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Investigation of Price Escalation and Its Mitigation Mechanisms on Selected Building Construction Projects of Jimma University

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ABSTRACT

Fee escalation in construction refers to a boom in the price of an item inside the preliminary agreement or the bottom cost of an undertaking. racking production mission fees must be an ongoing procedure that must always be carried out on all projects, because the reasons for which the price will increase vary from project to project and due to the construction segment. The motive of this observation was to assess fee escalation, escalation factors and mitigation mechanisms in deciding on construction initiatives. From February 1 to 30, 2020, a questionnaire was administered to twelve workers and interviews with seven key informants were conducted for an in-depth look at four selected Jimma University construction projects, which were project A to project D. Relative importance index values were generated and ranked for the elements affecting fee escalation to see their relative significance. It was found that there has been a moderate degree of charge increase within the initiatives studied, from 12% to 21%. The mitigation modalities observed with the aid of the projects, particularly inserting escalation clauses in contractual agreements, making changes requiring funding and increasing time limits, seem to be inadequate, as they do not provide a foundation for choices and remedy of disputes instead of mitigating the escalation of tasks starting from 3.21% to 12%.

KEYWORDS: Escalation, Mitigation, Price, Construction projects.

INTRODUCTION

Construction makes an important contribution to the economy of developing countries. This is because the construction industry builds infrastructure for other industries, creates jobs and transfers technology and entrepreneurship, because in developing countries construction takes place throughout the country (Ofori, 2007). Ethiopia is a developing country with a long development path. Investing in infrastructure development, in which the construction industry plays a leading role, is one of the key factors facilitating the achievement of the desired level of development in a developing country like ours (Johri and Olds, 2014). Understanding and measuring the concepts and different aspects of cost escalation are always important, so that various corrective actions can be taken to reduce costs. Consequently, the presence of a price escalation, its magnitude and related factors need to be thoroughly studied and investigated. Accordingly, the main objective of this study was to synthesize a general understanding of the problems related to price escalation in construction projects, with the aim of finding out the status of the price increase, the reasons for the escalation and the way in which the contracting parties have responded to or mitigated it. This document is the authors' original work and has never been used in any other research.

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MATERIALS AND METHODS

This research was carried out in Jimma town, which is 352 kilometers southwest of Addis Ababa and has a latitude of 7° 41' 3.59" N and a longitude of 36° 49' 31.79" E. Various building projects are underway in Jimma town. Jimma University's various construction projects are among the major public-owned construction projects in the area. This research has been conducted on four Jimma University building construction projects. The study was carried out (data collection period) from February 1 to February 30, 2020, according to the Gregorian calendar.

Population and Participants

This particular study focuses on four selected projects belonging to Jimma University, designated projects A to D for the purpose of this study. Because these are large projects, they are geographically close to each other and have approximately the same start time. They also belong to one of Jimma University's public-sector clients. Studying them individually, without including other projects, will give a clear and complete view of this purpose of this study. The research team involved a variety of stakeholders in construction projects. The various parties involved in these construction projects included as respondents to the survey representatives of contractors, consultants and clients.

All experts from these three stakeholder categories can be considered the study population. Excluding administrative functions, such as finance and human resources and sub-contractors, there are a total of 20 people. The management felt that there was not much information about price increases, the factors affecting price increases and the mechanisms of their effects. The number was small, because two of the projects were implemented by one contractor and the other two were implemented by another contractor. For a case study, different working documents of the project can be considered a study group.

Sampling Technique

To obtain adequate information from different perspectives, surveys of different respondents were issued. In each of the selected projects, all sites, constructions and offices are selected. Engineers, surveyors, project managers, consultants and two representatives of the client were included in order to give a total of 20 survey respondents. Since their number is small, questionnaires were distributed to all of them. For an in-depth interview, a total of seven respondents, including project managers, consultants and office engineers from each project were taken purposively. This sampling was carried out with the assumption that they are richer in information about the study topic than other professionals in the respective projects. From the voluminous working documents, the contractual papers, general bills of quantity (BoQ), claims of variation orders and time extension, schedules, the financial summary reports from the last interim payment certificate (IPC 39), proforma report sheets and salary increment letters were reviewed for the case study. Generally, the samples for each method of data collection are depicted in Table 1.

