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Implications of time overruns on public building project delivery in Uganda

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Abstract

This study investigates the implications of time overruns in the delivery of public building projects in Uganda, with a specific focus in Mbarara City. It identifies major causes of delays, quantifies their severity, and assesses the resulting impacts on cost, timelines, and service delivery. A descriptive survey design was adopted, and primary data were collected through structured questionnaires administered to 72 respondents, including 48 construction professionals (project managers, engineers, quantity surveyors, and architects) and 24 opinion leaders. Stratified random sampling ensured representativeness. Descriptive and inferential statistics were applied using SPSS, and delay severity was assessed using a ranking index based on a 5-point Likert scale. The most significant delay factors were design changes, delays in material procurement, weather disruptions, and logistical inefficiencies, with design changes recording the highest severity index (89%). Delays were found to contribute to cost escalations (mean = 4.25), extended project timelines, and negative public perception. ANOVA and t-tests revealed significant differences in how various professional groups perceived the impact of delay causes ($p < 0.05$). Unlike many prior studies that broadly examine infrastructure delays, this paper offers a location-specific, empirically grounded analysis of public building project delays in a fast-growing Ugandan city. The study contributes to theoretical understanding through the application of the Critical Path Method and Theory of Constraints and offers actionable strategies for policymakers, contractors, and consultants to mitigate time overruns.

Nomenclature and units

N	Total number of respondents
n	Sample size
p	Probability level or significance threshold (used in hypothesis testing)
SI	Severity Index
w	Weight assigned to each response on the Likert scale
f	Frequency of responses at each scale level
A	Maximum possible rating on Likert scale (typically 5)
α (alpha)	Significance level in hypothesis testing (commonly set at 0.05)
ANOVA	Analysis of Variance

1.0 Introduction

Infrastructure projects, particularly public building developments, are central to socio-economic transformation and urban development in emerging economies. However, these projects often suffer from significant schedule slippages commonly referred to as time overruns or delays which disrupt planned service delivery, escalate costs, and reduce public trust in governance (Damoah & Kumi, 2018).

A time overrun, for this study, is defined as the extension of a project's duration beyond its originally planned or contractually agreed timeline (Romzi & Shu Ing, 2022). In Uganda, time overruns in infrastructure projects such as schools, hospitals, and administrative buildings have become prevalent, with reported average delays extending up to 18 months in some road development cases (Colonnelli & Ntungire, 2018). While much research has explored construction delays in general infrastructure such as roads and dams, relatively fewer studies have been dedicated to public building projects, particularly at the municipal level.

Mbarara City, located in western Uganda, is a growing urban center with a significant portfolio of public infrastructure investments. Despite these investments, delays in project execution have led to stalled service delivery and economic inefficiencies. Previous studies (e.g., Alinaitwe, Apolot & Tindiwensi, 2013; Abarinda, Kibwami & Tutesigensi, 2019) have documented various causes of delays in the Ugandan construction industry, including design changes, material shortages, bureaucratic bottlenecks, and weather disruptions. However, these studies often aggregate data across project types and geographies, offering limited insights specific to public buildings in rapidly urbanizing cities like Mbarara.

Global studies on construction project delays (e.g., Jayasena & Kulatunga, 2023; Durdyev & Hosseini, 2020) emphasize the significance of differentiating delay factors by sector and context. In Uganda, current literature largely lacks nuanced, location-specific analyses of delays in urban public building projects, and many local studies rely on anecdotal evidence or outdated data (Basheka & Tumutegyereize, 2013; Hillary, 2021.). This gap hampers policy responses tailored to the unique administrative, economic, and environmental conditions in secondary cities like Mbarara.

This study aims to assess the implications of time overruns in the delivery of public building projects in Uganda, using Mbarara City as a case study. The study aims to identify common causes of delays in public building projects, assess their impact on project performance and stakeholder satisfaction, and provide practical recommendations for improving delivery efficiency.

Findings from this research are intended to guide contractors, consultants, policymakers, and urban planners in understanding root causes of delays and formulating interventions. By providing a data-driven and context-specific analysis, this study contributes to the broader discourse on construction management and infrastructure planning in Sub-Saharan Africa.

The remaining part of the paper is organized as follows: Section II reviews existing research relevant to the study. Section III details the methodology employed in this study. Section IV presents results and analysis. Section V discusses the results. Finally, Section VI provides conclusion and recommendations for policy and future research directions.

