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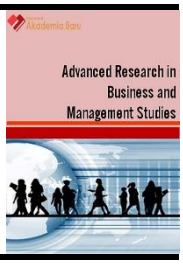

Analysing the Project Delay Causes and Improving Quality using Multi-Project Strategies

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ABSTRACT

Numerous reasons for project delays from the viewpoints of the client and the contractor have only been somewhat studied. The aim of this paper is to recognize the delays' underlying causes and issues ways to reduce them considering the progress of the project. Consequently, 106 contractor-side experts and 82 client-side experts in project management were the subjects of this study. The clients and contractors gave the same importance to factors like poor communications and governmental approvals in projects that were successful (had a time delay of less than 10%). Similar mitigating techniques including rigorous project monitoring, skill development training, and effective logistics planning were advised. When projects were unsuccessful (with a time delay of more than 10%), they displayed a wide range of behaviours.

1. Introduction

Delays come in a variety of forms, and academics use their own criteria to rank and recognize them. Delays can occur for a variety of causes, which vary from project to project and are particularly special to each project. Progress in reducing the delay via mitigation or remove the delay through acceleration are actions that can or may be appropriate in certain situations, depending on the projects under consideration.

The major reason of a delay is changes. If no adjustments are made to projects, they will be completed on schedule since there will be no or little disruptions to the work. Contractors would also like to work on projects where the plans have been finished and there have been no alterations or interruptions. In an ideal world, all construction projects would be completed on schedule, with no adjustments or disruptions. Contrary to belief that contractors cannot wait for

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adjustments to begin on a project since that is where they purportedly "make their money," most contractors would want their projects to be completed without alterations" [1].

Nevertheless, this is a utopian condition; in reality, adjustments are inherent in practically all large-scale projects owing to the fact that projects seldom begin until all drawings have been finalized and authorized. It is critical that all of the project's major stakeholders agree on how and by whom the project's modifications will be handled. This is in the best interests of the project since it benefits both the client and the contractor. The constant strive for progress necessitates the incorporation of modifications, even if they may cause some disruption to the job.

The stage at which modifications are recommended to be incorporated is critical since any large adjustments offered once the project is nearing complete would complex the operation, damage the timeline, and potentially create delays in completing. The alterations will raise the project's cost since failed works, modifications, and revisions will incur costs. A changed in work complicates a project, promotes delays, and raises project costs - all of which make owners dissatisfied [1]. A thorough literature research is conducted for the objectives in order to assess the kinds, causes, and solutions for delay prevention and mitigation.

2. Methodology

The Table 1 below shows research methodology and data processing methods have been used to improve the methodology for this research note in order to strengthen the timeline of the project and the existing integrated system.

Table 1
Methodology of the research

Research Objective	Research Question	Instrument & Data Collection	Deliverables
To identify leading causes of project delayed	What is the reason platform system has been delayed?	Literature review Project timeline and progress	Delay of project planning schedule Delay on project progress
To measure the causes of project delayed using questionnaire	Why have delays on the project? What is the sequence of delay? What is the effect of delay?	Questionnaire scope on workers who are involved in project management	Project performance Project planning schedule
To propose an improvement quality using multi-project strategies	How to improve the project quality?	Existing project	An improvement of project delay

2.1 Operational Framework

Operational framework on Figure 1 shown was divided by three stages follows by three objectives. On first stage which is knows as Objective 1 will compile related literature review like a journal paper, article, books etc. as a reference. And follow by project timeline and progress had been created.

On second stage or Objective 2, during this stage the researcher provides a one thousand sample to be fulfil by a respondent which must be workers involving the project. The respondents

will be giving about one month or less to complete a questionnaire and submit to researcher to compile and analyses the result before finalizing.

After finalizing the result, on last stage or Objective 3 to consider the solution and improvements improvise the quality of project and redesign timeline progress be more efficient.