Price Escalation

Delays and increased costs have significant impacts on project success depending on the type and scope of the project, but it is essential to identify who is responsible for such delays and cost increases (Hammad et al., 2008). Operationally, in this study, price escalation can be understood as the difference between the actual cost used for the work and the adjusted bid cost. Generally, escalation was calculated in two ways.

1. To calculate the magnitude of price escalation:

$$PE = Actual\ Cost(AC) - Adjusted\ Cost(ABC)$$ *Equation 1*

2. To calculate the percentage of price escalation:

$$PE = [\ AC - ABC\ ] * 100\ /BC$$ *Equation 2*

where

- *AC* is the actual cost.
- *ABC* is the bid cost as adjusted for the stage of work executed. For example, if the construction is executed at 40%, the ABC will be 40% of the bid cost. The ABC is equal to the bid cost for the complete project.

$$ABC = [\ BC * \%\ of\ work\ executed\ ]\ /100$$ *Equation 3*

BC is the bid cost which is the contract cost.

Table 1. Information matrix of the price escalation study at Jimma University building projects, Ethiopia, February 2020

Variables	Data-collection methods	Data-sources	Data-collection tools
Cost/price data	Document review	Different archives or documents	Checklist for data extraction
Factors affecting escalation	Literature review Survey Interview Document review	Literature Respondents to survey Informants crucial Archives and documents	Notebooks Questionnaire Interview guide Data extraction checklist
Escalation mitigation	Survey Interview	Survey respondents: Key informants	Interview Questionnaire guide

Data Processing and Analysis

Both the primary and secondary data were first prepared, Enter SPSS (Statistical Packages for Social Sciences), version 20 as well as an Excel sheet. SPSS was used to run general descriptive statistics while Excel was used to perform common arithmetic calculations and create graphs. The magnitude of price escalation was calculated and expressed in terms of numbers, percentages and averages. To determine the importance of the identified factors associated with price escalation, relative importance index (RII) scores were calculated. The RII was calculated from respondents' actual scores of the frequency of occurrence of the factors as follows (Ahmed et al., 2018):

$$RII = \sum W / (N * A) \qquad \textit{Equation 4}$$

where,

W is the weight that respondents give to each escalation element ranging from 0 to 4.

A is the maximum value out of 4 that the variable or factor has got.

N is the number of respondents who rated the factor or variable. Qualitative data was organized systematically and triangulated with related quantitative data. Finally, the results are presented in text form, tables and figures.

RESULTS AND DISCUSSION

Description of the Projects

The study included four construction projects labeled project A, project B, project C and project D, since for the sake of privacy, it would not be good to mention them by name. Two of them were being constructed by one foreign contractor and the other two by another local contractor.

Concerning contract price, project B was the most demanding one and required 791,244,083.85 ETB, whereas project D was the least expensive one (144,323,492.00 ETB). Considering the stage of work progress to date, project D was a completed project and the other three were ongoing. Project D was completed in March 2019 after nearly 4 years of delay. Some additional details of the projects are reported in Table 2 and Table 3.

Table 2. Contract price and time of Jimma University selected construction projects

Project	Contract Price	Starting Time	Expected End Time
Project A	686,511,964.39	June 2015	Nov. 2017
Project B	791,244,083.85	Mar. 2015	Aug. 2017
Project C	596,878,190.41	Mar. 2015	Feb. 2016
Project D	144,323,492.00	Sep. 2014	Jun. 2015

Price Increase Assessment

Price escalation in the construction projects of Jimma University was computed by comparing the contract or bid price that is adjusted for the stage/phase of work progress and the actual expensed money.