2.0 Literature Review

Delays in construction projects are a global phenomenon, yet their causes and implications vary by region, sector, and project type. In developing economies like Uganda, public infrastructure projects frequently experience time overruns, undermining their socio-economic benefits. This review synthesizes existing knowledge by categorizing delay factors into thematic domains: managerial, financial, technical, regulatory, and external causes. It also identifies gaps that this study addresses.

2.1 Managerial Factors

Poor project planning, weak coordination, and inadequate site supervision have consistently emerged as critical delay drivers. Alinaitwe, Apolot, and Tindiwensi (2013) identified contractor incompetence and delayed decision-making among supervising teams as leading to frequent work stoppages in Ugandan projects. Similarly, Durdyev and Hosseini (2020) emphasized the role of deficient managerial capacity in emerging markets, where inefficient scheduling and lack of proactive monitoring often escalate delays.

Leadership lapses, poor contractor selection, and ineffective stakeholder communication exacerbate these challenges (Hoque *et al.*, 2023). In Uganda, Muhwezi, Acai, and Otim (2014) reported that contractor-related inefficiencies and delays in certifying works contributed significantly to project lag in public building developments.

2.2 Financial Constraints

Cash flow problems, delayed contractor payments, and budget reallocations are major financial impediments to timely project execution. Studies by Giri (2023) and Abarinda, Kibwami, and Tutesigensi (2019) highlight that irregular disbursement of funds causes contractor demobilization and delays in material procurement.

Internationally, Idrees and Shafiq (2021) found that underfunding during execution phases leads to renegotiation of contracts, which is particularly problematic in public-sector projects where fiscal cycles may not align with project needs. In Uganda, frequent budget revisions due to political or administrative reshuffles further disrupt continuity in public building projects (Muzaale, Auriacombe, & Byaruhanga, 2022).

2.3 Technical and Design-Related Issues

Design changes, inaccurate drawings, and poor site investigations are recurring sources of technical delays. According to Muhwezi *et al*. (2014), design errors and inadequate detailing in drawings caused rework and scheduling disruptions in over 80% of public building projects surveyed.

Abdullah and Bera (2018) argue that scope creep, especially in government-funded projects, often stems from inadequate feasibility studies. Their findings align with those of Al-Momani (2000), who identified design deficiencies as primary delay factors in Jordan, and by extension, other developing economies. Design-related problems in Uganda are often compounded by limited technical capacity within local councils, resulting in late approvals and misinterpretation of construction documents.

2.4 Regulatory and Institutional Delays

Bureaucratic inefficiencies, especially in permitting and approval processes, contribute significantly to construction delays in Uganda. According to Colonnelli and Ntungire (2018), delays in securing environmental permits and inspection approvals typically add six months or more to project timelines.

This is corroborated by Damoah and Kumi (2018), who found that governance-related factors including corruption, weak procurement oversight, and limited inter-agency coordination directly correlate with project time overruns in Sub-Saharan Africa. In Uganda, Hillary (2021) observed that fragmented institutional roles among ministries, authorities, and district offices delay execution of both national and municipal infrastructure projects.

2.5 External and Environmental Factors

Unforeseen weather changes, force majeure events, and site-related challenges such as land disputes or sub-surface issues frequently delay project progress. Hoque *et al*. (2023) classified delays into excusable (e.g., adverse weather) and non-excusable (e.g., contractor negligence), highlighting the importance of risk-aware planning.

In Uganda, Muzaale *et al*. (2022) emphasized political interference, delayed inspections, and weather-related disruptions as key external factors prolonging project execution. Trauner *et al*. (2009) proposed Time Impact Analysis (TIA) as a suitable tool for quantifying and managing such disruptions in construction schedules.

2.6 Summary and Gap Identification

While the reviewed literature comprehensively documents various delay factors, several gaps remain. First, few studies focus exclusively on public building projects, which are structurally and institutionally different from road and energy infrastructure. Second, existing Ugandan studies lack context-specific, empirical analysis rooted in urban centers like Mbarara. Third, there is limited integration between empirical data and project management frameworks such as the Critical Path Method (CPM) or Theory of Constraints (TOC).

This study seeks to fill these gaps by:

i. Focusing on public building projects in Mbarara City, Uganda.
ii. Combining survey-based empirical data with theory-based interpretation.
iii. Providing actionable recommendations tailored to stakeholders in Uganda's urban infrastructure sector.

