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Analysis of Construction Project Cost Overrun by StatisticalMethod

Saurabh T. Daundkar[1], Mr. Sumit Thakur[2], Mrs. Sushma Awad[3]
[1]*Post Graduate Student, Department of Civil Engineering, RMD Sinhgad College of EngineeringPune, Maharashtra – India*
[2, 3]*Professor, Department of Civil Engineering, RMD college of engineering, Pune, Maharashtra – India*

***Abstract:** Most of the construction projects suffer from cost overruns due to a multiplicity of factors. The present work is carried out on studying significant factors causing cost overruns in construction projects. A questionnaire for the survey has been prepared by Authors based on 45 common factors for cost overruns identified from literature review and discussion with experts. These factors are related with Owner, Contractor, Consultant, and Management, Material, Equipment, Labor and External.*
The cost overrun methodology presented in this study gives statistical method which is used in construction sector for computing impact of project cost overruns. The finding of the paper will help the project manager to act on critical causes and further try to reduce cost overrun of project.
***Keywords:** Construction projects, Factors of cost overrun, Relative important index.*

I. INTRODUCTION

Throughout the world, the business environment within which construction organization operate continues to change rapidly . It provides huge employment to the people and plays very significant role in country economy. Project cost overrun is most common problems in the construction industry. Project overruns due to time and cost result in delays during project execution. In developing countries project overruns is a serious where implementation of project faces many uncertainties. It result in wastage of scare financial resources, delays in providing facilities, development and also make construction costlier. With globalization and technology driven economic growth all over the world, a scientific and systematic approach to project management becomes imperative to ensure that project objectives are attained within the constraints of time and resources.

To study the factors affecting cost overruns of construction projects a questionnaire has been prepared. The feedback was taken from respondents in Pune and Pimpri chinchwad region of Maharashtra in India. The Statistical method is carried out to understand the perception of construction's professionals in project towards factors influencing construction cost. An ordinal scale of measurement is applied for data measurement in questionnaire survey. Data is collected using develop structured questionnaire. The ranking of factor is calculated based on relative important index value.

II. LITERATURE REVIEW

Cost overrun is defined as excess of actual cost over budget. Cost overrun is also sometimes called "cost escalation," "cost increase," or "budget overrun" . A list of cost overrun factors and contributing to the cost overrun associated with buildings, roads and bridges construction is prepared based on literature review. A number of studies have been carried out to determine the causes of cost overruns in construction projects. Shambalid Ahady, Sakshi Gupta, R.K.Malik (2017) it was founded that causes of cost overruns like poor planning for implementation, Inadequate project formulation, Lack of proper contract planning and management, Lack of project management during execution . Dhanashree S Tejale (2015)" It was observed the factors for cost overrun are the Material shortage, Shortage of labor, Late delivery of materials and equipment, Unavailability of competent staff , Low productivity level of labors, Quality of equipment and raw material. For effective and efficient cost control of construction projects the Authors recommends that material management, resource planning and management, and proper financial management may be adopted. Abdussalam Shibani, Kumar Arumugam (2015) The researcher found cause of cost overrun by undertaking survey in his local areas on small scale and he also suggested to do it in large scale to get most accurate causes of cost overrun in construction project. Ashwini Arun Salunkhe,Rahul S. Patil (2014) After studying this report ,the conclusion was time and cost overrun have been a major recurring problem in construction industry.As the project is running on many number of factors & participant, these all are having individual causes. But the important participants like owner, contractor, and consultant have more influence on project performance. Ismail Abdul (2013) found significant factor causing cost overrun in construction project are shortage of labour low productivity level of labours, lack of experience of contractor and subcontractor , equipment breakdown, financial difficulties by contractor, unclear and inadequate detail drawing, design change.

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III. RESEARCH METHODOLOGY

The research methodology for present study has adopted questionnaire survey to identify significant factors influencing cost overruns in construction projects. To identify cost overruns factors, literature reviews, discussion with experts were carried out. From existing literature on the construction industry it was possible to identify certain major effects of cost overrun on project delivery. A questionnaire was then drawn up. As the outcome of review 40 factors of cost overrun were identified.