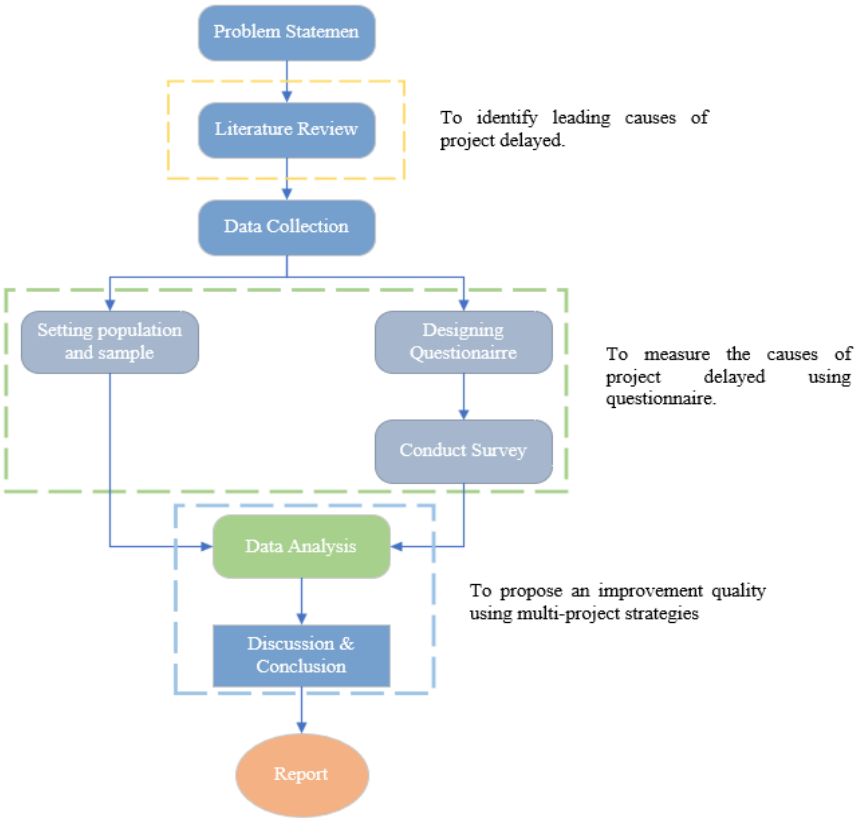

Fig. 1. Operational framework of project delay

2.2 Questionnaire Design

2.2.2 Delay factors

This study derived the causes of delay in the literature review and grouped them in five categories as shown in Table 2. These delay factors were used in the questionnaire survey. The questionnaire asked the respondents to evaluate the importance of causes of delay based on their experience with projects. The importance levels were measured using five-point Likert scales: one point (less than 1-month delay); two points (approximately 1-month delay); three points (approximately 2-months delay); four points (approximately 3-month delay); five points (more than 3-months delay) [18,19].

2.2.3 Mitigation strategy factors

The study summarizes the delay mitigation strategies found in the literature review that contribute to project success as shown in Table 2. The mitigation strategy factors were used in the questionnaire survey, in which the respondents weighted the importance using five-point Likert scales. The importance levels were measured using five-point Like scales: one point (very low, approximately 0–20% contribution); two points (low, approximately 20–40% contribution); three

points (medium, approximately 40–60% contribution); four points (high, approximately 60–80%); five points (very high, approximately 80–100%).