3.0 Methodology

This study adopted a mixed-methods research approach combining both quantitative and qualitative strategies to identify the causes and implications of time overruns in public building projects in Mbarara City. This triangulation approach ensures data validation through convergence and increases the reliability of findings (Creswell & Plano Clark, 2018).

3.1 Research Design

A descriptive survey design was employed. This approach is suitable for systematically gathering data to describe characteristics, patterns, and perceptions related to project delays in infrastructure delivery. It allowed the researcher to gather responses from a broad spectrum of stakeholders involved in project execution (Bryman, 2016).

3.2 Study Area and Population

The research was conducted in Mbarara City, Western Uganda, a rapidly urbanizing municipality with a high concentration of public infrastructure projects funded under various national and local initiatives. The study population comprised: Engineers, Architects, Quantity Surveyors, Project Managers, Site Supervisors, Porters and Masons, and Opinion leaders from local government and civil society.

These groups were chosen because of their direct or indirect involvement in project planning, supervision, and implementation.

3.3 Sampling Technique and Sample Size

A stratified random sampling method was applied. The population was divided into strata based on professional roles (e.g., engineers, architects), and participants were randomly selected from each stratum. This method ensures representative participation across the different stakeholder groups involved in infrastructure delivery.

The sample size was determined using Fisher's formula:

$$n = \frac{(Z)^2 \cdot p \cdot (1 - p)}{d^2} \quad (1)$$

Where:

n = required sample size
Z = Z-value (1.96 at 95% confidence)
p = estimated proportion (0.5)
d = margin of error (0.05)

Based on the formula, a total of 72 respondents were selected, comprising: 6 Project Managers, 12 Engineers, 12 Quantity Surveyors, 6 Architects, 12 Supervisors, and 24 Opinion Leaders.

3.4 Questionnaire Design and Administration

A structured questionnaire was developed and pre-tested to ensure clarity and relevance. The tool included:

i. Section A: Demographic data (e.g., profession, years of experience, project type involvement).
ii. Section B: Causes of delays using a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).
iii. Section C: Effects of delays on cost, quality, and delivery timeline.
iv. Section D: Recommendations and perceptions on delay mitigation strategies.

A total of 85 questionnaires were distributed; 72 were completed and returned, representing an 84.7% response rate.

3.5 Data Collection Procedures

Data collection involved field visits and engagement with local construction stakeholders. Consent was obtained from participants, and anonymity was assured. The researcher also reviewed contract documents, inspection reports, and project budgets for secondary data on actual versus planned timelines and costs.

3.6 Data Analysis Techniques

Quantitative data was analyzed using the Statistical Package for Social Sciences (SPSS) version 25. The following techniques were used:

i. Descriptive statistics: Means, frequencies, and standard deviations to summarize delay factors.
ii. Severity Index Ranking: Computed to prioritize causes based on Likert scale ratings.
iii. Inferential statistics: T-tests and ANOVA to assess variation across professional groups.
iv. Graphical representation: Bar charts and pie charts were used to enhance visual clarity.

Qualitative data from open-ended questionnaire items and document reviews were thematically analyzed, coded, and triangulated with quantitative findings for deeper insight.

3.7 Justification of the Methodology

The use of a mixed-methods approach is appropriate because it:

i. Combines objective quantification of delay factors with contextual depth from qualitative narratives.
ii. Ensures comprehensive stakeholder inclusion across professional roles.
iii. Facilitates robust analysis for evidence-based recommendations.

This method aligns with the study's aim to explore not just the existence of delays, but also the magnitude, impact, and strategic solutions applicable to Mbarara City's context.

4.0 Results and Analysis

This section presents the results of the survey conducted among 72 respondents from Mbarara City. The analysis is structured to show the types and severity of delays, their causes, and their impacts on public building project delivery. It utilizes descriptive statistics, severity ranking indices, and comparisons with prior literature to contextualize the findings.

4.1 Demographic and Project Characteristics

Table 1 shows the distribution of participants by professional role:

Table 1 Respondents by professional role

Respondents	Distribution
Project Managers	6 (8.3%)
Engineers	12 (16.7%)
Quantity Surveyors	6 (8.3%)
Architects	12 (16.7%)
Site Supervisors	12 (16.7%)
Opinion Leaders	24 (33.3%)
Total	72 (100%)

Projects evaluated varied in type and budget, with timelines ranging from 6 months to over 3 years. Nearly 79% of projects were delayed beyond their contractual durations, consistent with findings by Damoah and Kumi (2018) in similar urban contexts.