Table 3. As of February 2020, the present work progress and budget utilization status of Jimma University construction projects

Projects	Current Executed Budget (AC)		Progress at Work (%)	Work Expense Equivalent (ABC)	Escalation	
	Amount	(%)			Amount (ETB)	(%)
Project A	578,081,649.08	84.21	81	556,074,691.2	22,006,957.92	3.21
Project B	245,360,116.25	31.01	32	253,198,106.8	-7,837,990.58	-0.99
Project C	633,820,142.20	106.19	94	561,065,499	72,754,643.21	12.19
Project D	150,801,486.33	104.49	100	144,323,492	6,477,994.33	4.49

As depicted in Table 3, except for project B, only 32% of which was completed, the other three projects have experienced price escalation. To put these quantifications into perspective, project A experienced a price escalation of 3.21% (22,006,957.92 ETB), project D a price escalation of 4.49% (6,477,994.33 ETB) and project C a price escalation of 12.19% (72,754,643.21 ETB). The arithmetic mean of price escalation of the three projects was 6.63%, 4.73% and 4.73% when project B was considered. When we calculate the total escalation in ETB, it was about 93,401,604.88 ETB (for all projects) and 101,239,595 ETB when we consider only the three projects, excluding project B.

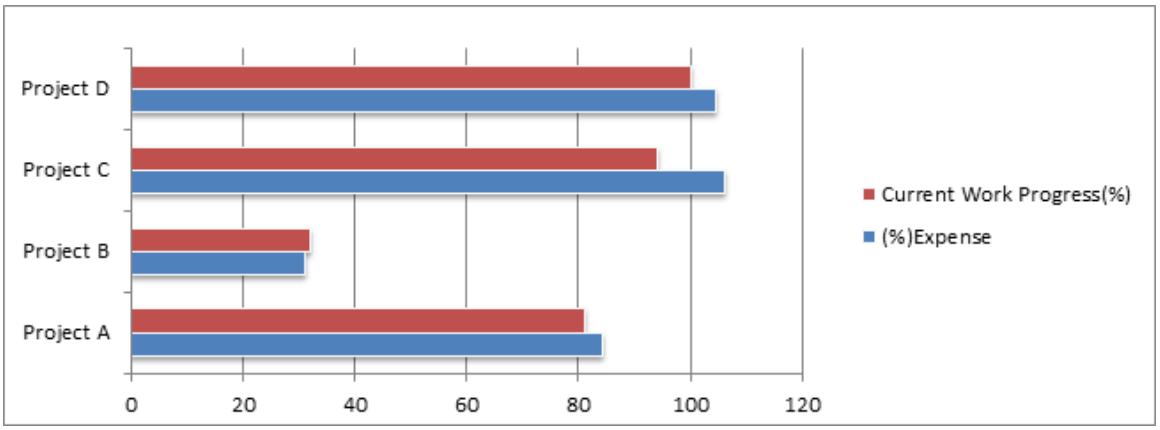

Figure (1): The percentage of work and financial expenditure on Jimma University construction projects

Project B, let alone experiencing price escalation, did not fully use its allotted budget, because the actual cost used to complete the work is lower than the budget allocated for the completed work. However, it is more probable that even this project will experience price escalation in the future for two very important reasons. First, the phase of construction or work progress is only one-third (32%), which implies that the project is only in its early phase of construction given that it is the largest of all the studied projects concerning the budget. Another reason for the presumed price escalation is a delay. The project was assumed to be completed in 2017. But, even at this time, in February 2020, the construction is still ongoing, which means that until this time, there are two and a half years of delay. If it continues at this speed, assuming that the reasons are constant and not yet solved, the project will face nearly 8 years of delay when it is completed. Therefore, these

pieces of evidence indicate that it is highly probable that the project will experience price escalation in its remaining work. Various kinds of literature state that in the construction industry, price escalation is almost inevitable, especially in large complex projects. Larger projects are more prone to delay, the addition of a volume of work and uncertain conditions; hence, it is more likely that they will experience escalation (Yogeswaran et al., 1998; Cunningham., 2017). If so, we can generalize that almost all of the projects experience price escalation. Of the twelve survey respondents, nine of them believed that there was a price escalation in their projects, while three of them did not. Those respondents who were working on project C and project D believed that their organizations did not experience price escalation. This may be because projects C and D were nearly completed and completed, respectively, which has raised the respondents' morale to say that their project is successful.