Table 2
Summary of delay mitigation strategies

Group	Number	Delay Causes	References
Client-related	O1	Change in scope	[14-18,20-24]
	O2	Owner's poor supervision	
	O3	Poor communication and coordination	
	O4	Delays in approval	
	O5	Delays in procuring materials	
	O6	Lowest bid tender award	
	O7	Owner's inadequate funds or budget allocation	
	O8	Damaging materials/equipment during progress	
Contractor -related	C1	Poor quality materials and equipment	[14,17,21-24]
	C2	Poor cost management	
	C3	Poor project planning and scheduling	
	C4	Contractor's poor site supervision	
	C5	Additional work attributable to mistake	
	C6	Misrepresentation of information before bid	
	C7	Poor cost estimation	
	C8	Contractor's late payment to suppliers or works	
	C9	Late procurement order of material and equipment	
	C10	Change in types and specifications	
Design-related	D1	Design changes during construction	[17,21,24,25]
	D2	Inappropriate data collection	
Infrastructure and socially related	I1	Worker's absenteeism	[14,17,20,21,24]
	I2	Workers' low motivation and morale	
	I3	Worker's strikes	
	I4	Poor working conditions	
	I5	Unskilled or inexperienced labour	
	I6	Late delivery of material and equipment	
	I7	Delay in obtaining permits from authorities	
Externally related	E1	Force Majeure attributable to natural disaster	[14,17,22-24]
	E2	Unexpected geological condition	
	E3	Political instability or controls	

2.3 Survey

The authors circulated 300 questionnaires electronically to different professional project clients and contractors [26]. Table 3 describes the respondents' profiles experience of the respondents. All respondents were asked to evaluate the causes of as mitigation strategies based on their project experiences. One-hundred ninety-nine responses were collected and one hundred eighty-eight were confirmed valid. Eighty-two responses were collected from the project client group and 106 from the project contractor group, as shown in Table 4. Figure 2 indicates the project profile to

which the respondents referred to answer the questions. The distribution of (b) projects planned, and schedule performance varied and is relatively uniform. (a) Project types are skewed slightly toward distribution rather than power generation and transmission projects.

Table 3
Respondents' profiles experience

Number	Mitigation Strategy Factors	References
M1	Proper planning of project financial arrangements	
M2	Use of skilled labours with experience on similar projects	
M3	Consideration of donor's influence	
M4	Close project supervision	
M5	Use of suitable time estimation skills	
M6	Conducting capacity training	
M7	Timely procurement and supply of materials and equipment	
M8	Timely payments of completion certificates	[2-13]
M9	Proper presentation of information during tendering	
M10	Finishing design on time	
M11	Timely site visits	
M12	Motivating workers to raise morale	
M13	Risk identification and assessment	
M14	Proper logistics management	
M15	Top management's support	

Table 4
Respondent and years of experience

	Owner		Contractor		Total	
	Number (Respondents)	Experience (Years)	Number (Respondents)	Experience (Years)	Number (Respondents)	Experience (Years)
Project Manager	37	8	27	2.5	64	13
Engineer	32	13	48	13	80	8
Technicians	9	25	20	8	29	2.5
Consultants	4	15	11	15	15	15
Total	82		106		188	

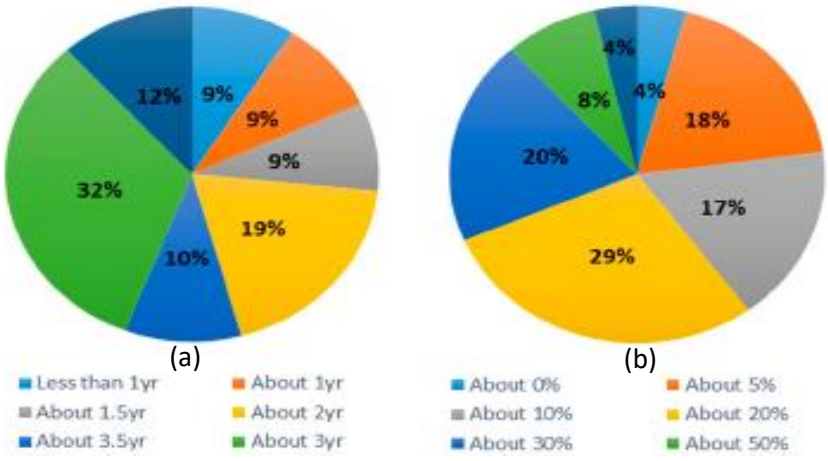

Fig. 2. Percentage of project profile (a) and (b)