4.2 Types of Delays Experienced

Respondents identified multiple types of delays. The following figure (Figure 1) summarizes the frequency distribution:

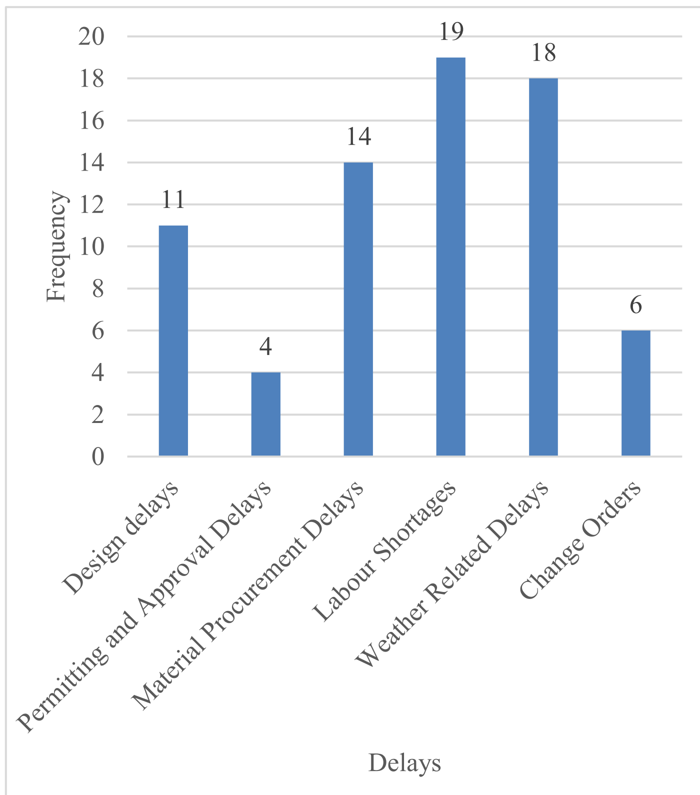

Figure 1 Types of delays encountered in Mbarara public building projects

Delays were categorized as:

i. Excusable and non-excusable (Jayasena & Kulatunga, 2023),
ii. Compensable and non-compensable (Trauner *et al*., 2009),
iii. Critical path delays, which had the highest project impact.

4.3 Causes of Delays

Respondents rated the frequency and severity of various delay causes using a 5-point Likert scale. A Severity Index (SI) was computed using the formula:

$$SI = \frac{\sum(w \times f)}{A \times N} \times 100 \quad (2)$$

Where:

w = weight of each rating (1 to 5),
f = frequency of responses,
A = highest possible rating (5),
N = total responses.

Table 2 shows ranked causes of delays by severity index.

Table 2 Ranked Causes of Delays (by Severity Index)

Cause of Delay	Mean Score	Severity Index (%)	Rank
Design Changes	4.45	89	1
Delays in Material Procurement	4.30	86	2
Weather Conditions	4.15	83	3
Logistical Challenges	3.95	79	4
Contractor-Related Inefficiencies	3.80	76	5
Delayed Regulatory Approvals	3.65	73	6
Political Interference	3.55	71	7
Inadequate Site Investigation	3.30	66	8
Labor Shortages	3.10	62	9

These results are consistent with previous studies by Muhwezi *et al*. (2014), who identified design flaws, material delays, and contractor inefficiencies as leading delay factors.

Figures 2–7 illustrate the top six delay factors (based on Severity Index).

