

Identification of Causes of Time and Cost Overrun, it's Impact and Control in Metro Projects in India

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ABSTRACT:-Metro rail systems are required in cities not only to offer an efficient public transportation system, but also to reduce traffic and improve environmental conditions. Many cities already have metro rail plans in the works, but implementation is hampered by a number of issues. The goal of this study paper is to examine the primary causes of schedule and expense delays, as well as to collect data from a diverse group of construction experts working on Metro Projects using a questionnaire survey. The main conclusions drawn from the data should benefit the construction industry in better assessing not only the major causes of delays as well as the causes of delays in overall construction projects, but also how to reduce them through appropriate planning and the use of splitting working methods.

Almost every metro project in India is running behind schedule. In megaprojects, delays are often regarded as the most common, challenging, and dangerous issue. The bulk of construction projects in underdeveloped countries have time overruns. All projects, regardless of their size or complexity, are plagued by deadlines and unpredictability. Every construction project encounters delays, which vary widely from one project to the next. Prior studies on time and cost overrun factors are thoroughly evaluated in this study. Aside from fulfilling the growing demand, sound decision-making throughout the construction phase can help to avoid delays. More research is needed, however. This might involve, among other things, research into decision-making procedures, the content of construction site management training programmes, the value of apprenticeship programmes in building a more skilled workforce, and the potential for expanded use of pre-cast

materials. This study looked into the reasons for construction project delays in India.

Keywords:-Delay, metro, cost, time, budget, management, planning, quality, and schedule are all terms that can be used to describe a situation.

I. INTRODUCTION:-

Metro construction is part of infrastructure development. Metro projects are critical for a city's and, ultimately, a country's growth. Due to their magnitude and character, such as sort, site/location, neighbouring urban development, and so on, most infrastructure projects are frequently accompanied by considerable environmental and social impacts at various stages of pre-construction, construction, and operation. These repercussions could be beneficial or destructive, depending on their ability to affect the surrounding environment as well as the local population. The project has long been chastised for its lack of efficiency and expansion. The term "advanced construction technology" encompasses a wide range of modern techniques and processes, such as the most recent advancements in materials technology, design procedures, quantity surveying, and other related fields, cost-effective facilities management services, structural analysis and design, and management studies. Integrating innovative construction technology into reality can improve quality, efficiency, safety, sustainability, and value for money.

- What is the metro system's purpose?
- It utilises a quarter of the energy per passenger kilometre compared to a road-based system.
- It does not pollute the air in the city.
- Reduces the quantity of background noise. It takes up no road space if it's a Metro, and about 2 metres of road width if it's elevated. If

it's a light-capacity system, it can carry the same amount of traffic as 5 bus lanes or 12 private car lanes (either way).

- Is more stable, comfortable, and secure than a road-based system.
- It can save travel time in half to seventy percent depending on road conditions.

When a project's expected timeframe deviates from the baseline due to a range of circumstances that occur during the project, which are usually referred to as delays in a construction project, it is referred to as time overrun. The number of days necessary to finish a component of the project increases as a result of delays.

Overspending Cost overruns are the differences between the quantity surveyor's or estimator's original estimate and the actual cost. In the construction industry, cost overruns are referred to as "cost surge" and "budget overrun." The difference between the actual cost of finishing the project and the original anticipated cost is known as cost overruns. In the form of an equation, it may be written as follows:

Cost Overrun = Final Contract Amount – Original Contract Amount / Original Contract Amount, according to (Kavuma et al., 2019).

Purpose of Study :-

- To identifying factors/reasons of time and cost overrun in metro projects
- To study the impact of time delay and cost overrun for metro projects and its mitigations.
- To study cost-benefit analysis process through proposed study for Metro project.

II. LITERATURE REVIEW:-

Probabilistic analysis has long been associated with risk assessment in construction projects. In order for such strategies to work, events must be mutually exclusive, exhaustive, and conditionally independent. However, because there are so many variables in construction, identifying causality, dependence, and correlations can be challenging. As a result, subjective analytical approaches for quantifying the impact of construction risk and uncertainty have been developed, based on historical data and individual and organisational experiences.

We specified numerous suggested methodologies and approaches to follow in scientific publications and other theoretical literature not related to the projects covered in this thesis on how to detect, evaluate, analyse, and manage risk in construction and Metro construction. As previously said, reading about their specific qualities reveals that they are all

subjective analytical methodologies based on the experience of the people and firms involved. They also include the fundamentals of recognising hazards, assessing risks, and discussing risk management, elimination, and transfer strategies. Three methods uncovered after a literature review are listed below.

