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Factors Affecting Construction Project Cost in Post Covid-19 Scenario

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Abstract: The COVID-19 outbreak has indeed affected the construction sector in one way or the other across the world and this has also caused a number of issues that caused a transformation in how projects are structured and managed as well as costs. This research aims to analyze the factors that contributed to the increase in construction costs that were noted after the COVID pandemic, accompanied by several others where the conflict increased building costs. Through extensive literature review, industry reports and empirical data, this study brings out the key factors which have caused the surge in construction prices. These factors include Timeliness and relevance, Economic repercussions, Management of risk and adaptation, and Innovation in technology. Further, the research also looks into how these increases in construction costs have affected the various stakeholders in the construction ecosystem. These stakeholders include government agencies, investors, developers, and contractors. In addition, the study provides insights into the long-term implications of the post-COVID construction cost increase on project planning, risk management, sustainability measures, and the sector's resilience. Finally, these research findings contribute to a more in-depth understanding of the intricate dynamics defining the post-pandemic construction industry. Furthermore, it offers recommendations that may be put into practice to successfully navigate the ever-changing cost landscape in a complex economic situation.
Keywords: Construction Project Cost, Covid-19, Supply Chain Management, Innovation in Technology, Management of Risk and Adaptation.

I. INTRODUCTION

The construction sector is widely regarded as one of the most crucial and complex sectors globally. The significance of this matter lies in its involvement in numerous intricate jobs that necessitate meticulous execution in order to attain optimal efficiency. The majority of activities inside a building project are accompanied by elevated expenses. Consequently, even a tiny error has the potential to result in substantial financial obligations. Effective management of any construction operation is imperative due to the inherent high costs and irreversible nature of such activities [1]. The estimation of construction costs is often recognized as the most crucial element of the pre-construction phase.

The global spread of the COVID-19 epidemic has had a particularly negative impact on the building sector. Known for being intricate and heavily reliant on external factors, the construction industry saw significant interruptions during the epidemic, including issues with the supply chain, a lack of workers, and sudden adjustments to project timelines. Accurate cost estimation falls within the key aspects of the building project management process, and the current outbreak has adversely affected traditional estimation techniques. The construction sector clearly differs from most industries in its requirement that everyone on a project be engaged in some fashion at the actual construction project site. Hence, the building sector needs to consider how the industry handles this unforeseen condition.

Many countries have responded using restrictive and mitigation measures that not only reshaped daily living patterns but also disrupted specific and traditional industries, greatly compelling construction businesses to adapt. To ensure that all stakeholder input is considered in advance and to avoid confusion later, collaboration has also become a crucial part of the cost assessment process. Collaboration has been a problem for team members mainly in labor industries, such as the mechanical industry (Boktor et al., 2014). Prior research has offered insights into how economic recessions, natural disasters, and other crises can affect construction costs [2].

Globally, the COVID-19 epidemic had spread. In addition to its effects on the health sector, COVID-19 has had a serious impact on several other industries, including tourism, economy, manufacturing, society, and construction. The construction business industry's main facets are company operations, construction projects, and financial matters.

During the COVID-19 pandemic, project stakeholders in the construction sector lacked knowledge about how to manage the project [3]. This leads to a lack of cost performance.

In construction projects, cost overruns are thought to be a recurring occurrence [4]. Cost variations from the project baseline are one measure of project success that shows how well the project is doing. All of the pertinent elements for the time overrun, or vice versa, are included in the cost overrun.

U.S. Bureau of Labor Statistics (2020) stated that the total contribution of employment in the United States is 5%. The International Labor Organization reports that 74% of workers are employed in the construction sector, meaning that the sector contributes significantly to low-income nations worldwide [5].

The primary objective of this research article is to undertake a thorough examination of the ways in which the COVID-19 epidemic has influenced and transformed the methodologies employed in building cost estimation. The study aims to pinpoint the specific difficulties faced by construction industry specialists as well as the adjustments taken to deal with the disruptions caused by the epidemic. By doing so, we aim to offer valuable insights that can inform more resilient and adaptable cost estimation strategies in a post-pandemic world.

Our study uses a mixed-methods approach that includes data analysis, interviews, and questionnaires. We will examine specific case studies to understand how the pandemic's impact on cost estimation varies across regions and project types.

This research paper will be structured into several sections, including an extensive literature review, a research methodology discussion, an analysis of findings, and a conclusion with recommendations and implications for the future construction industry.

By addressing these questions, this research intends to provide valuable insights that can inform resilient and adaptable cost estimation strategies in the construction sector, both during and after COVID-19.