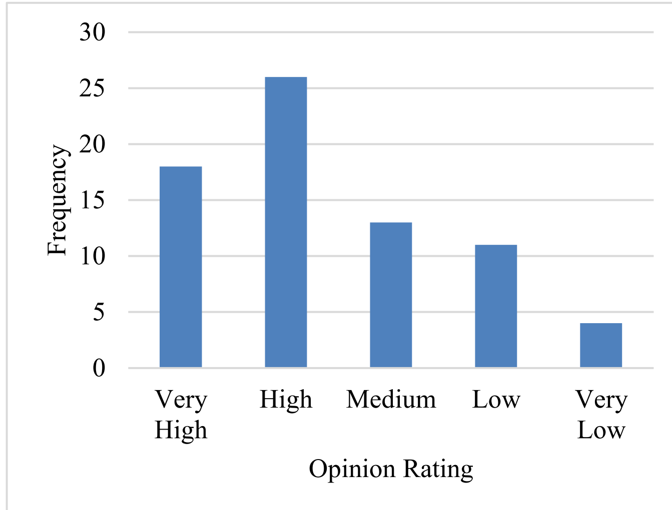

Figure 2 Effect of design changes on delay of public building projects

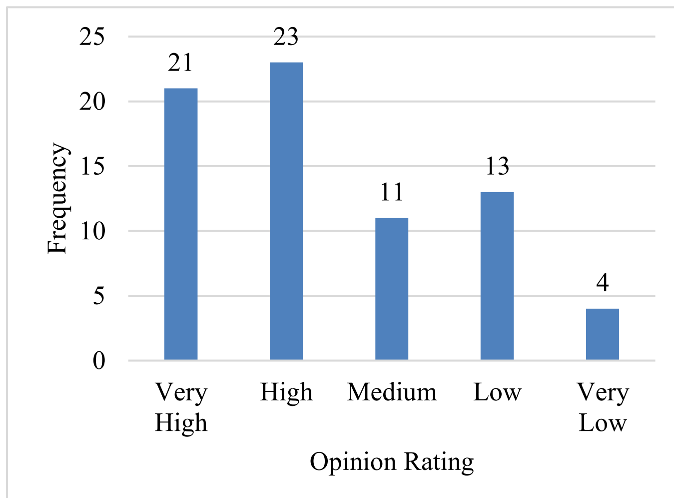

Figure 3 Effect of material shortages on delay of the projects

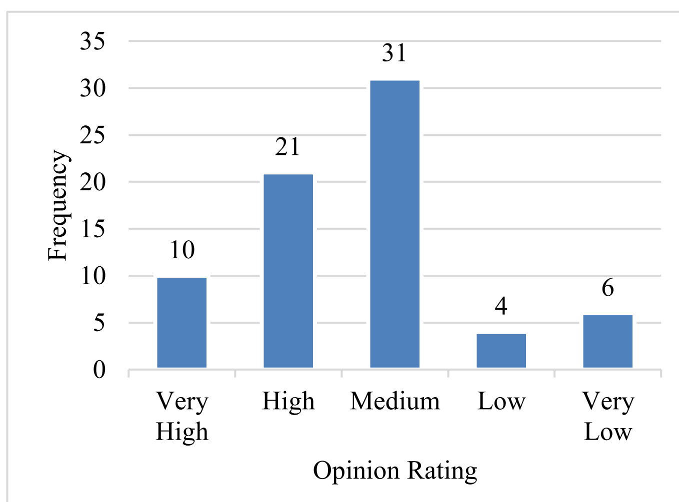

Figure 4 Effect of weather changes on delay of public building projects

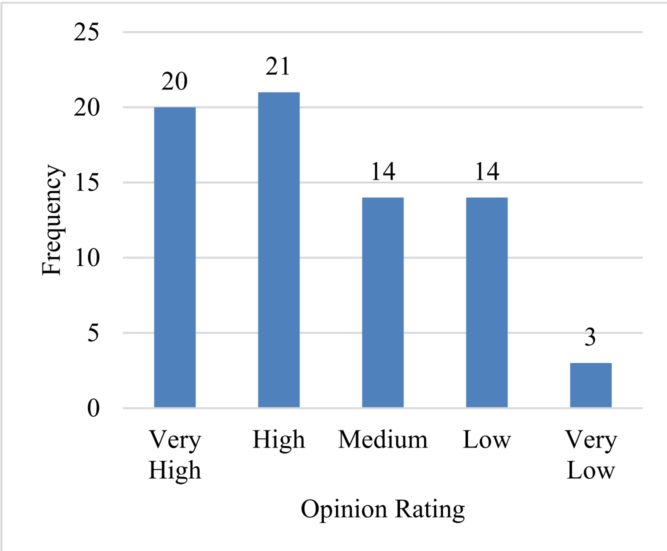

Figure 5 Effect of unforeseen issues on delay of public building projects

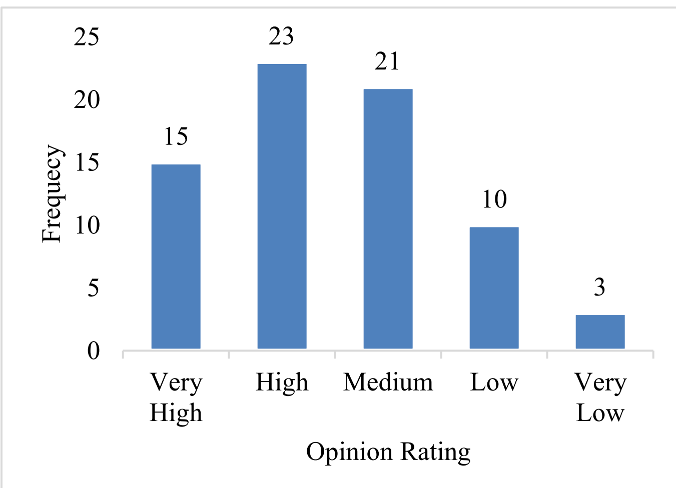

Figure 6 Effect of logistical challenges on delay of public building projects

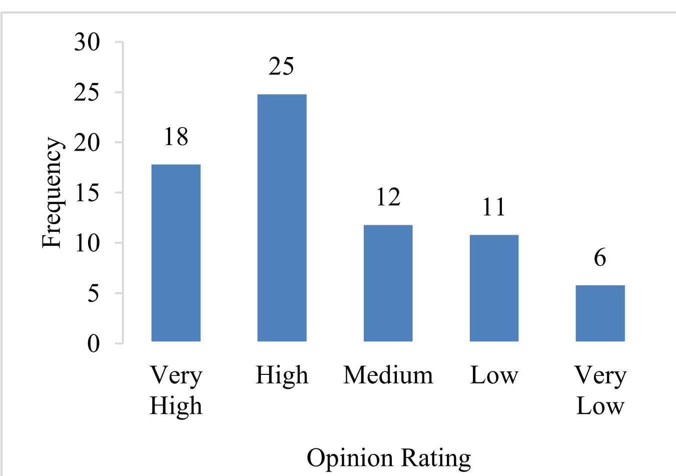

Figure 7 Effect of contract related on delay of public building projects

4.4 Impacts of Time Overruns

The study evaluated three major impact areas:

i. Financial Impact: Cost overruns due to extended labor/equipment rental.