This method focuses on hazards as they arise during the project life cycle, employing a project framework to identify and mitigate risk using the well-known risk identification and project control framework. Users must follow a rational set of procedures and do this analysis on a frequent basis throughout the project's life cycle. Based on the literature study completed for this thesis, it is uncertain.

Yash Kumar Mittal and Virendra Kumar Paul determined the key causes of metro rail project delays in India (2018). They come up with a top 10 list of delay-factors: The effects of unforeseen subsurface and changing ground conditions, (shortage of construction materials in the market, delays in design approvals and decision making, labour shortages, lack of data collection and survey prior to design, and delays in obtaining permits from local bodies were among the factors identified. Project management interventions based on the identified key reasons of delay can help enhance the schedule compliance of planned metro rail projects. A range of variables can be used to mitigate the usage of suitable course correction strategies that target the critical Delays.

In India, metro rail projects frequently have delay and cost overruns. The Delhi metro was India's first modern metro system, having launched in 2002. The project's first phase performed wonderfully in terms of schedule and cost compliance. Other projects completed in the last decade include Namma Metro, Rapid Metro, Mumbai Metro, Jaipur Metro, Chennai Metro, Kochi Metro, and Hyderabad Metro. Almost every one of these metro rail projects has been postponed, causing major schedule delays. Given the scale and frequency of metro rail project delays, it is necessary to investigate the projects to uncover the root reasons.

Vishwas H S, Dr G D Gidwani (2017) evaluated risk and suggested management methods in the construction of a metro railway line in Hyderabad. Because construction has a greater injury rate than other industries, recognising hazards is crucial to preventing accidents. The steps in risk identification and risk assessment are hazard identification, risk assessment, risk control, risk control implementation, monitoring and review. The methodology was used to identify threats on the building site using Job Safety Analysis. Its

purpose is to make manufacturing more efficient. The method used is SREDIM (select, record, evaluate, develop, install, and measure). Different threats were discovered, and measures were put in place. There were seven sections including design risk, external risk, environmental risk, organisational risk, project management risk, right of way risk, and construction risk.

Causes of Time and Cost Overrun :- Delay is one of the most regular, noticeable, and critical issues in civil engineering development, and it has a substantial impact on total performance. Despite advances in the construction industry and evidence of improvement in academic approaches to the problem, time delays remain an important component that can be considered a significant determinant in project performance.

Cost overruns are a typical occurrence in the construction sector, and they are virtually always linked to the majority of interlinked processes. It is becoming more severe in developing countries, where the outcomes frequently exceed half of the task's normal cost. According to (Adam et al., 2017), 63 percent of projects sponsored by the World Bank (WB) have gone over budget.

Another significant concern in the construction industry is waste from rework, as well as material loss due to improper storage, both of which result in a waste of resources and time. Such waste from rework and storage can be connected to highly predictable delays that can be avoided by employing lean techniques like six-sigma and 5S. When a process is identified as a major issue, it can be resolved by determining the root causes of process failure via value stream mapping. Many techniques to solving the problem have been devised, but are the processes effective enough to produce a better project solution? The purpose of staying competitive in the workplace is to identify inefficient processes and suggest ways to improve

their productivity. In order to give better services and eliminate processes, the purpose of process refinement should be decided from the standpoint of customers.

III. METHODOLOGY :-

In this project, a questionnaire survey is used as a tool to determine the various factors and most impacting parameters. It also provides a systematic approach and an easy structure through which all of the parameters are covered and can be easily analysed.

A) This is the procedure that was followed:

1. First, cost-influencing criteria are selected through a thorough literature analysis and data collected from various government agencies, contractors, site engineers, supervisors, and labour supervisors.
2. All of the above elements were factored into a structured questionnaire, which was organised in descending order by the majority of people's repetition.
3. On a scale of 0 to 10, each factor was rated
Using a scale of 0 to 10, a person might convey the intensity of the impact of a single cost element being the most advanced
4. The scale was split in half.
 - 1) Influence range: 0 to 4.
 - 2) Influential 5 to 10
5. There were 80 questionnaires distributed in total, and gathered from a variety of government agencies, contractors, and construction sites
Engineers, supervisors, and labour supervisors are among those that work in the construction industry.
6. The individual components' scale values Table 1,2,3 and 4 show the results of 80 questionnaires.