The primary focus of current research endeavors revolves around the evaluation of time efficiency, accessibility, and precision in relation to the construction cost methodology. This paper seeks to augment the existing body of literature by identifying additional crucial criteria. This research additionally included additional elements that contribute to the major alteration of construction project cost due to the COVID-19 pandemic i-e. timeliness and relevance, economic repercussions, management of risk and adaptation and innovation in technology.

This study addresses the need to broaden the scope of construction cost by incorporating factors that have become particularly significant during the COVID-19 pandemic. For instance, timeliness and relevance of data have become critical, as delays and disruptions have rendered older data less reliable. The pandemic's economic effects, including inflation, rising material prices, and shifting consumer preferences, also call for new assessment techniques that can react quickly to changes in the market. Additionally, risk management has grown more complicated, requiring more reliable risk assessment instruments that can take into consideration both known and unknown difficulties. Furthermore, new approaches are needed to properly utilize the rapid improvements in technology, such as digital tools for remote collaboration and automated data collection. This study offers a more thorough framework for construction cost in the post-pandemic construction environment by examining these factors. The primary goals are:

i. To establish the primary procedures for examining how the COVID-19 pandemic has impacted building costs.

ii. To verify the suggested approach and guarantee the precision and caliber of the information gathered.

II. METHODOLOGY

The approach used to accomplish the goal of this study is presented in figure 1. To explore the changes in construction project costs after COVID-19, the authors utilized a survey technique to compare the pre-COVID and post-COVID comparisons. It involves identifying the various factors that are crucial to evaluating two processes. A total of 24 factors were identified that are essential for evaluating the two processes. These factors were analyzed and grouped into four major categories to streamline the evaluation process. This categorization helps in organizing the factors logically, facilitating a more focused analysis in the later stages of research.

Information gather based on survey questions created and delivered according to the factors described in step three. To create the questionnaire, 24 factors have been identified. The purpose was to develop questions that would help to record information about the relevance and consequences of these factors. A pilot test was done before administering the surveys in order to assess the questions validity, precision, and coherency in its data gathering system. The refine surveys were then administered to the participants of our study to obtain more information for analysis.

For statistical analysis of data got from the surveys. Thus, the collected survey responses were statistically analyzed to compare the significance and significance of each of the factors singled out in the previous step. It makes it easy to explain the nature of the two processes because it facilitates the determination of pattern, correlation and insight of the factors that affect these processes. This step is important in making conclusions on the results which will be gathered in the process.

Finally, in order to reach a conclusion of the research study, an elaborate conclusion was made from the responses elicited from the survey data set. This conclusion synthesizes the survey data analysis with the analysis of a case study project in order to provide an overview of the processes. The conclusion offers the result interpretation and practical implications given such findings to the literature of the study.

This approach facilitates a structured approach to the research problem thus improving dependability and validity of the study findings.

Survey-based method

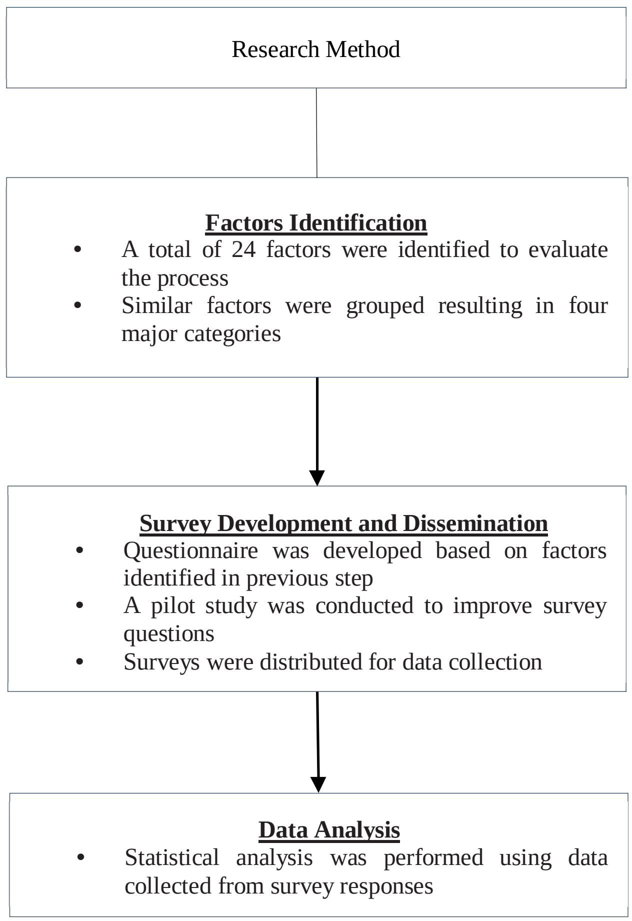

Figure 1. Details of the Methodology

A. Survey

Based on the general literature, it is clear that survey methodology is effectual in gathering data on different research interests. It is one of the allowed techniques to collect data for any given research study according to [7]. This is perfectly acceptable because such an approach considers the views of those considered to be knowledgeable in the matter under consideration.