ii. Service Delivery Impact: Delays in providing public amenities.
iii. Reputational Impact: Erosion of public trust in contractors and authorities.

Table 3 below shows the project impact assessment.

Table 3 Project impact assessment

Impact Area	Mean Score	Standard Deviation
Increased Project Cost	4.25	1.138
Delayed Service Delivery	4.10	1.146
Negative Public Perception	3.85	1.321

Figure 8 shows cumulative impact on cost, delivery, and public perception.

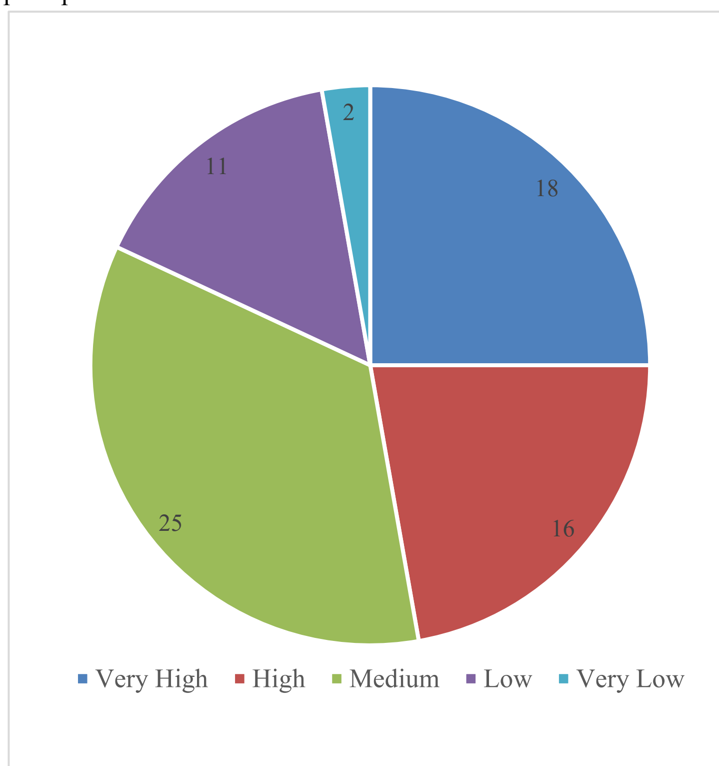

Figure 8 Effect of delays on public building projects in Mbarara City, on regional development and infrastructure

4.5 Comparative and Inferential Analysis

ANOVA Test

A one-way ANOVA was conducted to determine whether perceptions of delay severity significantly differed across professional categories.