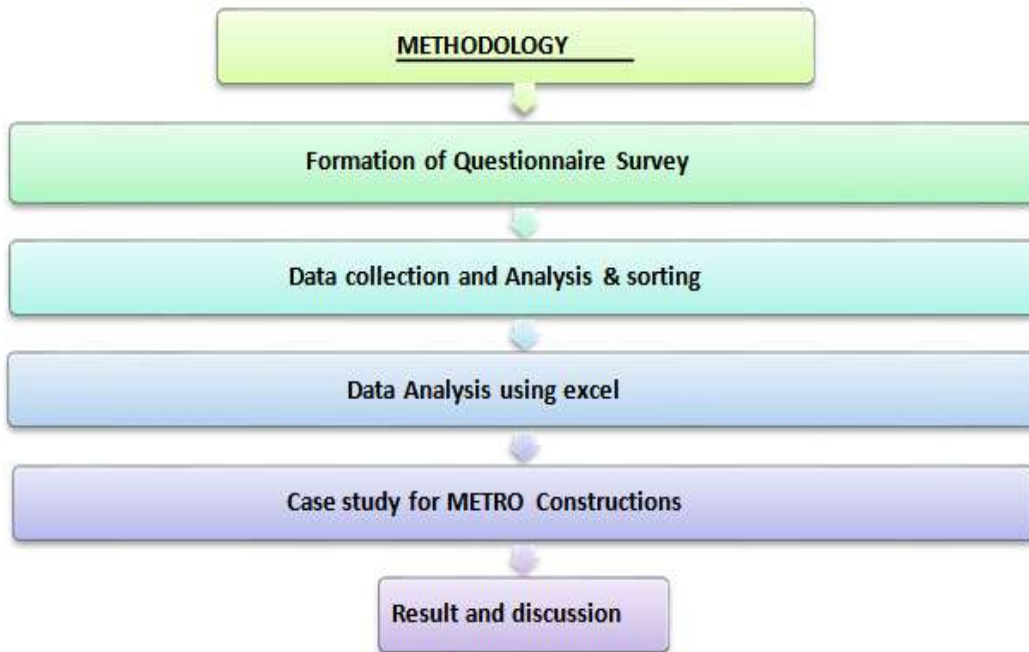


Figure: Methodology Flow

Factors :-

➤ **Factors Influencing Time Overrun:-**

- Availability of modern equipment and method.
- Change in contract midways.
- Clearance from authorities like railways.
- Climatic Conditions(like delay due to rain in 2019 rainy season.
- Delay in obtaining security clearance at site in public places.
- Delay in planned activities.
- Delay in project site handover.
- Difficult terrain conditions.
- Labour availability due to pandemic.
- Labour having poor knowledge regarding the new techniques.
- Lack of management during execution.
- Land Acquisition.
- Local issues (like Ganesh Mandal protest)
- Political issues(like Election 2019)

➤ **Factors Influencing Cost Overrun:-**

- Accidents on construction site.
- High maintenance cost of machinery.
- High transportation cost
- Improper risk management.
- Increase in prize of raw materials.
- Ineffective planning and scheduling of project.
- Lack of financial management and planning.
- Rework due to change in plans and conditions.
- Social Securities(Wages paid to workers during lockdown)

Questionary Survey :-

- Availability of modern equipment and method.
0 1 2 3 4 5 6 7 8 9 10
- Change in contract midways.
0 1 2 3 4 5 6 7 8 9 10
- Clearance from authorities like railways.
0 1 2 3 4 5 6 7 8 9 10
- Climatic Conditions(like delay due to rain in 2019 rainy season.
0 1 2 3 4 5 6 7 8 9 10
- Delay in obtaining security clearance at site in public places.
0 1 2 3 4 5 6 7 8 9 10
- Delay in planned activities.
0 1 2 3 4 5 6 7 8 9 10
- Delay in project site handover.
0 1 2 3 4 5 6 7 8 9 10
- Difficult terrain conditions.
0 1 2 3 4 5 6 7 8 9 10
- Labour availability due to pandemic.
0 1 2 3 4 5 6 7 8 9 10
- Labour having poor knowledge regarding the new techniques.
0 1 2 3 4 5 6 7 8 9 10
- Lack of management during execution.
0 1 2 3 4 5 6 7 8 9 10
- Land Acquisition.
0 1 2 3 4 5 6 7 8 9 10
- Local issues (like Ganesh Mandal protest)
0 1 2 3 4 5 6 7 8 9 10
- Political issues(like Election 2019)