Twenty-four factors were identified in this study and these four major categories which are shown in table 1 are: Four major issues that are very important when it comes to managing construction projects given the COVID-19 situation must be Timeliness/Relevance and Economics, Risk/Adjustment and Technology. Timeliness and Relevance bring focus on timely and adequate decision making keeping the construction project relevant and well-functioning during the COVID-19 pandemic. It also stresses the importance of work that can be done as fast as possible in the face of rapidly changing conditions, for example, new rules of protection against a virus or a new administration regulation that affects work in the construction site. Among the common themes are economic consequences which relate to the cost implications of coronavirus on construction projects, productivity loss, and the resulting pressures that contractors and other parties incure. It has cautioned the need for financial flexibility and the capacity to adapt to the existing fluidity within the economy due to such restrictions such as lock-downs and limited supplies as well restricted workforce. Risk and Adaptation Management is centred on the approaches that can be utilized to handle risks that are related to the outbreak. This can encompass defining possible threats (including threats to health of workers or due to the lack of some materials) and defining measures should the threats emerge, including modification of safety measures targeted at workers, changes in overall schedules or diversification of suppliers. The last part, Technology advancement also discusses the use of technological advancement in addressing the effects of the pandemic. It suggests that adopting new technologies, such as digital tools for remote collaboration, automated processes, or advanced materials, can help the construction industry adapt more effectively to the changing environment, ensuring continuity and efficiency despite the disruptions caused by COVID-19.

In addition, to gather information regarding the significance of each component, survey questions were developed and disseminated to practitioners using a scale ranging from one to five, where one indicates the least amount of agreement and five indicates the most agreement. To determine the relevance of the survey process, data were collected for pre- and post-COVID construction cost adjustments separately. Comparative research was then carried out to determine the significance of each aspect i.e., pre and post covid construction. Practitioners working in project control firms were provided with a link to an online survey to facilitate the distribution of the questionnaire. During the initial phase of survey, the respondents were asked to provide general information regarding their information and job experience in construction cost. As soon as the project was completed, surveys were gathered, and conclusions, findings, and outcomes were made. This section, "Analysis and Findings," describes the whole analysis of data that the researcher collected.

Table 1 List of significant factors identified for analysis

Category	Type	Factors	Code
Timeliness and relevance (TR)	Independent Variable (IDV)	Post-pandemic supply chain disruptions negatively impact project timelines/costs.	**TR.1**
	IDV	Changes in regulations/permitting processes influenced by post-COVID-19 guidelines, delay project timelines/increase costs.	**TR.2**
	IDV	Remote work/virtual collaboration shifts after pandemic, challenge project timelines/relevance.	**TR.3**
	IDV	Implementing stringent health/safety protocols to mitigate COVID-19 risks raises project costs/timelines.	**TR.4**
	IDV	Post-COVID-19 the emphasis on environmental sustainability/resilience in construction projects has increased.	**TR.5**
Economic repercussions (ER)	IDV	Disruptions in the supply chain have affected the availability/cost of materials.	**ER.1**
	IDV	Lack of skilled labor post-pandemic.	**ER.2**
	IDV	No changes in regulatory requirements or building codes post-pandemic.	**ER.3**
	IDV	Delays/disruptions in construction projects due to the pandemic.	**ER.4**
	IDV	Project financing affected by fluctuations in market conditions/economic uncertainty.	**ER.5**
	IDV	Challenges in securing funding or accessing capital for construction projects.	**ER.6**
Management of risk and adaptation (MRA)	IDV	lack of adoption in risk management strategies post-COVID-19.	**MRA.1**
	IDV	Inadequate adaption of strategies in controlling/mitigating cost-related risks.	**MRA.2**
	IDV	insufficient influence of technology adoption/innovation on	**MRA.3**

		construction project costs post-COVID-19.	
	IDV	Insufficient effect of investments in technology in reducing costs or improving efficiency in construction projects.	**MRA.4**
	IDV	Lack of measures taken to mitigate the effects of disrupted supply chains on project budgets.	**MRA.5**
Innovation in technology (IIT)	IDV	No impact of adoption of remote collaboration tools on project cost efficiencies.	**IIT.1**
	IDV	The integration of virtual meetings, project management software, and communication platforms has failed to influence cost management in construction projects.	**IIT.2**
	IDV	Insufficient impact of BIM in reducing errors, improving coordination, and optimizing resource utilization in the construction process.	**IIT.3**
	IDV	No impact of integration of automation/robotics in construction processes on project costs.	**IIT.4**
	IDV	No effect of utilization of advanced materials/prefabrication techniques on construction project costs.	**IIT.5**
	IDV	Lack of enhancement of supply chain resilience/digital procurement processes on construction project costs.	**IIT.6**

III.RESULTS

A. *Responses' Statistical Summary*

The SPSS analysis provides a statistical summary of responses for four sets of variables labeled Timeliness and relevance (TR), Economic repercussions (ER), Management of risk and adaptation (MRA), Innovation in technology (IIT), based on a 5-point Likert scale questionnaire as shown in below Table 2 to 5.