These questionnaires were distributed to Owners and Contractors of construction Industry. The data from the questionnaire was analyzed statistically. The perspective of owner and contractor has been analyzed to rank the causes of cost overruns based on their Relative important index . Relative important index method was used for arranged in order of rank assessment of factors and found outthe top most significant factors of cost overruns.

The questionnaire was designed so that it is easy to read and responses are easy to fill in. An ordinal scale of measurement will be applied for data measurement in questionnaire survey. These sections were designed to obtain the responses on a ordinal scale that indicates the relative importance of various cost overrun. Ordinal scale use in this study will be adopted from (Enshassi et al. 2009) i.e Extremely Significant (E.S); Very Significant (V.S); Slightly Significant (S.S) and Not Significant (N.S). However, abbreviation replace with numbers i.e 1 for not significant (0%); 2 for slightly significant (25%); 3 for moderately significant; 4 for very significant (75%) and 5 for extremely significant (100). will be adopted to understand the perception of personnel of the owner and contractors involved in handling construction projects. For reliability of data Authors decided the minimum experience of respondents (owner and contractor) as 5 years. The questionnaire has been given personally to the respondents and communicated to fill without hesitation or with no bias.

In the study Relative Important index (RII) have been employed and calculated for ranking of causes of cost overrun in the construction project. The RII is used to rank the different causes. These rankings make it possible to cross-compare the relative importance of the factors as perceived by the two groups of respondents (i.e. owner and contractors). Each individual cause's RII perceived by all respondents should be used to assess the overall rankings in order to give an overall picture of the causes of construction cost overrun in construction industry.

All the numerical scores of each of the identified factors were transformed to relative importance indices to determine the relative ranking of the factors. Higher the value of RII, more important is the cause of cost overrun.

IV. DATA COLLECTION

As discussed earlier questionnaire survey have been carried out among the two major participants namely Government and Private representative from construction projects firms. The respondents involved in the survey had several years of experience (more than 5 years minimum) in handling various types of projects such as buildings, roads and bridges. Total 50 sets of questionnaires were distributed, 36 responses were received. Table-1. shows brief Summary of survey conducted. The respondents are senior employees of their companies and holding executive and managerial position. The reliability of the survey results is expected to be high because all the respondents are top-level experienced management officials in their organizations.

TABLE-1. PERCENTAGE OF QUESTIONNAIRE DISTRIBUTED AND RESPONSES RECEIVED

Respondents	Questionnaire distributed	Responses return	Percentage of responses
Owner	25	19	76%
Contractor	25	17	68%
Total	50	36	72%

V. DATA ANALYSIS AND DISCUSSION OF RESULTS

The summary of cost overrun factors and relative important index (RII) of respective factors is given in Table-2. RII value was calculated as (Enshassi and Mohamed 2009 ; Desai and Bhatt 2013) with the following expression.

$$RII = \Sigma W / A \times N$$

Where,

W = Weighting given to each factor by the respondents and ranges from 1 to 5 where '1' is 'not significant' and '5' is 'extremely significant',

A = Highest weight (I.e. 5)

N = Total number respondents

A. Ranking of Cost Overruns

The ranking of reasons of cost overrun for construction projects has been done based on relative important index (RII) value calculated for each group of respondent .(i.e. Owner and Contractor and also the overall respondents.)

Table-3 shows the top most significant factors of cost overrun ranked by overall respondents.

TABLE-2. TEN MOST IMPORTANT CAUSES OF COST OVERRUN.

SR NO	FACTORS OF COST OVERRUN	OVERALL	
		RII	RANK
1	Escalation and fluctuation of material prices	0.744	1
2	Poor site management	0.700	2
3	Project over time cost	0.689	3
	Cash flow of project	0.686	4
5	Poor communication and coordination by owner and other parties	0.683	5
6	Inadequate planning and scheduling	0.666	6
7	Financial difficulties by contractor	0.661	7
8	Shortage of labour	0.660	8
9	Material shortage	0.650	9
10	Cost of rework	0.646	10

From the analysis of results, it was found that escalation and fluctuation of material prices are ranked high by both respondentowner and contractor. These Factors are elaborated in more detail as follow.