3. Results

3.1 Causes of Delays in Successful Projects

Table 5 depicts the causes of delays in successful power projects. Several causes namely client's insufficient financing or budget allocation (O7 1st Rank), the contractor's late payment to suppliers or workers (C8 2nd Rank), late delivery of supplies and equipment (I6 3rd Rank), and delays in acquiring permissions from authorities (I7 4th Rank) are rank highest in the overall group.

The final four in the client group include insufficient money or budget allocation (O7 1st Rank), late delivery of supplies and equipment (I6 2nd Rank), unskilled or inexperienced labour (I5 3rd Rank), and changes in scope (O1 4th Rank).

The contractor's late payment to suppliers or workers (C8 1st Rank), lowest bid tender award (O6 2nd Rank), delays in sourcing supplies (O5 3rd Rank), and inadequate communication and coordination (O3 4th Rank) are the final four in the contractor group. The top four delay issues were identified by the client and contractor groups.

Contractors evaluated late payment to suppliers or labour (C8), lowest bid tender award (O6), and inadequate communication and coordination (O3) much higher than clients. Contractors' late payments to suppliers or personnel are the result of financial difficulties. Furthermore, it is quite usual to encounter incidents when a contractor or subcontractor who has not been paid in full intimidates workers or suspends contract activity until the remainder is paid in full.

Tendering for the lowest offer is a big problem for contractors, and it frequently results in poor performance. Contractors may offer the lowest price in order to get the contract, but they may then use low-quality procedures to save money. As a result, this aspect has a higher impact on the contractor than on the client. Work overload, poor communication techniques on the side of workers, imprecise and inconsistent site information, and misreading of orders can all lead to poor communication and cohesion.

Table 5
Causes of delays in successful power projects

Group	Number	Total		Owner		Contractor		U-Test
		Mean	Rank	Mean	Rank	Mean	Rank	Sig.
Client-related	O1	2.53	6	2.41	5	2.69	11	0.421
	O2	2.19	27	2.05	27	2.39	24	0.169
	O3	2.45	13	2.18	19	2.82	5	0.042
	O4	2.38	17	2.10	23	2.73	9	0.118
	O5	2.49	8	2.23	16	2.86	3	0.068
	O6	2.48	9	2.08	24	3.04	2	0.009
	O7	2.74	1	2.90	1	2.55	19	0.265
	O8	2.17	28	2.16	20	2.19	33	0.930
Contractor - related	C1	2.27	28	2.16	20	2.19	33	0.930
	C2	2.45	14	2.38	8	2.54	20	0.515
	C3	2.27	24	2.21	17	2.36	26	0.452
	C4	2.51	7	2.31	10	2.79	6	0.145
	C5	2.35	20	2.14	21	2.62	14	0.065
	C6	2.32	21	2.26	14	2.39	25	0.484
	C7	2.46	11	2.37	9	2.59	17	0.754
	C8	2.64	3	2.29	11	3.14	1	0.023
	C9	2.43	15	2.27	12	2.68	12	0.278

Group	Number	Total		Owner		Contractor		U-Test
		Mean	Rank	Mean	Rank	Mean	Rank	Sig.
	C10	2.46	12	2.40	6	2.56	18	0.864
Design-related	D1	2.37	18	2.27	13	2.50	21	0.593
	D2	2.17	29	2.07	25	2.30	30	0.683
	D3	2.39	16	2.13	22	2.75	8	0.148
	D4	2.26	25	2.00	32	2.64	13	0.087
	D5	2.32	22	2.05	28	2.71	10	0.056
Infrastructure and socially related	I1	1.87	34	1.74	35	2.03	34	0.466
	I2	2.13	32	2.05	29	2.23	32	0.608
	I3	1.8	35	1.86	33	1.71	35	0.317
	I4	2.21	26	2.05	26	2.41	23	0.178
	I5	2.47	10	2.50	3	2.43	22	0.909
	I6	2.56	4	2.54	2	2.59	16	0.936
	I7	2.55	5	2.39	7	2.77	7	0.346
Externally related	E1	2.16	30	2.02	31	2.36	27	0.664
	E2	2.15	31	2.03	30	2.32	28	0.441
	E3	2.37	19	2.19	18	2.61	15	0.218