Null hypothesis (H0): No significant difference in perceived severity.

p-value = 0.017 ($\alpha = 0.05$)

Result: Since $p < 0.05$, we reject H0. There is a statistically significant difference in how different professional groups perceive the severity of delay causes.

T-Test

A t-test was used to compare public-sector opinion leaders and construction professionals on the impact of design changes.

p-value = 0.042 ($\alpha = 0.05$)

Conclusion: There is a significant perceptual gap between technical professionals and policy stakeholders on the role of design changes in causing delays.

4.6 Integration with Literature

i. Design changes (ranked 1st) align with studies by Giri (2023) and Okada *et al*. (2017), who note that late modifications disrupt procurement and scheduling.
ii. Material shortages and logistical delays echo global findings by Idrees & Shafiq (2021).
iii. Weather and approval delays were consistent with the Uganda-specific findings of Muzaale *et al*. (2022).

The dominance of design and logistical factors suggests that delays are more often systemic and managerial than technical or external, confirming assertions by Abarinda *et al*. (2019) that institutional inefficiency is a core delay determinant. Nnadi et. al (2018) opined that time and cost overrun are risks that need adequate awareness to mitigate project abandonment.

5.0 Discussion

This section interprets the results in light of the study's objectives, existing literature, and relevant theoretical frameworks. It highlights why certain delay factors dominate and explores their broader implications for infrastructure planning and delivery in Mbarara City and similar developing urban contexts.

5.1 Delay Factors: Structural, Organizational, and Environmental Dimensions

The most significant contributors to project delays in Mbarara City i.e. design changes, material procurement delays, weather disruptions, and logistical challenges reveal systemic and organizational weaknesses rather than isolated technical failures.

Design Changes

Design-related delays, ranked highest by respondents, are rooted in:

i. Inadequate stakeholder consultation during project scoping,
ii. Late-stage design modifications requested by clients or funders, and
iii. Insufficient architectural detailing that leads to rework during implementation.

This supports previous findings by Muhwezi *et al*. (2014) and confirms observations by Okada, Simons, and Sattineni (2017) that design-related rework is a major cause of time overruns in public sector construction. It also aligns with the Critical Path Method (CPM) framework, as design errors impact early activities that cascade down the schedule's critical path, delaying overall completion.

Material and Logistical Delays

Material shortages and logistical inefficiencies point to procurement system fragility. Delays in bidding processes, lengthy payment cycles, and reliance on imported materials increase project vulnerability. These issues mirror the constraints reported by Giri (2023) and Damoah & Kumi (2018) in other Sub-Saharan countries.

Within the Theory of Constraints (TOC), this bottleneck (in supply and logistics) represents a key limiting factor that must be resolved to improve overall system throughput. Without reforming public procurement policies and logistics planning, other improvements will yield limited results.

Weather Conditions

Weather-related disruptions were the third most cited cause. Given Mbarara's bimodal rainfall pattern and exposure to climate variability, construction schedules that fail to account for seasonal conditions are susceptible to delay. These findings reinforce Hoque *et al*.'s (2023) assertion that environmental risk factors must be incorporated into baseline schedules through robust risk management planning.

5.2 Interplay of Delay Causes and Broader Implications

Delay factors do not act in isolation. For example:

i. Design changes often trigger material reordering, further delayed by procurement inefficiencies.
ii. Contractor delays due to labor shortages are aggravated by poor supervision and lack of real-time monitoring tools.
iii. Regulatory approval lags, often bureaucratic in nature, compound issues by halting work midway even when other resources are ready.

This interplay illustrates how time overruns are a product of multi-layered dysfunctions across project governance, technical planning, and resource availability.

The implications are wide-reaching:

i. Cost Overruns: Extended project timelines lead to increased labor, equipment rentals, and administrative overheads confirmed by a mean cost impact score of 4.25.
ii. Reduced Public Confidence: Continued underdelivery in government-funded projects contributes to erosion of public trust in both local authorities and implementing contractors.
iii. Service Delivery Failures: Delayed construction of health centers, schools, and government offices affects communities reliant on public infrastructure for essential services.

5.3 Theoretical Reflections and Practical Relevance

Critical Path Method (CPM)

As a scheduling tool, CPM emphasizes early identification of activities that control project duration. The dominance of early-phase issues like design errors and planning gaps suggests that critical path activities are not sufficiently risk-buffered, making projects vulnerable to minor disruptions.

Theory of Constraints (TOC)

TOC posits that addressing the most significant constraint leads to improvement in overall performance. In this context, the primary constraint lies in institutional planning and coordination specifically between design, procurement, and contractor mobilization.