B. Escalation and Fluctuation of Material Prices

It is rank 1st in overall ranking. Price fluctuation can generally be defined as the rise or fall of price of goods, materials and services on the markets. Price fluctuation can occur at any market, i.e at international markets, local market and/or at the labour market. A contractor who tenders at a fixed price runs the risk that he may later have to pay more formaterials and labor than the prices and wages current at the time of his tender .

There are many causes of the recent material price fluctuations in the construction industry. They involve both domestic and international market forces, as well as aspects of the construction industry that make it particularly vulnerable to average cost fluctuation.

The reasons for fluctuation are several, the major ones being:

1) Supply and demand imbalances

2) Exchange rate changes - If there is depreciation in the exchange rate, then exports will become cheaper abroad, but imports will appear to be more expensive. Firms will be paying more for their overseas raw materials leading to increase prices of domestic economy.

3) Imported inflation: In a global economy, firms import a significant proportion of their raw materials or semi-finished products. If the cost of these imports increases for reasons out of domestic control,then once again firms will be forced to increase prices to pay the higher raw material costs.

4) High Energy and Transportation Costs

C. Poor Site Management

It is rank 2nd in overall ranking. Construction management (CM) is a professional service that uses specialized, project management techniques to oversee the planning, design, and construction of a project, from its beginning to its end. The purpose of Construction management is to control a project's time / delivery, cost and quality.

D. Site Management

Means the management of physical barriers and methods and non- physical means to limit human and environmental exposure to contamination at and/or emanating from a site, as well as the implementation of any necessary monitoring, reporting, certification and/or operation and maintenance of a remedy, after the issuance of a notice of completion. Failure of site management leads to delay in project completion, which increase the project cost because fluctuation of market price daily.

E. Project Over Time Cost

It is 3rd in overall ranking. Delay is one of the most general, major and serious issues affecting the time factor in construction projects in civil engineering. Time overload is a crucial factor, even with technical advancements and improved understanding of project management by project managers, time overrun is a critical factor. The explanations for the delay in projects are different. Delays are caused by factors such as "postponement of material delivery to the site, malfunction of equipment, political problems, and several weather conditions. Delays in some circumstances make the situation much more difficult. Recognizing the delay causes and selecting precise and correct measures to minimize the detrimental effect of delays on the length of projects is important for a thorough evaluation.

F. Cash Flow of Project

It is 4th in overall ranking. Cash flow has an impact on every aspect of the construction project implementation process. A lack of funds can lead to project and business failure. Contractors must compare actual income and expenses to predicted values during the construction process. If these figures change, the contractor should adjust the schedule and update the project plan as soon as possible to accommodate the new situation. If the contractor had a solid understanding of cash flow forecasting, they could manage cash flow more efficiently and correctly during the construction process, avoiding unnecessary expenses.

G. Poor Communication And Coordination By Owner And Other Parties

It is 5th in overall ranking. According to the Project Management Institute (PMI) more than half of all project budget risk is due to ineffective communications and improper time management of project communications. Poor communication or miscommunication often results in increased costs.

An additional zero on a material amount can wreak havoc with a budget. There are many other ways in which communication can break down. For example, if a change in building material is not communicated in a timely fashion, you may have to eat the cost of the material ordered in error. Sometimes, the terminology can be the culprit. For example, the designer's name for a material may not be what you call it.

Misunderstandings can also lead to tasks not being executed properly. When that happens, revisions can cause budget overruns as well as time delays.

This paper has highlighted factors and the need to reduce cost overrun by owner and contractor. Owner should facilitate payment to the contractors in order to overcome delay, cost overrun and claims. There should be adequate contingency allowance in order to cover increases in material cost. Quality materials should be of a greater interest for contractors in order to improve cost, time and quality performance. This can be done by conducting quality training and meetings that are important for performing an improvement. Contractors should make available source of finance during construction project, adequate and proper materials procurement and developing human resources in the construction industry through proper and continuous training programs about construction projects cost. These programs can update participant's knowledge and can assist them be more familiar with project management techniques and processes at all levels of managerial people should participate in important decision making. There should be continuous coordination, cooperation, relationship and flow of information between all the people involve through project life cycle for resolving problems and developing project performance. Contractor should sequence the work according to schedule and also should have Cost Engineer in their projects to successful control cost

