) technique indicates that the factor takes enough variation from that variable for the factor loading for grouping the factor. In essence, factor loading is the correlation between the factor and the variable. It displays the variation on that particular aspect that the variable may account for.

Table -11: Component Wise Identified Factors

Component	Factors	Loading Variance
Component 1	Preparation of Proper Rate Analysis and Documents	34.950 %
	Type of Material	
	Clarity in Respective Purchase Order / Work Order	
	Timely Completion of Work & Tracking the Progress	
Component 2	Bidding as per Market Rate & Future Analysis	9.653 %
Component 3	Managing the Resources while Execution	7.141 %
	Use of Value Engineering	
Component 4	Terms with the Vendor	5.432 %
Component 5	Did not meet the cut-off point (0.7)	5.242 %
Component 6	Did not meet the cut-off point (0.7)	4.564 %
Cumulative Loading Variance		66.982 %

VI. CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

As a contractor, a person or a firm has to think about all the aspects of the project from where the profit margin can be increased and that too without tempering the quality of the project. This research is aimed in identifying the factors that can be helpful for the contracting firms to manage their costing in every phase of the construction project.

A total number of 25 factors were determined based on the examined literature. 60 experienced professionals evaluated these factors using a Likert scale based on their significance in a questionnaire survey. RII and the factor analysis method were used to analyze the responses received in the survey.

Inter-Staff Coordination & Communication, Preparation of Proper Rate Analysis and Documents, Studying and Understanding Tender Documents, Clarity in Respective Purchase Order / Work Order, Timely Completion of Work & Tracking the Progress, Executing work as per Specifications, Preparation and Tracking of Budget, Type of Material, Strategy for Material Management (Just in Time), Bidding as per Market Rate & Future Analysis are the most important factors for construction cost management, according to the analysis done by RII Method.

Factor analysis is entirely separate method than RII, on the other hand. Preparation of proper rate analysis and documents, type of material, clarity in respective purchase order / work order, timely completion

of work & tracking the progress, bidding as per market rate & future analysis, managing the resources while execution, use of value engineering, terms with the vendor are the most important factors, according to the Rotated Component Matrix.

As RII is an absolute approach and focus on one variable at a time, but factor analysis is a relative method and focuses on a group of factors simultaneously, the identified factors majorly differ for the two analytical methods. However, some of the identified factors are same in both the methods of analysis. The importance of any factor that is related to the cost of project is decided upon using a number of factors that are provided by factor analysis.

Preparation of Proper Rate Analysis and Documents, Clarity in Respective Purchase Order / Work Order, Timely Completion of Work & Tracking the Progress, Type of Material, Bidding as per Market Rate & Future Analysis are the most important factors that affects cost management for any construction project, according to the analysis done by both the methods.

6.2 Future Scope

The current study project used the RII and Factor analysis methods to identify key factors, with some of them varied. The goal of future study might be to choose the best approach among the given factors according to the type of project.

The research is restricted to determining viability factors and grading their value. Future research may concentrate on carrying out a real-world case study to verify the findings of the analysis.

Although the environment and circumstances in India are the focus of this study, comparable issues may be investigated elsewhere.

VII. ACKNOWLEDGMENT

I want to thank my thesis guide Professor Jayraj V. Solanki (P.G. Head) and Professor Ankit S. Patel (P.G. Coordinator) for helping me with my dissertation and for always inspiring, guiding and motivating me to achieve the end goal. Without their help this research work wouldn't have been possible.

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