1) *Timeliness and relevance (TR) (TR.1 to TR.5)*
   - Sample Size: 223 respondents (no missing data).
   - Mean Scores: Range between 2.39 and 2.57, indicating that responses slightly lean toward lower agreement levels.
   - Variability: Standard deviations range from 1.316 to 1.361, suggesting moderate spread in responses.
   - The most frequent response for all items is either 1 (Strongly Disagree) or 2 (Disagree), reflecting an overall tendency for lower trust perceptions.
   - Minimum and Maximum: Responses span the full range of the Likert scale, from 1 to 5.
2) *Economic repercussions (ER) (ER.1 to ER.6)*
   - Sample Size: Again, all 223 responses are valid.
   - Mean Scores: Range from 2.48 to 2.59, slightly higher than trust, indicating slightly better employee relationship perceptions.
   - Variability: Standard deviations are between 1.287 and 1.399, reflecting consistency in the variability of responses.
   - Mode: Frequent responses vary between 1 (Strongly Disagree) and 2 (Disagree), signaling mixed opinions.
3) *Management of risk and adaptation (MRA) (MRA.1 to MRA.5)*
   - Sample Size: Complete data for all 223 participants.
   - Mean Scores: Values hover around 2.46 to 2.56, suggesting slightly lower perceptions compared to employee relationships.
   - Variability: Standard deviations range from 1.304 to 1.361, reflecting moderate diversity in responses.
   - Mode: Frequent responses mostly center around 1 and 2, similar to trust and employee relationship scores.
4) *Management of risk and adaptation (MRA) (MRA.1 to MRA.5)*
   - Sample Size: Full participation from all 223 respondents.
   - Mean Scores: The range is 2.40 to 2.61, showing slight variation but still indicative of generally lower agreement levels.
   - Variability: Standard deviations from 1.293 to 1.355 highlight moderate variation in responses.
   - Mode: Most common responses are predominantly 1 and 2, consistent with prior categories.

Table 2 Statistical summary of responses TR

		TR (1)	TR (2)	TR (3)	TR (4)	TR (5)
(N) -sample size	valid	223	223	223	223	223
	Missed	0	0	0	0	0
(x̄) - Mean		2.39	2.47	2.55	2.57	2.46
Mean (Standard error)		.089	.088	.090	.088	.091
(M) - Median		2.00	2.00	2.00	2.00	2.00
(Mo) - Mode		1	1a	1	2	1
(σ) - Standard deviation		1.323	1.318	1.341	1.316	1.361
(V) - Variance		1.752	1.737	1.798	1.732	1.853
(R) - Range		4	4	4	4	4
Min.		1	1	1	1	1
Max.		5	5	5	5	5
Summation		532	551	569	574	548

Table 3 Statistical summary of responses TR

		ER (1)	ER (2)	ER (3)	ER (4)	ER (5)	ER (6)
(N) - sample size	223	223	223	223	223	223	
	0	0	0	0	0	0	
(x̄) - Mean		2.57	2.59	2.48	2.52	2.48	2.48
Mean (Standard error)		.094	.089	.089	.086	.091	.089
(M) - Median		2.00	2.00	2.00	2.00	2.00	2.00
(Mo) - Mode		1	2	1	2	1	1
(σ) - Standard deviation		1.399	1.322	1.332	1.287	1.352	1.328
(V) - Variance		1.957	1.747	1.773	1.656	1.827	1.764
(R) - Range		4	4	4	4	4	4
Min.		1	1	1	1	1	1
Max.		5	5	5	5	5	5
Summation		574	578	553	563	552	553

Table 4 Statistical summary of responses MRA

		MRA (1)	MRA (2)	MRA (3)	MRA (4)	MRA (5)
(N) - sample size	valid	223	223	223	223	
	Missed	0	0	0	0	
(x̄) - Mean		2.56	2.53	2.52	2.53	2.46
Mean (Standard error)		.091	.089	.087	.088	.090
(M) - Median		2.00	2.00	2.00	2.00	2.00
(Mo) - Mode		2	2	1	2	1

(σ) - Standard deviation	1.361	1.325	1.304	1.314	1.338
(V) - Variance	1.852	1.755	1.701	1.728	1.790
(R) - Range	4	4	4	4	4
Min.	1	1	1	1	1
Max.	5	5	5	5	5
Summation	570	564	562	564	549