- 0 1 2 3 4 5 6 7 8 9 10
- Accidents on construction site.
- 0 1 2 3 4 5 6 7 8 9 10
- High maintenance cost of machinery.
- 0 1 2 3 4 5 6 7 8 9 10
- High transportation cost
- 0 1 2 3 4 5 6 7 8 9 10
- Improper risk management.
- 0 1 2 3 4 5 6 7 8 9 10
- Increase in prize of raw materials.
- 0 1 2 3 4 5 6 7 8 9 10
- Ineffective planning and scheduling of project.
- 0 1 2 3 4 5 6 7 8 9 10
- Lack of financial management and planning.
- 0 1 2 3 4 5 6 7 8 9 10
- Rework due to change in plans and conditions.
- 0 1 2 3 4 5 6 7 8 9 10
- Social Securities(Wages paid to workers during lockdown)
- 0 1 2 3 4 5 6 7 8 9 10

Analysis :-

The Analysis was carried out in two stages i.e.

- 1) Lower scale analysis
- 2) Higher scale analysis

The procedure for the analysis is as follows

- 1) The total sum of the individual factor was calculated by multiplying the scale value to the no.

of times the factor got the same scale value in 80 questionnaires.

- 2) This total was then divided with number of questionnaire and the mean (X) was obtained

$$X = \text{TOTAL} / N$$

- 3) After mean, standard deviation (σ) was calculated from the following formula given below

$$\sigma = \sqrt{\frac{\sum X^2}{N} - X^2}$$

NN

- 4) At last the coefficient of variance (C.V.) of individual factors was calculated by following formula

$$C.V = \sigma / X$$

- 5)The C.V. for a single variable seeks to explain the variable's dispersion in a way that is irrespective of the measurement unit. The greater the dispersion in the variable, the higher the CV. The CV for a model is also used to describe the model fit in terms of the squared residuals and outcome values. The lesser the residuals are in comparison to the expected value, the lower the C.V. This signifies an excellent model matches.

The factor with the highest mean value was identified as the most cost impacting factor, and these factors were ordered in ascending order based on the mean value acquired by the individual factors.

Time Influencing Factors:-

Lower scale analysis

Table 1

FACTORS	SCALING COEFFICIENT					TOTAL	MEAN (X)	S.D. (σ)	C.V.
	0	1	2	3	4				
Land Acquisition	1	1	5	8	6	59	0.74	0.08	11.11
Delay in obtaining security clearance at site in public places	0	4	10	7	11	89	1.11	0.12	11.11
Clearance from authorities like railways.	1	8	14	8	9	96	1.20	0.13	11.11
Delay in planned activities.	5	7	15	6	14	111	1.39	0.15	11.11
Delay in project site handover	6	8	10	10	12	106	1.33	0.15	11.11
Lack of management during execution.	8	8	13	11	8	99	1.24	0.14	11.11
Local issues (like Ganesh Mandal protest)	0	2	2	5	5	41	0.51	0.06	11.11

Political issues(like Election 2019)	0	1	2	4	4	33	0.41	0.05	11.11
Availability of modern equipment and method.	7	7	7	5	11	80	1.00	0.11	11.11
Labour availability due to pandemic.	0	1	1	1	4	22	0.28	0.03	11.11
Change in contract midways.	8	7	10	10	9	93	1.16	0.13	11.11
Climatic Conditions(like delay due to rain in 2019 rainy season)	1	1	2	1	2	16	0.20	0.02	11.11
Labour having poor knowledge regarding the new techniques.	9	6	9	11	11	101	1.26	0.14	11.11
Difficult terrain conditions	6	5	6	8	13	93	1.16	0.13	11.11

Higher scale analysis

Table 2

FACTORS	SCALING COEFFICIENT						TOTAL	MEAN (X)	S.D. (σ)	C.V.
	5	6	7	8	9	10				
Land Acquisition	7	9	10	11	15	7	452	5.65	0.63	11.11
Delay in obtaining security clearance at site in public places	7	14	7	9	8	3	342	4.28	0.47	11.11
Clearance from authorities like railways.	10	6	6	10	4	4	284	3.55	0.39	11.11
Delay in planned activities.	7	8	5	7	4	2	230	2.88	0.32	11.11
Delay in project site handover	11	8	3	6	5	1	227	2.84	0.32	11.11
Lack of management during execution.	7	9	7	6	2	1	214	2.68	0.30	11.11
Local issues (like Ganesh Mandal protest)	5	5	13	15	15	13	531	6.64	0.74	11.11
Political issues(like Election 2019)	6	4	9	16	22	12	563	7.04	0.78	11.11
Availability of modern equipment and method.	9	11	5	6	9	3	305	3.81	0.42	11.11
Labour availability due to pandemic.	3	1	8	19	24	18	625	7.81	0.87	11.11
Change in contract midways.	12	12	4	5	1	2	229	2.86	0.32	11.11
Climatic Conditions(like delay due to rain in 2019 rainy season)	1	2	15	17	24	14	614	7.68	0.85	11.11