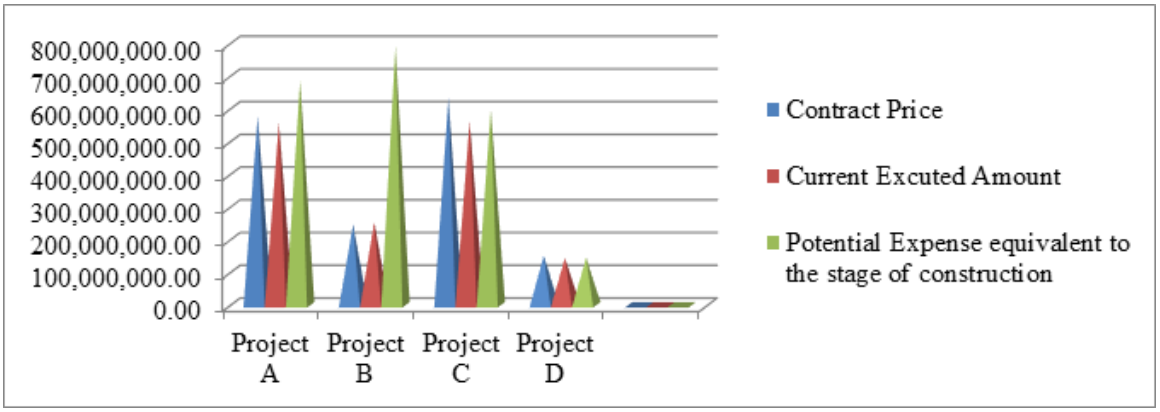

Figure (2): The bid and executed budgets of Jimma University construction projects

Generally, it can be said that there was price escalation in all of the studied construction projects, which ranged from 3.21% to 12.19%. But, since the projects are ongoing, the escalation may exceed these figures when the projects are completed. This is because, as will be discussed in the case study (project A), even if the project is at 81% of work completed at the time of the study, it is estimated that the final price escalation will reach nearly 9.70% after the project. We infer from this statement that all the ongoing projects will have additional escalations. As compared to other study findings and reports in Ethiopia, these figures cannot be considered as warranted; they are justifiable. Ethiopian literature reported that road projects must have escalations up to 83.20%, with an average of around 21% (Koshe and Jha, 2016). Another professional report in Ethiopia stated that there is a shortage of some construction inputs in the study area, leading projects to experience price escalations of up to 28% (Ikechukwu et al., 2017). When we compare the escalation of price obtained from the current study to these Ethiopian sources, the current study finding is moderate. This may be for different reasons. First, three of the projects in this study are ongoing projects which are yet to face escalation in the future, since all of them have delays. Another reason for the observed variation may be that the previous studies and reports are not specific to building construction projects, probably implying that there may be escalation differences based on the type of project. Another plausible explanation is that of time variation between the previous studies and the current study. As time goes on, project parties may learn from their experience about good project management. The capacity of contractors may be another reason. Both of the contractors for the projects selected for the present study had many years of experience and good material and equipment capacities.

Factors Influencing Price Increases

Table 4 shows the relative importance based on a survey of Jimma University construction project participants in February 2020. From Tables 2 and 3, we can understand that in all of the projects there is a time overrun (project delay). The respondents also confirmed, as presented Figure 5, that delay is one of the major factors contributing to escalation. From

theoretical evidence, it has been reported that one of the factors for price escalation is delay (Ayalew et al., 2016). When there is a delay, the values for cost escalation are uncertain (Shane et al. 2009). If the duration of project development is longer, the project probably experiences price escalation (El-Sawalhi and Eleyan, 2022), because when there is a delay, the cost would be subjected to inflation (Amoa-Abban and Allotey, 2014). Therefore, based on theoretical and empirical evidence, we can infer that one of the contributing factors to the observed price escalation in the studied projects is project delay.