However, as seen in Table 5, there are few significant differences between clients and contractors in successful projects when compared to failing projects in Table 5. If the project proceeds smoothly, the clients and contractors will understand each other and resolve the differences between their various points of view.

3. 2 Causes of Delays in Unsuccessful Projects

The causes of delay in failed power projects are shown in Table 6. The top four in the group overall include poor cost estimation (C7 1st Rank), late delivery of material and equipment (I6 3rd Rank), late purchase orders for material and equipment (C9 4th Rank), and additional work owing to mistakes (I5 5th Rank).

Late delivery of material and equipment (I6 1st Rank), late procurement orders for material and equipment (C9 2nd Rank), poor cost estimation (C7 3rd Rank), and the client's insufficient money or budget allocation (O7 4th Rank) are the top four in the client group.

Poor cost estimation (C7 1st Rank), untrained or inexperienced labour (I5 2nd Rank), late delivery of material and equipment (I6 3rd Rank), and poor cost management (C2 4th Rank) are the top four in the contractor group. As a result, the client and contractor groups scored the top four delay issues identically, indicating that their opinions on delay factors are not considerably different.

However, there are some substantial disparities in rank between clients and contractors. Clients prioritised obstacles in acquiring permissions from authorities (I7) and unanticipated geological circumstances (E2) above contactors. Contractors, on the other hand, ranked change in scope (O1), poor supervision by the client (O2), approval delays (O4), misrepresentation of information before bid (C6), inappropriate data collection (D2), failure in planning and designing risk (D4), workers' strikes (I3), and poor working conditions (I4) significantly higher than clients. These causes are mainly linked to clients or external forces rather than the contractor.

Table 6
Causes of delay in failed power projects

Group	Number	Total		Owner		Contractor		U-Test
		Mean	Rank	Mean	Rank	Mean	Rank	Sig.
Client-related	O1	3.09	26	2.60	32	3.36	15	0.000
	O2	2.94	33	2.34	35	3.25	23	0.000
	O3	2.87	35	2.74	28	2.94	35	0.389
	O4	3.28	16	2.97	24	3.44	10	0.018
	O5	3.00	32	2.76	27	3.13	29	0.107
	O6	3.16	21	3.03	20	3.23	24	0.321
	O7	3.48	9	3.61	5	3.42	11	0.228
	O8	3.05	29	3.03	21	3.06	31	0.902
Contractor - related	C1	3.17	20	2.95	25	3.29	21	0.370
	C2	3.59	6	3.50	8	3.64	5	0.700
	C3	3.37	10	3.38	10	3.37	14	0.472
	C4	3.31	12	3.24	14	3.34	17	0.777
	C5	3.32	11	3.35	12	3.31	19	0.767
	C6	3.08	27	2.54	33	3.37	13	0.000
	C7	3.86	1	3.76	3	3.92	2	0.937
	C8	3.54	7	3.53	7	3.54	7	0.421
	C9	3.61	4	3.84	2	3.49	8	0.082
	C10	3.13	23	3.05	19	3.17	28	0.818
Design-related	D1	3.12	25	3.21	16	3.07	30	0.207
	D2	3.03	31	2.66	30	3.22	25	0.009
	D3	2.88	34	2.63	31	3.01	34	0.071
	D4	3.28	17	2.92	26	3.47	9	0.002
	D5	3.29	14	3.18	17	3.35	16	0.689
Infrastructure and socially related	I1	3.13	24	3.03	22	3.18	27	0.642
	I2	3.04	30	3.03	23	3.04	32	0.476
	I3	3.16	22	2.68	29	3.42	12	0.015
	I4	3.06	28	2.51	34	3.34	18	0.000
	I5	3.60	5	3.22	15	3.79	3	0.317
	I6	3.74	3	3.92	1	3.65	4	0.193
	I7	3.29	15	3.49	9	3.19	26	0.029
Externally related	E1	3.20	19	3.08	18	3.26	22	0.995
	E2	3.23	18	3.59	6	3.04	33	0.012
	E3	3.50	8	3.38	11	3.56	6	0.817