Table 5 Statistical summary of responses IIT

		IIT (1)	IIT (2)	IIT (3)	IIT (4)	IIT (5)	IIT (6)
(N) - sample size	valid	223	223	223	223	223	223
	Missed	0	0	0	0	0	0
(x̄) - Mean		2.49	2.61	2.56	2.58	2.40	2.52
Mean (Standard error)		.091	.088	.087	.087	.089	.089
(M) - Median		2.00	2.00	2.00	2.00	2.00	2.00
(Mo) - Mode		1	2	1	2	1	1
(σ) - Standard deviation		1.355	1.321	1.293	1.298	1.328	1.335
(V) - Variance		1.837	1.744	1.671	1.686	1.764	1.782
(R) - Range		4	4	4	4	4	4
Min.		1	1	1	1	1	1
Max.		5	5	5	5	5	5
Summation		555	581	571	576	536	536

B. Reliability statistics

The internal consistency of the dataset was evaluated through Cronbach Alpha method as a measure of the reliability coefficient. In terms of reliability, a high alpha Cronbach of 0.976 was gotten by using 22 items for the analysis. This means that the items have high internal reliability and are evenly and accurately gauging the construct, which is beneficial for the ensuing statistical analysis of the dataset.

Table 6 Reliability statistics

Cronbach's Alpha	**N of Items**
.976	22

C. Descriptive Statistics

The descriptive statistics table provides an overview of the data collected for various items, including their sample size (N), minimum and maximum values, mean, and standard deviation. For all items (TR.1 to IIT.6), the sample size remains consistent at 223. Each item's lowest and maximum scores range from 1 to 5, reflecting the survey's scale. The items' mean scores range from 2.39 to 2.61, showing that responses tilt slightly toward agreement or neutrality.

The standard deviations, which measure the spread of the data, range from 1.287 to 1.399, showing moderate variability in participants' responses across the items. For instance, IIT.2 has the highest mean (2.61), suggesting a stronger agreement trend compared to other items, while TR.1 has the lowest mean (2.39), reflecting a slightly lower level of agreement. Overall, these statistics provide insights into the central tendencies and variability of responses for each item.

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Table 7 Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation
TR.1	223	1	5	2.39	1.323
TR.2	223	1	5	2.47	1.318
TR.3	223	1	5	2.55	1.341
TR.4	223	1	5	2.57	1.316
TR.5	223	1	5	2.46	1.361
ER.1	223	1	5	2.57	1.399
ER.2	223	1	5	2.59	1.322
ER.3	223	1	5	2.48	1.332
ER.4	223	1	5	2.52	1.287
ER.5	223	1	5	2.48	1.352
ER.6	223	1	5	2.48	1.328
MRA.1	223	1	5	2.56	1.361
MRA.2	223	1	5	2.53	1.325
MRA.3	223	1	5	2.52	1.304
MRA.4	223	1	5	2.53	1.314
MRA.5	223	1	5	2.46	1.338
IIT.1	223	1	5	2.49	1.355
IIT.2	223	1	5	2.61	1.321
IIT.3	223	1	5	2.56	1.293
IIT.4	223	1	5	2.58	1.298
IIT.5	223	1	5	2.40	1.328
IIT.6	223	1	5	2.52	1.335
Valid N (listwise)	223				