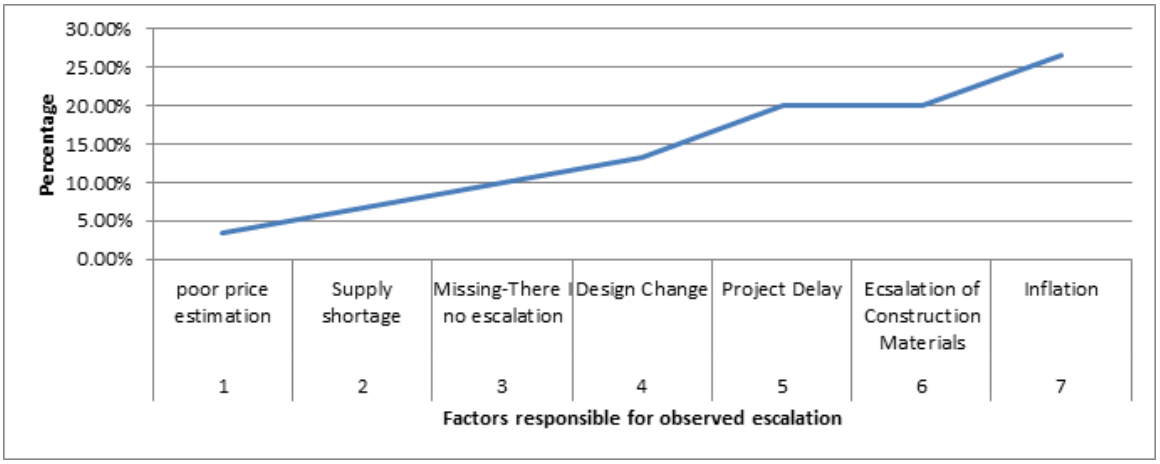

Figure (3): Variables mentioned as factors of price escalation among Jimma University construction projects, February 2020

From Table 4, we can understand that in all of the projects there exists a time overrun (project delay). From theoretical shreds of evidence, it has been reported that one of the factors for price escalation is delay. Therefore, we can infer that one of the contributing factors to the observed price escalation in the study projects is project delay. Respondents were further asked about which category of construction inputs experienced price escalation. Accordingly, all of the respondents mentioned that they experienced price escalation in construction materials and five of them (41.7%) said that there was an escalation in labor prices. But, only three (25%) and two (16.7%) respondents mentioned that there was an escalation in the construction equipment and overhead costs, respectively. Those respondents who believed that there was price escalation in their project were asked to rate the frequency of occurrence in the current project of different empirically known factors (Musarat et al., 2021). The relative important index (RII) was calculated for each of the factors based on the frequency of occurrence of known factors, which were classified as client-related, contractor-related, consultant-related, internal and external. The table indicates the categories of factors of escalation that are classified and ranked based on their RII score, which is rounded to two decimal points.

Table 4. Based on the perception scores of study participants from Jimma University construction projects, February 2020, this index measures the relative importance of the various factors that contribute to price increases

S. no.	A. Client–related factors	Rating of Factors			
		W	RII	Rank	Mean
1	Unrealistic schedules	26	0.72	1	0.65
2	Slow decision-making	33	0.69	2	
3	Changes /additional work orders	30	0.63	3	
4	Delay in handing over of the site	30	0.63	3	
5	Delay in the contract award	22	0.61	4	