3.3 Mitigation Strategies in Successful Projects

Table 7 depicts the measures used to reduce project delays in successful power building projects. The top three in the overall group are close project supervision (M4 1st Rank), capacity training (M6 2nd Rank), and effective logistics management (M14 3rd Rank).

Table 7
Measures used to reduce project delays in successful power building projects.

Number	Total		Owner		Contractor		U-Test
	Mean	Rank	Mean	Rank	Mean	Rank	Sig.
M1	3.29	14	3.24	12	3.35	14	0.683
M2	3.32	12	3.19	14	3.52	9	0.328
M3	3.16	15	2.95	15	3.48	11	0.093
M4	3.65	1	3.67	1	3.62	7	0.922
M5	3.54	5	3.43	6	3.69	4	0.296
M6	3.64	2	3.50	4	3.86	1	0.256
M7	3.41	9	3.33	10	3.54	8	0.430
M8	3.38	11	3.45	5	3.26	15	0.583
M9	3.42	8	3.37	9	3.50	10	0.580
M10	3.43	7	3.31	11	3.63	5	0.257
M11	3.53	6	3.40	8	3.71	3	0.248
M12	3.32	13	3.24	13	3.45	12	0.461
M13	3.39	10	3.40	7	3.36	13	0.796
M14	3.61	3	3.52	3	3.72	2	0.381
M15	3.59	4	3.57	2	3.63	6	0.975

3.4 Mitigation Strategies in Unsuccessful Projects

Table 8 represents the project delay mitigation measures used in failed power building projects. The findings varied considerably from those in Table 6, and eight of the fifteen mitigation options changed significantly across clients and contractors, suggesting that if the project does not go as planned, clients and contractors will consider alternative remedies. If these various approaches are not understood and integrated, the project will be delayed.

The top three in the group overall are timely payments of completion certificates (M8 1st Rank), adequate preparation of project finance arrangements (M1 2nd Rank), and consideration of Donor's Influence (M3 3rd Rank). In the client group, the top three are timely procurement and supply of materials and equipment (M7 1st Rank), top management's support (M15 2nd Rank), and proper planning of project financial arrangements (M1 3rd Rank), while in the contractor group, the top three are conducting capacity training (M6 1st Rank), timely payments of completion certificates (M8 2nd Rank) and finishing the design on time (M10 3rd Rank). Table 8 shows that the U-test showed no significant differences between clients and contractors.

Numerous researches have been conducted on the causes of construction project delays and mitigation techniques. Consequently, several construction projects continue to be delayed, resulting in poor project performance, such as cost and schedule overruns, disagreements, adjudication, lawsuit, and full project termination. As a result, this study attempted to identify more particular information for clients and contractors, as clients and contractors have varied responsibilities and capabilities for dealing with delay management. Furthermore, the delay reasons and mitigation method might vary based on the project's difficulty and performance. As an outcome, this study proposed independent delay reasons and mitigation measures for successful and unsuccessful projects.