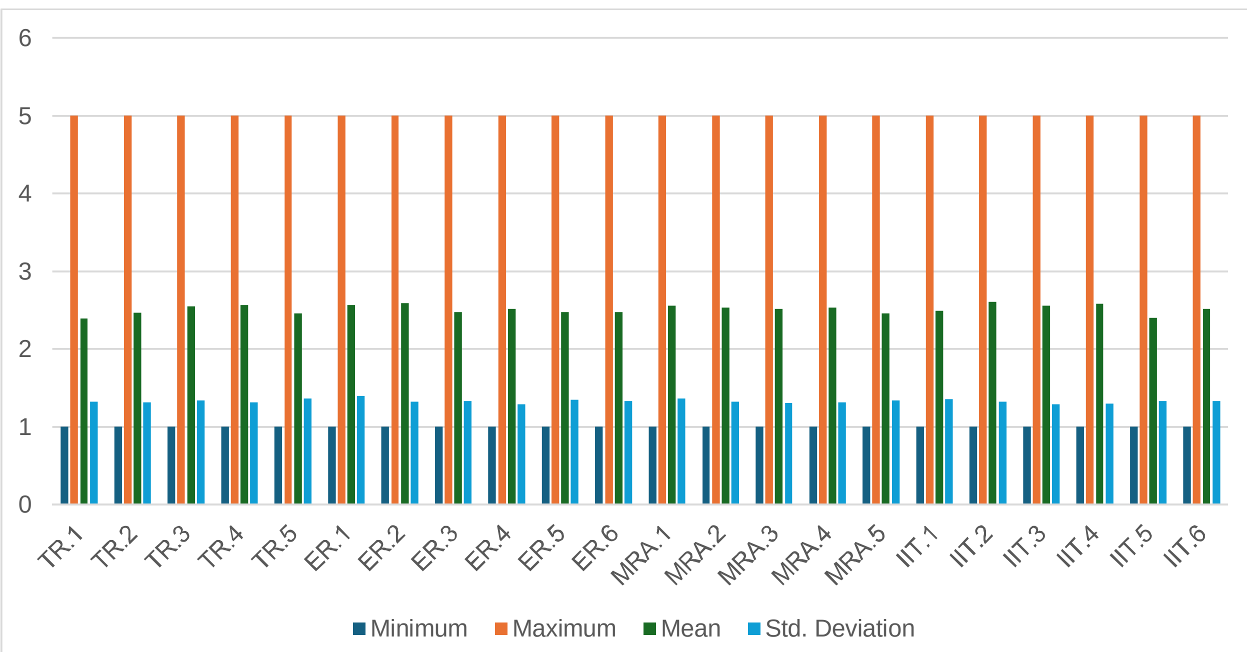

Figure 2. Descriptive statistics

D. T-TEST

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
TR.1	26.919	222	.000	2.386	2.21	2.56
TR.2	27.998	222	.000	2.471	2.30	2.64
TR.3	28.416	222	.000	2.552	2.37	2.73
TR.4	29.206	222	.000	2.574	2.40	2.75
TR.5	26.959	222	.000	2.457	2.28	2.64
ER.1	27.474	222	.000	2.574	2.39	2.76
ER.2	29.283	222	.000	2.592	2.42	2.77
ER.3	27.809	222	.000	2.480	2.30	2.66
ER.4	29.298	222	.000	2.525	2.35	2.69
ER.5	27.347	222	.000	2.475	2.30	2.65
ER.6	27.880	222	.000	2.480	2.30	2.66
MRA.1	28.051	222	.000	2.556	2.38	2.74
MRA.2	28.511	222	.000	2.529	2.35	2.70
MRA.3	28.854	222	.000	2.520	2.35	2.69
MRA.4	28.733	222	.000	2.529	2.36	2.70
MRA.5	27.477	222	.000	2.462	2.29	2.64
IIT.1	27.424	222	.000	2.489	2.31	2.67
IIT.2	29.457	222	.000	2.605	2.43	2.78
IIT.3	29.581	222	.000	2.561	2.39	2.73
IIT.4	29.709	222	.000	2.583	2.41	2.75
IIT.5	27.022	222	.000	2.404	2.23	2.58
IIT.6	28.242	222	.000	2.525	2.35	2.70

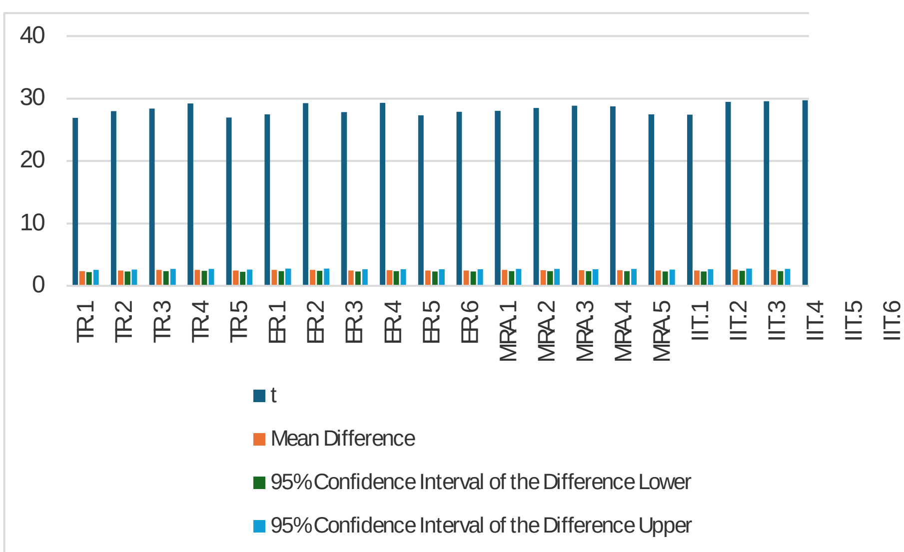

Figure 3. T-TEST

1) All Factors Are Significantly Above 0

- The t-values obtained for each row is substantially high (all above 26) coupled with a p-value of .000 (which indicates p < .001).
- All the mean differences are greater than 0 and thus, the 95% confidence intervals (CIs) for all mean differences do not contain the value of 0.
- Thus, it is safe to say that all factors TR (Timeliness & Relevance), ER (Economic Repercussions), MRA (Management of Risk & Adaptation), and IIT (Innovation in Technology) have mean ratings greater than the neutral baseline mean of 0.