Labour having poor knowledge regarding the new techniques.	8	10	6	3	5	2	231	2.89	0.32	11.11
Difficult terrain conditions	8	6	10	12	6	0	296	3.70	0.41	11.11

**Cost Influencing Factors:-
Lower scale analysis**

Table 3

FACTORS	SCALING COEFFICIENT					TOTAL	MEAN (X)	S.D. (σ)	C.V.
	0	1	2	3	4				
Increase in prize of raw materials	1	0	1	5	4	33	0.41	0.05	11.11
Accidents on construction site	1	2	3	4	5	40	0.50	0.06	11.11
Rework due to change in plans and conditions	6	3	9	9	8	80	1.00	0.11	11.11
Improper risk management	2	4	5	7	9	71	0.89	0.10	11.11
Social Securities(Wages paid to workers during lockdown)	0	1	0	3	1	14	0.18	0.02	11.11
High maintenance cost of machinery	3	2	7	8	9	76	0.95	0.11	11.11
Lack of financial management and planning	1	2	5	7	6	57	0.71	0.08	11.11
Ineffective planning and scheduling of project.	4	7	5	9	12	92	1.15	0.13	11.11
High transportation cost	0	2	9	12	5	76	0.95	0.11	11.11

Higher scale analysis

Table 4

FACTORS	SCALING COEFFICIENT						TOTAL	MEAN (X)	S.D. (σ)	C.V.
	5	6	7	8	9	10				
Increase in prize of raw materials	4	2	6	23	24	10	574	7.18	0.80	11.11
Accidents on construction site	5	7	12	14	21	5	502	6.28	0.70	11.11
Rework due to change in plans and conditions	4	7	10	11	12	1	338	4.23	0.47	11.11
Improper risk management	6	4	15	12	10	6	405	5.06	0.56	11.11
Social Securities(Wages paid to workers during lockdown)	2	1	6	24	27	15	643	8.04	0.89	11.11
High maintenance cost of machinery	8	7	12	14	8	2	370	4.63	0.51	11.11
Lack of financial management and planning	6	7	10	17	13	6	455	5.69	0.63	11.11
Ineffective planning and scheduling of project.	8	5	10	12	7	1	309	3.86	0.43	11.11
High transportation cost	8	5	8	18	13	0	387	4.84	0.54	11.11

Lower scale analysis

Table 5

FACTORS	SCALING COEFFICIENT					TOTAL	MEAN (X)	S.D. (σ)	C.V.
	0	1	2	3	4				
Delay in planned activities.	5	7	15	6	14	111	1.39	0.15	11.11
Delay in project site handover	6	8	10	10	12	106	1.33	0.15	11.11
Labour having poor knowledge regarding the new techniques.	9	6	9	11	11	101	1.26	0.14	11.11
Lack of management during execution.	8	8	13	11	8	99	1.24	0.14	11.11
Clearance from authorities like railways.	1	8	14	8	9	96	1.20	0.13	11.11
Change in contract midways.	8	7	10	10	9	93	1.16	0.13	11.11
Difficult terrain conditions	6	5	6	8	13	93	1.16	0.13	11.11
Delay in obtaining security clearance at site in public places	0	4	10	7	11	89	1.11	0.12	11.11
Availability of modern equipment and method.	7	7	7	5	11	80	1.00	0.11	11.11
Land Acquisition	1	1	5	8	6	59	0.74	0.08	11.11
Local issues (like Ganesh Mandal protest)	0	2	2	5	5	41	0.51	0.06	11.11
Political issues(like Election 2019)	0	1	2	4	4	33	0.41	0.05	11.11
Labour availability due to pandemic.	0	1	1	1	4	22	0.28	0.03	11.11
Climatic Conditions(like delay due to rain in 2019 rainy season	1	1	2	1	2	16	0.20	0.02	11.11