	B. Contractor–related factors				
1	Financial difficulties	32	0.67	1	
2	Low bid	30	0.63	2	
3	Planning and scheduling deficiencies	27	0.56	3	
4	Non-availability of a sufficient number of skilled labor	20	0.56	4	
5	Lack of coordination between project participants	25	0.52	5	0.59
	C. Consultant-related factors				
1	Slowness in giving instructions	25	0.69	1	
2	Poor coordination/communication between consultants & other parties	23	0.64	2	
3	Poor inspection plan by consultant	22	0.61	3	
4	Poor site management by contractor	20	0.61	4	0.62
5	Lack of sufficient experience of consultant	20	0.56	5	
	D. Internal factors				
1	Changes to the project's schedule	24	0.67	1	
2	Engineering and construction complexity	23	0.64	2	
3	Ambiguity in contract provision	28	0.58	3	
4	Delivery/procurement approach	21	0.53	4	0.56
5	Poor estimation	23	0.48	5	
6	Inconsistency in the application of contingencies	23	0.48	5	
	F. External factors				
1	Fluctuations in the money exchange rate	37	0.77	1	
2	Increase in demand for construction materials	34	0.71	2	
3	Material cost increases	34	0.71	2	
4	Productivity	25	0.69	3	
5	Shortage of labor/skilled	24	0.67	4	
6	Local concern	20	0.61	5	
7	The limited capacity of material producers	29	0.60	6	0.63
8	Bad weather conditions	21	0.58	7	
9	Change in legislation	18	0.55	8	
10	Environmental impact	19	0.53	9	
11	Site condition	18	0.50	10	

When we compare the importance of different factors of price escalation based on their relative importance index score, some major findings are as follows. From a simple observation of the scores, we can say that client-related factors are more dominant, followed by consultant-related factors and then by contractor-related factors. This is verified by the support of descriptive statistics, yielding mean relative importance index scores of 65%, 62% and 59%, respectively. From client-related factors, unrealistic schedules were rated as the top important factor (RII = 72%), while extra work orders and delays in handing over the site were equally ranked as the third important factor (RII = 63%). On the other hand, "delay in the contract award" was ranked by the respondents as the least important (with RII = 61%) client-related factor.

When we analyzed the contractor-related factors similarly, the top most important factor was found to be "financial difficulties" (RII =67%), while "lack of coordination between project participants" was ranked as the least important variable (RII =52%).

Likewise, among consultant-related factors, "slowness in giving instructions" was rated as the most important factor (RII =69%), while "lack of sufficient experience of consultant' was the least important factor (RII =56%).

When comparing the internal and external factors of price escalation, it is clear that external factors are

weighted more than internal factors, with a mean relative importance index score of 63% and 56%, respectively. To describe the two categories of factors separately, we can scan from the table that 'project schedule change', with an RII score of 67%, was ranked as the first most important internal factor, while from the eleven external factors, 'fluctuations in the money exchange rate' is the top factor on the list (RII =77%). The 'increase in material cost' and the 'increase in demand for construction materials,' both of which can impede timely and sufficient supply of construction inputs, were ranked as the second most important external factors (RII = 71%). It seems that "site condition" was not a difficulty as compared to other external factors, since it was rated as the least important external factor with an RII of just 50%. Among the internal factors, "poor estimation" and "inconsistency in the application of contingencies' were equally valued as the least important factors for the observed price escalation (RII = 48%).

Price-escalation Mitigating Mechanisms

Of nine of those respondents who believed that there was price escalation in their project, eight of them responded that the action taken to mitigate the escalation was 'claiming for compensation', while one responded that the measure was 'absorbing the effect on the profit margin'.

When survey respondents were asked about which of the construction materials they took escalation mitigation measures for, the majority mentioned cement (26.3%), reinforcement (23.7%) and fuel (21.1%) as the three top priorities.

The respondents were asked to suggest what intervention their project should take to mitigate the observed price escalation in construction materials. The following are the major statements that show the workers' perception of how their project can mitigate material price escalation. One consultant described the measures to be taken as *"first preparing a material schedule for the overall work for the project and listing out major items of material and purchasing them at an early stage of work to reduce the extra cost of material purchasing"*. Another respondent, who is a project manager, stated the necessary measure as "*completion of the project within the given time. I mean helping the contractor to get the necessary payments, drawings, … etc. on time, so that there will be no delay*. These two statements imply one major solution to mitigate price escalation. That is solving the delay, which was the major cause of escalation. The statements further pointed out that the mechanisms of mitigation should focus on addressing the causes of delay, which can be considered as root causes of price escalation.

In line with the above standing, the respondents mentioned the solutions to price escalation as' training of staff and reducing turnover for increasing effectiveness or productivity; proper monitoring based on schedule; efficient resource planning; and incorporating price escalation clauses in the contract agreement'.