2) Mean Differences Around 2.4 to 2.6

- The "Mean Difference" column has a minimum value of 2.38 and a maximum value of 2.61 i.e. the spread is rough.
- These mean difference values positively support the rating suggesting that participants perceived these post-COVID factors exceptionally favorable.
- Concerning the post-COVID mean differences, there appears to be very low variance which suggests that all respondents perceived these factors to be present or impactful.

3) Practical Implication

- By using zero as your test value, you have set the condition that each factor is not equal to zero.
- In the context of post-COVID phenomena, these factors seem to indicate a significantly positive score suggesting a strong perceived presence (assuming you have set your scale in such a way that higher values imply more impact or greater agreement).

IV. CONCLUSION, CONTRIBUTION AND RECOMMENDATIONS

A. Conclusion

Through this study, the objective that was sought was to determine and analyze particular aspects that have led to a rise in costs of construction in the pandemic era. The COVID-19 pandemic has greatly affected many businesses across different sectors. Changes in logistics, manpower availability, overall budget, and even delays added to the problems within the construction industry.

This study aimed to determine the underlying reasons for excessive expansion in the project finances, which included excessive project timelines, increased safety measures, material scarcity owing to supply chain issues, increased project wages as a result of lack of manpower, and new regulations alongside the changes in economic health. These conclusions were drawn through a quantitative survey alongside qualitative interview with industry experts and key informants.

The results of the analysis suggest that there are a number of issues which have both directly and indirectly affected cost containment within construction projects. There is evidence that most companies have not performed cost containment properly. For example, regulations regarding the use of new innovative safety instruments have been overly strict. This, however, did manage to stabilize costs along with government spending, investment in advanced digital project management, and flexible employment policies. The latter, on the whole, allowed for innovative approaches to cost control in the industry.

B. Contribution

This research contributes to the literature in the following ways to explain cost management in construction projects during the COVID-19 pandemic. First, the work involves an assessment of the possible predictors of construction project costs in the post COVID-19 conditions, and the findings can help in understanding the key changes in the construction industry in response to the crisis.

Second, since the study is an empirical one, it brings into focus the specific areas that construction project managers and other industry players should consider to avoid cases of cost overrun and enhance cost accuracy. The study provides a clear roadmap when it comes to handling the issues of cost in a volatile environment CRM, especially due to the impacts of the COVID-19 pandemic.

Finally, in the study is an emphasis that is placed on the evaluation of strategies of innovation within the domain of materials used in construction and flexible cost management in construction projects. This highlights the importance of better acceptance of innovation and adoption of more suitable technologies, digital tools and communication approaches that should lead to better management practices and, therefore, help reduce costs associated with a traditional approach to construction work.

C. Recommendations

Based on the study's findings, numerous recommendations are made for construction project managers, industry professionals, and politicians to consider in order to better manage construction project costs in a post-COVID-19 scenario.

1) *Strengthen Supply Chain Resilience:* The analysis also pointed out that cost fluctuations were in part caused by supply chain disruptions. In order to solve this problem, project managers should buy materials from different suppliers and strive to develop more effective and elastic supply chains that would help them to manage uncertainties, such as pandemics.
2) *Adopt Technology and Automation:* Application of some of the technologies like BIM, drone and project management software, leads to high efficiency and reduced costs. Applying these technologies may help construction firms to limit mistakes, enhance the certainty of planning, and optimize project delivery.
3) *Invest in Workforce Development and Retention:* It also emerged that there will be a problem of shortage of labor in the post pandemic period. There is therefore a need for the industry to provide training for its talent, and the apprenticeships as well as working on the employee turnover rate as well. Also, increasing the standards of working conditions and using stronger incentives to attract and maintain employees pay rates will go a long way in their realization.
4) *Flexibility in Contract Terms:* Based on the position, flexibility within construction contracts should be established with reference to situations such as disease outbreaks and functional disruption in construction environments in post-pandemic period. These provisions can be to the advantage of an organisation in managing its costs since flexibility can be achieved more especially on timelines and costs of projects.
5) *Enhance Collaboration and Communication:* On the silver level, the following were identified to have an impact on cost risks; awareness of stakeholders on the issue; contractors, suppliers, and clients all played a central role in cost risks control since they have to communicate a lot for efficient running. To manage external projects, project managers should encourage work in an open and collaborative environment, utilizing digital media to ensure that they are informed, thus enable them to make faster sound decisions in absence of constant contact.
6) *Policy and Regulatory Support*: Government officials can therefore help facilitate construction sector’s bounce back. Efforts by the current government in devising ways of helping the construction firms gets some form of financial support, tax breaks or some form of relief package as a result of the COVID-19 impact can go along way in easing the impacts felt. Besides, clearing the bureaucratic processes can ensure that the project gets approved faster without much delay.