Tables 5 and 7 can be used if the project progress meets the intended timeline or if delays are less than 10% of the expected schedule. Clients and contractors are likely to provide comparable delay factors. They must deal with insufficient money or budget allocation, late payment to

suppliers or labour by the contractor, late delivery of supplies and equipment, and delays in getting approvals from authorities. They can develop a mitigation strategy that includes careful project monitoring, capacity training, and effective logistics management.

Conversely, if the project is delayed by more than 10% of its original timeline, the client and contractor should consult Tables 5 and 7. Clients and contractors must investigate the reason of the delay as well as the mitigation approach. Clients and contractors are prone to blame the other party for their poor performance. The client must assess late material and equipment deliveries, late procurement orders for material and equipment, poor cost estimation, and the client's insufficient money or budget allocation. Bad cost estimation, untrained or inexperienced labour, late delivery of material and equipment, and poor cost management must all be investigated by the contractor. Upon an examination of the reasons of the delays, the client can devise mitigation techniques such as timely procurement and delivery of materials and equipment, top management support, and effective planning of project financial arrangements. However, the contractor can implement mitigation techniques such as capacity training, timely payment of completion certificates, and timely completion of the design.

Table 8
Measures used to reduce project delays in failed power building projects.

Number	Total		Owner		Contractor		U-Test
	Mean	Rank	Mean	Rank	Mean	Rank	Sig.
M1	4.09	2	4.48	3	3.87	4	0.001
M2	3.87	10	4.10	10	3.75	8	0.104
M3	3.95	6	4.28	7	3.78	7	0.001
M4	3.83	13	4.03	12	3.72	9	0.106
M5	3.95	7	4.38	5	3.71	10	0.001
M6	4.04	3	3.95	14	4.10	1	0.325
M7	3.98	5	4.58	1	3.65	12	0.000
M8	4.13	1	4.23	8	4.07	2	0.356
M9	4.03	4	4.38	6	3.84	5	0.005
M10	3.95	8	4.03	13	3.90	3	0.487
M11	3.77	14	4.21	9	3.53	14	0.001
M12	3.74	15	3.82	15	3.70	11	0.667
M13	3.86	12	4.40	4	3.56	13	0.000
M14	3.89	9	4.10	11	3.78	6	0.095
M15	3.87	11	4.53	2	3.51	15	0.000

4. Conclusions

This research investigated the reasons of delays and mitigation techniques used by the client and contractor in successful and unsuccessful power projects. According to the findings of this study, the reasons of delays and mitigation techniques differed greatly based on project progress performance, as detailed below.

First, if the project progress is on track, there should be minimal interruptions between both the client and the contractors. Clients and contractors may readily identify the reasons of delays and develop mitigation strategies to ensure their success. The client, in particular, should manage the money and supervise the budget, whilst the contractor should handle late payments to suppliers or work.

Furthermore, if the project development is significantly delayed, there are significant differences between clients and contractors. Additionally, the client and contractor assess the reasons of the delays and mitigation plans to catch up with the development in different ways. As a result, decision makers should urge the client and contractor-side specialists to identify and convey the different gaps. They should then collaborate to develop mitigating methods. The client, in particular, should manage the monitoring of late deliveries of material and equipment, as well as the cost calculation, finding, and budget management, whereas the contractor should handle deficient cost estimation, unskilled and inexperienced workers.

Consequently, decision makers are heavily involved in a variety of causes and mitigation techniques. The project is delayed due to the execution of the lowest bid tender and insufficient money or capital budget. The mitigation strategy prioritises top management support. The decision maker's engagement should enhance these causes and mitigation techniques.

Although this study leads to better construct project delay management, it has significant drawbacks. Initially, this study's examination was carried out at a project management. As a result, if practitioners use this study in other sectors or countries, they must take these particular factors into account. Second, this study did not take into account the project size, project detail categories, or respondents' expertise levels. These characteristics can have an impact on the causes and mitigation techniques. As an outcome, in the future, this study will examine the reasons of delays and mitigation techniques based on project size and respondents' experience levels.

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