Table 6

FACTORS	SCALING COEFFICIENT					TOTAL	MEAN (X)	S.D. (σ)	C.V.
	0	1	2	3	4				
Ineffective planning and scheduling of project.	4	7	5	9	12	92	1.15	0.13	11.11
Rework due to change in plans and conditions	6	3	9	9	8	80	1.00	0.11	11.11
High maintenance cost of machinery	3	2	7	8	9	76	0.95	0.11	11.11
High transportation cost	0	2	9	12	5	76	0.95	0.11	11.11
Improper risk management	2	4	5	7	9	71	0.89	0.10	11.11
Lack of financial management and planning	1	2	5	7	6	57	0.71	0.08	11.11
Accidents on construction site	1	2	3	4	5	40	0.50	0.06	11.11
Increase in prize of raw materials	1	0	1	5	4	33	0.41	0.05	11.11

Social Securities(Wages paid to workers during lockdown)	0	1	0	3	1	14	0.18	0.02	11.11
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Higher scale analysis

Table 7

FACTORS	SCALING COEFFICIENT						TOTAL	MEAN (X)	S.D. (σ)	C.V.
	5	6	7	8	9	10				
Labour availability due to pandemic.	3	1	8	19	24	18	625	7.81	0.87	11.11
Climatic Conditions(like delay due to rain in 2019 rainy season	1	2	15	17	24	14	614	7.68	0.85	11.11
Political issues(like Election 2019)	6	4	9	16	22	12	563	7.04	0.78	11.11
Local issues (like Ganesh Mandal protest)	5	5	13	15	15	13	531	6.64	0.74	11.11
Land Acquisition	7	9	10	11	15	7	452	5.65	0.63	11.11
Delay in obtaining security clearance at site in public places	7	14	7	9	8	3	342	4.28	0.47	11.11
Availability of modern equipment and method.	9	11	5	6	9	3	305	3.81	0.42	11.11
Difficult terrain conditions	8	6	10	12	6	0	296	3.70	0.41	11.11
Clearance from authorities like railways.	10	6	6	10	4	4	284	3.55	0.39	11.11
Labour having poor knowledge regarding the new techniques.	8	10	6	3	5	2	231	2.89	0.32	11.11
Delay in planned activities.	7	8	5	7	4	2	230	2.88	0.32	11.11
Change in contract midways.	12	12	4	5	1	2	229	2.86	0.32	11.11
Delay in project site handover	11	8	3	6	5	1	227	2.84	0.32	11.11
Lack of management during execution.	7	9	7	6	2	1	214	2.68	0.30	11.11

Table 8

FACTORS	SCALING COEFFICIENT						TOTAL	MEAN (X)	S.D. (σ)	C.V.
	5	6	7	8	9	10				
Social Securities(Wages paid to workers during lockdown)	2	1	6	24	27	15	643	8.04	0.89	11.11
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Lack of financial management and planning	6	7	10	17	13	6	455	5.69	0.63	11.11

Improper risk management	6	4	15	12	10	6	405	5.06	0.56	11.11
High transportation cost	8	5	8	18	13	0	387	4.84	0.54	11.11
High maintenance cost of machinery	8	7	12	14	8	2	370	4.63	0.51	11.11
Rework due to change in plans and conditions	4	7	10	11	12	1	338	4.23	0.47	11.11
Ineffective planning and scheduling of project.	8	5	10	12	7	1	309	3.86	0.43	11.11

IV. CONCLUSION:-

Considering time influencing factors as per the lower scale analysis in table 5 “Delay in planned activities.” has highest mean of 1.39. So this is the most time influencing parameter as per lower scale analysis. But lower scale analysis represents the factors which has least influence on time. As per the higher scale analysis table no. 7 “Labour availability due to pandemic” is the most time influencing parameters as per higher scale analysis. Also these factors have a greater influence on time. Considering cost influencing factors as per the lower scale analysis in table 6 “Ineffective planning and scheduling of project.” has highest mean of 1.15. So this is the most cost influencing parameter as per lower scale analysis. But lower scale analysis represents the factors which has least influence on cost. As per the higher scale analysis table no. 8 “Social Securities(Wages paid to workers during lockdown)” is the most time influencing parameters as per higher scale analysis. Also these factors have a greater influence on cost.

As values of C.V. and S.D. obtained in both the analysis are nearly equal hence above results are based on the mean of data calculated in the table 1,2,3and 4. Also the accuracy of the questionnaire survey depends on the number of questionnaire i.e. more the number of questionnaires more is the accuracy of the results

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