VI. CONCLUSION

The present study identified and analyzed causes of cost overrun in construction industry in Pune and pimpari Chinchwad region. It was observed the factors for cost overrun are the Escalation and fluctuation of material prices, Poor site management , Material shortage, , Late delivery of materials and equipment,, Low productivity level of labors, Quality of equipment and raw material. For effective and efficient cost control of construction projects the Authors recommends that material management, resource planning and management, and proper financial management may be adopted.

An attempt is made to capture the variables that best explain the occurrence and non-occurrence of cost overrun in construction projects. Statistical method could assist the decision makers in identifying factor causing cost overrun for better project development to avoid the delays and complete the project on planed schedule time.

VII. APPENDIX

Table-3 Ranking Of Causes Of Cost Overrun

SR NO	FACTORS OF COST OVERRUN	OWNER		CONTRACTOR		OVERALL	
		RII	RANK	RII	RANK	RII	RANK
1	Unavailability of competent staff	0.642	10	0.647	11	0.645	12
2	Shortage of labour	0.684	4	0.635	14	0.660	8
3	Low productivity level of labors	0.621	16	0.588	28	0.605	26
4	Lack of experience of contractor and subcontractor	0.621	16	0.600	26	0.611	23
5	Late delivery of materials and equipment	0.611	20	0.612	22	0.611	20
6	Material shortage	0.653	8	0.647	11	0.650	9
7	Waste rate of materials	0.747	1	0.741	1	0.744	1
8	Escalation and fluctuation of material prices	0.579	29	0.624	19	0.601	28
9	Equipment breakdown	0.600	27	0.588	28	0.594	30
10	Quality of equipment and raw material	0.642	10	0.576	32	0.609	24
11	Low level of equipment operating skill	0.611	20	0.624	19	0.617	18
12	Lack of software	0.442	43	0.424	43	0.433	43
13	Market share of organization	0.642	10	0.635	14	0.639	14
14	Delay in progress payment	0.516	37	0.506	39	0.511	39
15	Profit rate of project	0.632	14	0.741	1	0.686	4
16	Cash flow of project	0.453	42	0.482	41	0.467	41
17	Project design cost	0.579	29	0.588	28	0.584	32
18	Material and equipment cost	0.621	16	0.671	6	0.646	10
19	Cost of rework	0.642	10	0.612	22	0.627	16
20	Inaccurate time and cost estimate	0.474	41	0.459	42	0.466	42
21	Liquidity of organization	0.579	29	0.553	36	0.566	34
22	Cost of variation order	0.558	32	0.576	32	0.567	33
23	Overhead percentage of project	0.379	45	0.412	44	0.395	44
24	Differentiation of currency prices	0.547	33	0.647	11	0.597	29
25	Project labour cost	0.695	3	0.682	4	0.689	3
26	Project over time cost	0.389	44	0.400	45	0.395	45
27	Motivation cost	0.505	38	0.529	38	0.517	38
28	Regular project budget update	0.589	28	0.635	14	0.612	19
29	Cost control system	0.653	8	0.624	19	0.638	15
30	Inadequate planning and scheduling	0.674	6	0.659	8	0.666	6
31	Improper construction method by sub contractor	0.547	33	0.565	35	0.556	36
32	Financial difficulties by contractor	0.663	7	0.659	8	0.661	7

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33	Poor site management	0.705	2	0.694	3	0.700	2
34	Poor communication and coordination byowner and other parties	0.684	4	0.682	4	0.683	5
35	Conformance to specification	0.505	38	0.506	39	0.506	40
36	Project complexity	0.547	33	0.576	32	0.562	35
37	Absenteeism rate through project	0.611	20	0.600	26	0.605	25
38	Unclear and inadequate detail drawing	0.611	20	0.612	22	0.611	20
39	Planned time for construction	0.632	14	0.659	8	0.645	11
40	Mistake during construction	0.611	20	0.612	22	0.611	20
41	Design change	0.505	38	0.541	37	0.523	37
42	Time needed to rectify defects	0.621	16	0.588	28	0.605	26
43	Mistake and discrepancies in design documents	0.537	36	0.635	14	0.586	31
44	Delays in producing design document	0.611	20	0.671	6	0.641	13
45	Late in reviewing and approving design document by consultant and client	0.611	20	0.635	14	0.623	17