Interviewees have said that their project has been asking for financial claims to mitigate price escalation, stating that the contracts allow price escalation. Accordingly, one interviewee stated the mitigation mechanism as *"by adapting the price escalation formula which is stated on GCC for items stated on FPPA"*. Similarly, another respondent took note that financial claim is possible to mitigate price escalation, mentioning a legal basis by saying "*using the formula of PPA 2006(GCC and SCC)..."*.

Contrary to this, one interviewee suggested another way of controlling price escalation, recommending *"reduction of costs of goods, lowering tariffs and lowering distribution costs"* to mitigate the price escalation.

CONCLUSION

We can conclude that even if price escalation has occurred in three of the four studied construction projects so far, it is highly probable that escalation will occur in all of the projects when they are completed. The magnitude of escalation varies among the construction projects, but generally, the level of escalation is only moderate.

On close examination of the findings, it would be more likely to conclude that the project price escalation and the majority of the factors are highly preventable or controllable. Some of the findings also suggested that there were problems in planning, like scope determination and time forecasting, as well as budget underestimation, all of which can be considered as factors for price escalation. The well-practiced

escalation mitigation mechanisms were claiming for finance, time extension and making escalation adjustments whenever there was cost escalation of the construction inputs. To ensure the legality of these actions, the parties included clauses in the contract document. Therefore, contractual clauses may be seen as one of the mitigation mechanisms applied. But, this is not a guarantee to mitigate escalation; rather, it only governs the parties' behaviors or actions and solves legal disputes. Hence, it may be difficult to consider it as an escalation-mitigation mechanism. Therefore, it is nearly plausible to conclude that there was a poor application of escalation-mitigation mechanisms.

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REFERENCES

Ahmed, S., Memon, A.H., Memon, N.A., Laghari, A.N., Akhund, M.A., and Imad, H.U. (2018). "Common factors of cost escalation in construction industry of Pakistan". Engineering, Technology & Applied Science Research, 8 (6), 3508-3511.

Amoa-Abban, K., and Allotey, S. (2014). "Cost overruns in building construction projects: A case study of a government of Ghana project in Accra". Developing Country Studies, 4 (24), 54-64.

Ayalew, T., Dakhli, Z., and Lafhaj, Z. (2016). "Assessment on performance and challenges of Ethiopian construction industry". Journal of Architecture and Civil Engineering, 2 (11), 01-11.

Cunningham, T. (2017). "What causes cost overruns on building projects?- An Overview."

El-Sawalhi, N., and Eleyan, A. (2022). "Factors affecting cost escalation in construction projects in Gaza strip." Available at: SSRN 4146414.

Hammad, A.A.A., Ali, S.M.A., Sweis, G.J., and Bashir, A. (2008). "Prediction model for construction cost and duration in Jordan". Jordan Journal of Civil Engineering, 2 (3), 250-266.

Ikechukwu, A.C., Fidelis I.E., and Kelvin, O.A. (2017). "Causes and effects of cost overruns in public building construction projects delivery in Imo State, Nigeria". J. Bus. Mgt., 7, 13-20.

Johri, A., and Olds, B.M. (2014). "Cambridge handbook of engineering education research". Cambridge University Press.

Koshe, W., and Jha, K. (2016). "Investigating causes of construction delay in Ethiopian construction industries". Journal of Civil Construction and Environmental Engineering, 1 (1), 18-29.

Musarat, M.A., Alaloul, W.S., and Liew, M. (2021). "Impact of inflation rate on construction projects' budget: A review". Ain Shams Engineering Journal, 12 (1), 407-414.

Ofori, G. (2007). "Construction in developing countries". Construction Management and Economics, 25 (1), 1-6.

Shane, J.S., Molenaar, K.R., Anderson, S., and Schexnayder, C. (2009). "Construction project cost escalation factors". Journal of Management in Engineering, 25 (4), 221-229.

Yogeswaran, K., Kumaraswamy, M.M., and Miller, D.R. (1998). "Claims for extensions of time in civil-engineering projects". Construction Management & Economics, 16 (3), 283-293.