Stakeholder Theory

Delays were found to differ in perception across stakeholder groups ($p = 0.017$ in ANOVA tests), indicating fragmented stakeholder alignment. This is consistent with Stakeholder Theory (Gutterman, 2023), which emphasizes that success depends on effective coordination among owners, consultants, contractors, and regulators.

5.4 Toward Delay Mitigation: Strategic Insights

Findings suggest the following interventions:

i. Front-load Stakeholder Engagement: Collaborative design sessions and user consultations should be held during the planning phase to reduce mid-stream changes.
ii. Digitize Procurement and Project Monitoring: Use of platforms like e-GP and construction management software can reduce procurement lag and enhance schedule tracking.
iii. Adopt Adaptive Scheduling: Incorporate Time Impact Analysis (TIA) to evaluate likely schedule risks due to weather or supply delays.
iv. Enhance Contractor Prequalification: Evaluate technical capacity and historical performance during contractor selection to reduce risk of underperformance.

These strategies, when institutionalized, will help reduce project inefficiencies and enhance timely delivery of infrastructure.

6.0 Conclusion and Recommendations

6.1 Conclusion

This study investigated the causes and implications of time overruns in the delivery of public building projects in Mbarara City, Uganda. Drawing from survey responses of 72 professionals and opinion leaders, the findings reveal that design changes, material procurement delays, logistical inefficiencies, and weather disruptions are the most critical factors contributing to project delays. These delay drivers are not isolated but interact dynamically, often compounding their individual effects.

The study further establishes that time overruns lead to significant cost escalations, delayed public service delivery, and negative public perception of infrastructure projects. Statistical analysis (ANOVA and t-tests) confirmed significant perceptual variations across professional groups regarding delay causes and impacts. The results also align with prior literature and reinforce theoretical insights from the Critical Path Method (CPM) and Theory of Constraints (TOC), which highlight the need to focus on early-phase planning and system bottlenecks.

The findings underscore the importance of addressing both technical and institutional weaknesses to improve project delivery outcomes in Uganda's urban infrastructure sector.

6.2 Actionable Recommendations

Based on empirical data and theoretical grounding, the following strategic recommendations are proposed:

Institutionalize Early Design Finalization and Review. Stakeholders should adopt integrated design workshops at the planning stage to minimize future changes. This will reduce rework and disruptions along the critical path. *Target group*: Architects, consultants, planning authorities.

Data link: Design changes ranked highest (Severity Index = 89%).

Reform Procurement and Supply Chain Management. The government should implement digital procurement systems and establish framework contracts for key construction materials to avoid long lead times and shortages.

Target group: Policy makers, public procurement officers.

Data link: Material delays (Severity Index = 86%); logistical delays (79%).

Strengthen Risk-Responsive Scheduling Tools. Adopt project planning methods such as Time Impact Analysis (TIA) and weather-adjusted Gantt charts to anticipate and manage seasonality and external disruptions.

Target group: Project managers, engineers, supervisors.

Data link: Weather-related delays (Severity Index = 83%).

Enforce Stakeholder Coordination Protocols. Establish stakeholder coordination frameworks with clearly defined roles and periodic review meetings to improve decision-making timelines and reduce regulatory delays.

Target group: Project sponsors, municipal regulators, local contractors.

Data link: Regulatory approval delays (Severity Index = 73%).

6.3 Implications for Key Stakeholders

Table 4 shows implications for key stakeholders.

Table 4 Implications for key stakeholders

Stakeholder	Implication
Policymakers	Must streamline regulatory approvals and enforce performance-based contracting.
Contractors	Need capacity enhancement in scheduling and adaptive risk management.
Consultants	Should ensure early and comprehensive stakeholder design reviews.
Local Authorities	Must coordinate across departments to improve implementation oversight.

6.4 Suggestions for Future Research

To deepen understanding and further inform policy and practice, the study recommends:

i. Comparative analysis of delay causes in public vs. private sector projects in Uganda.
ii. Exploring how contract types (e.g., fixed-price vs. design-build) influence project delays.
iii. Investigating the impact of regional variations in delay patterns across other urban centers.
iv. Assessing the effectiveness of digital construction management tools in reducing overruns.

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Declaration of conflict of interest

The authors declare no conflict of interest. This study was conducted independently and was not influenced by any commercial, financial, or personal relationships that could be construed as a potential conflict.

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