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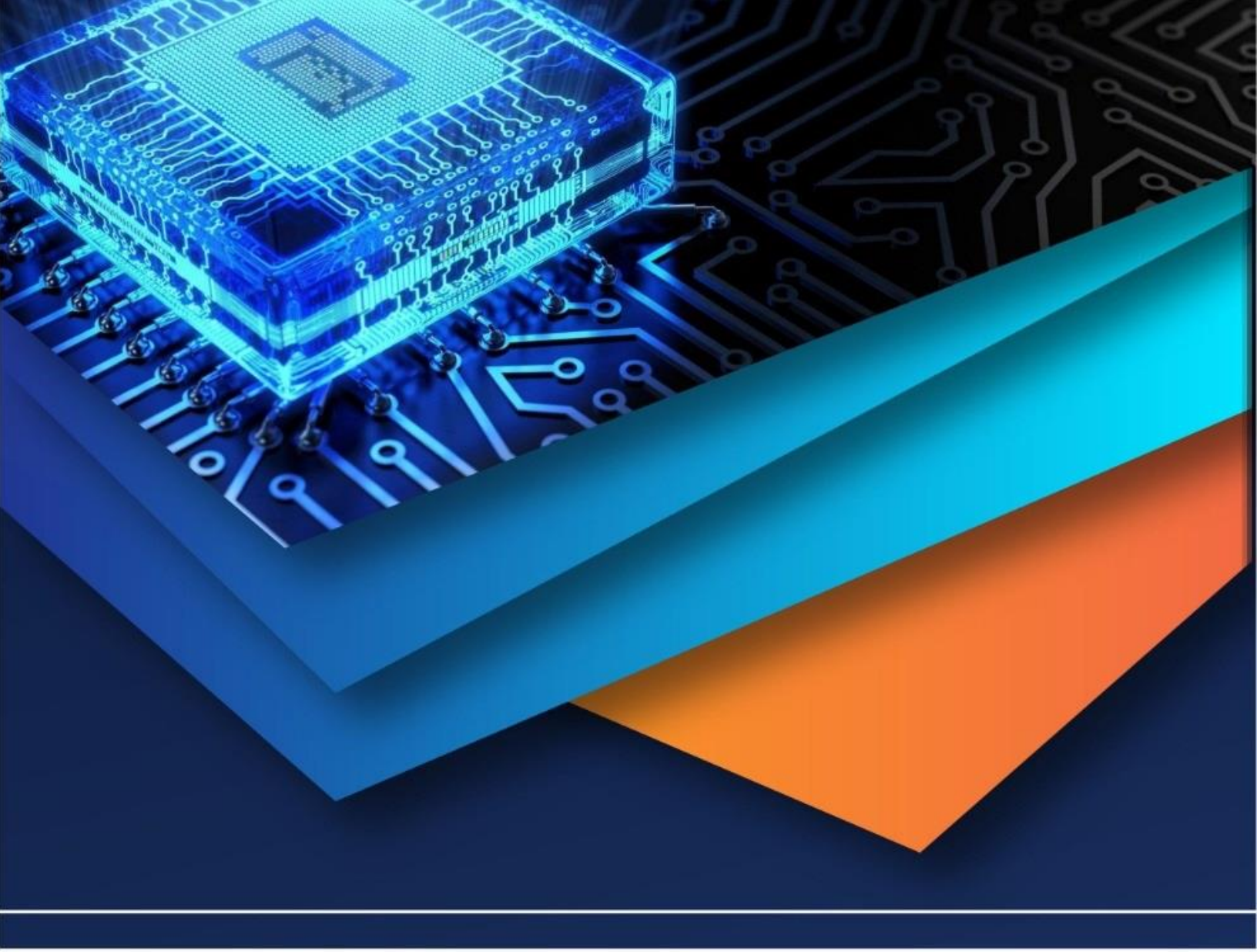
SR NO	FACTORS OF COST OVERRUN	OWNER		CONTRACTOR		OVERALL	
		RII	RANK	RII	RANK	RII	RANK
1	Unavailability of competent staff	0.627	3	0.506	8	0.566	4
2	Shortage of labour	0.663	1	0.600	2	0.631	2
3	Low productivity level of labors	0.563	6	0.520	7	0.541	5
4	Lack of experience of contractor and subcontractor	0.500	9	0.506	8	0.503	12
5	Late delivery of materials and equipment	590	5	0.600	2	0.595	3
6	Material shortage	0.636	2	0.720	1	0.678	1
7	Waste rate of materials	0.481	11	0.453	12	0.467	20
8	Escalation and fluctuation of material prices	0.500	9	0.546	5	0.523	9
9	Equipment breakdown	0.472	12	0.546	5	0.509	11
10	Quality of equipment and raw material	0.590	5	0.493	9	0.541	5
11	Low level of equipment operating skill	0.481	11	0.400	16	0.440	26
12	Lack of software	0.345	23	0.346	20	0.345	41
13	Market share of organization	0.372	21	0.426	13	0.399	36
14	Delay in progress payment	0.490	10	0.586	3	0.538	6
15	Profit rate of project	0.381	20	0.426	13	0.403	35
16	Cash flow of project	0.472	12	0.546	5	0.509	11
17	Project design cost	0.454	14	0.413	15	0.433	30
18	Material and equipment cost	0.518	8	0.466	11	0.492	13
19	Cost of rework	0.381	20	0.560	4	0.470	18
20	Inaccurate time and cost estimate	0.500	9	0.480	10	0.490	14
21	Liquidity of organization	0.472	12	0.386	17	0.429	31
22	Cost of variation order	0.372	21	0.360	19	0.366	39
23	Overhead percentage of project	0.363	22	0.360	19	0.361	40
24	Differentiation of currency prices	0.481	11	0.413	15	0.447	23
25	Project lab our cost	0.409	19	0.480	10	0.444	28
26	Project over time cost	0.336	24	0.453	12	0.394	37
27	Motivation cost	0.454	14	0.306	21	0.380	38
28	Regular project budget update	0.472	12	0.400	16	0.436	29
29	Cost control system	0.545	7	0.426	13	0.485	15