In conclusion, this study may serve as a starting point for dealing with cost-related challenges in the construction industry in the post COVID-19 world while recognising the enormous various challenges this industry has experienced. With these recommendations, it will be possible for the stakeholders to manage the ongoing uncertainties and towards the development of long-lasting construction environment that would favour efficient costs.

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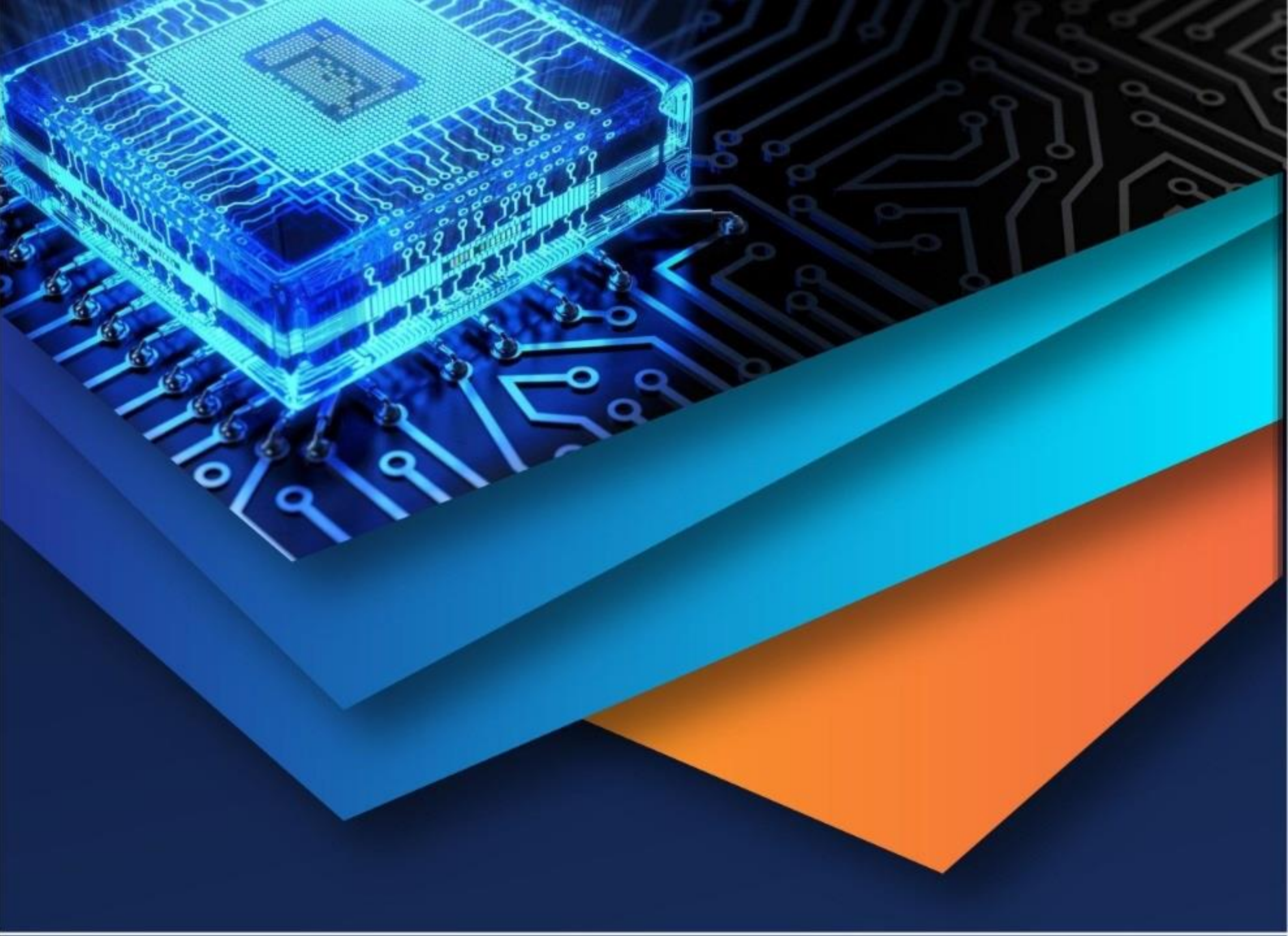

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