30	Inadequate planning and scheduling	0.434	17	0.533	6	0.483	16
31	Improper construction method by sub contractor	0.563	6	0.373	18	0.468	19
32	Financial difficulties by contractor	0.600	4	0.466	11	0.533	7
33	Poor site management	0.600	4	0.453	12	0.526	8
34	Poor communication and coordination byowner and other parties	0.481	11	0.560	4	0.520	10
35	Conformance to specification	0.409	19	0.466	11	0.437	27
36	Project complexity	0.418	18	0.400	16	0.409	33
37	Absenteeism rate through project	0.445	15	0.413	15	0.429	31
38	Unclear and inadequate detail drawing	0.463	13	0.480	9	0.471	17
39	Planned time for construction	0.436	16	0.413	15	0.424	32
40	Mistake during construction	0.436	16	0.466	11	0.451	22

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41	Design change	0.463	13	0.426	14	0.444	25
42	Time needed to rectify defects	0.463	13	0.453	12	0.458	21
43	Mistake and discrepancies in design documents	0.409	19	0.400	16	0.404	34
44	Delays in producing design document	0.436	16	0.466	11	0.451	22
45	Late in reviewing and approving design document by consultant and client	0.372	21	0.520	7	0.446	24

A construction project is deemed **successful** when it is finished within budget, on schedule, and according to its standards and specifications. Although similar in nature and objectives, construction projects can vary drastically in scope, timelines, environment, complexity, conditions, management structures, and budget. Without a system to centralize information and ensure alignment between stakeholders, variances in these factors can trigger massive disruption. For example, if your contractor overlooks a specific logistics or labor dependency, their timeline could end up being completely inaccurate, leading to bottlenecks and delays.

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