



Delays of Private Construction Projects in Baguio City: Examining the Role of Material Shortages and Inadequate Planning

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Abstract

Construction project delays remain a pervasive challenge in the Philippines, particularly in Baguio City where geographic and climatic constraints compound traditional project management issues. This study examines how material shortages and inadequate planning contribute to delays in private construction projects within this mountainous urban environment. A qualitative research design was employed, utilizing semi-structured interviews with 23 stakeholders, including project managers, contractors, architects, engineers, and project owners, supplemented by project documentation. Data were analyzed through thematic analysis to identify recurring patterns and contextual drivers of delay. Findings reveal that supply-side limitations are central to the emergence of material shortages, driven by Baguio's mountainous terrain, restricted road accessibility, and unpredictable weather that consistently disrupt logistics. Planning deficiencies further exacerbate delays, including unrealistic scheduling based on lowland benchmarks, inaccurate cost estimation that ignores transport surcharges, and insufficient risk assessment of local hazards. Stakeholder perspectives diverged: contractors attributed delays to owner-related financial instability and scope deviations, while design teams were criticized for imposing non-local material specifications. These results highlight the compounded impact of geographic constraints on project management, demonstrating how traditional delay variables are intensified in Baguio's context. The study underscores the need for adaptive planning protocols that integrate localized scheduling, risk matrices, and collaborative delivery strategies. The research contributes to project management literature by showing that construction delays in Baguio City are not solely the result of universal factors but are uniquely shaped by environmental and logistical realities. A proposed "Baguio-Adjusted Planning Protocol" offers a holistic framework to mitigate these challenges through data-driven scheduling, contingency planning, and enhanced stakeholder collaboration.

Keywords: construction delays, material shortages, project planning, supply chain management, Baguio City



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INTRODUCTION

The global construction industry remains a vital economic pillar, yet it struggles to meet the growing demand for sustainable infrastructure, as evidenced in the Philippines where residential construction decreased by 7.8% while non-residential projects surged by 9.5% in 2024 (Philippine Statistics Authority, 2025). In Baguio City, this dynamic is exacerbated by a 16.7% average increase in condominium prices, reaching Php 15,039.59 per square meter, which severely compromises project budgets and schedules. Despite the city's Comprehensive Land Use Plan (CLUP) projecting high levels of

urbanization and increased material demand over the next decade, the region's mountainous topography and limited resource-carrying capacity create significant bottlenecks, frequently resulting in project delays of three to six months. These challenges directly intersect with Sustainable Development Goal 9 (SDG 9), yet the local industry often fails to adopt resilient strategies like lean construction or localized supply chains (Berawi et al., 2023). Central to these disruptions is insufficient planning, specifically the failure to integrate realistic timelines and risk analysis (Shabbir et al., 2023). While material shortages and planning gaps are recognized universal issues,

this study addresses a critical research gap by qualitatively exploring how these factors are uniquely compounded by the geographical and economic constraints of a mountainous metropolis like Baguio.

This study investigates the causes and consequences of construction project delays in private construction projects in Baguio City. In order to systematically examine the interplay of material shortages, planning deficiencies, and stakeholder perspectives within Baguio's unique construction environment, the study was structured around the following research questions:

1. To what extent do supply-side limitations versus demand-side contribute to material shortages in Baguio's private construction sector?
2. What specific planning deficiencies are perceived by stakeholders as the most prevalent and impactful causes of project delays in Baguio City?
3. How do the perceptions of project managers, contractors, and project owners differ regarding the primary causes and mitigation of delays, and where do their perspectives misalign?
4. Based on their direct experiences, what context-specific mitigation does stakeholders recommend addressing the challenges unique to the Baguio City environment?

The study's theoretical framework integrates three core project management theories to analyze the interplay between material shortages, inadequate planning, and delays in Baguio City's private construction sector. Central to this approach is the "Project Management Triangle" (or Iron Triangle), which posits that time, cost, and scope are inextricably linked; a disruption in material supply or planning necessitates trade-offs that often result in project failure if these fundamental constraints are not balanced (Baratta, 2006,

cited in Panchal & Khokrale, 2024). Supporting this, the "Theory of Constraints" (TOC) is utilized to identify and manage the geographical and logistical bottlenecks unique to Baguio, viewing resource scarcity as a system limitation that must be optimized to enhance performance (Udom & Waribugo, 2022). Finally, the study incorporates "Lean Construction" principles to explore the elimination of waste and the optimization of workflows (Berawi, et. al., 2023). Together, these frameworks provide a lens to simplify complex procurement processes, enhance stakeholder collaboration, and identify efficiency improvements to mitigate the extension of project timelines in a mountainous urban context.

LITERATURE REVIEW

Construction Project Delays in the Philippine Context. Construction project delays are a pervasive global issue driven by interconnected management and production challenges that consistently lead to underperformance (Albtoush, 2024; Luthan et al., 2024). In the Philippines, these problems are particularly acute due to fundamental weaknesses in managing the iron triangle of scope, schedule, and cost, where a disruption in one variable inevitably destabilizes the others (Song & Hao, 2023; Santos & Jocson, 2024). This situation is further aggravated by the sluggish adoption of Building Information Modelling (BIM) and a lack of real-time data, which undermines proactive decision-making (Dimaculangan, 2023). Recent domestic research highlights that schedules become unstable when recurrent constraints, such as site readiness and procurement disruptions, are not prioritized during preliminary planning (Pedron et al., 2025). Specific cases in Northern Mindanao and Candon City illustrate how right-of-way (RRROW) disputes, logistical constraints, and poor stakeholder coordination directly trigger significant budget and time overruns (Layno & Famadico, 2024; Batin & Llobrera-Diamse, 2025). Ultimately, these systemic delays result from unrealistic scheduling that underestimates work complexity and a failure to resolve planning gaps before

implementation, necessitating a more integrated and technology-driven approach to project management (Albtoush, 2024; Luthan et al., 2024).

The “Baguio-Specific” Challenge: Compounding Logistical Factors. Nationwide construction delays are well-documented, yet literature often overlooks the compounded impacts of geographical constraints unique to Baguio City, where mountainous topography inherently hinders supply chains and inflates transportation costs (Ilagan et al., 2025; Teshome, 2024). Insights from other regional industries, such as Benguet coffee production, demonstrate that highland delivery reliability depends heavily on complex market linkages and coordination (Batani, 2020), while local mobility is further compromised by tourism intensity and weather disruptions (Liponhay et al., 2023). Given that even lightweight products face significant logistical hurdles, the movement of bulky construction materials like cement and steel is exponentially more problematic, leading to increased delays and cost overruns. Current mountain logistics literature emphasizes that highland supply chains are highly sensitive to coordination due to limited routing flexibility and unstable last-mile conditions (Teshome, 2024; Bertolini, 2024). Consequently, logistics planning in the Baguio setting must be treated as a core construction risk area rather than a routine procurement matter, particularly as alternative delivery technologies face significant operational and regulatory hurdles (Langit et al., 2025).

Material Shortages as a Supply Chain Bottleneck. Material shortages are a complex, global construction challenge increasingly driven by disruptive events like pandemics and natural calamities, which create cascading bottlenecks (Kouvelis et al., 2023). Because materials often exceed half of a project's total cost, these shortages destabilize the Project Management Triangle, leading to budget overruns and schedule fluctuations (Yildız et al., 2024). In the Philippines, this volatility is exacerbated by high infrastructure demand and

a reliance on imported inputs, which increases exposure to global supply shocks (Gui et al., 2022). Applying Lean Construction principles can mitigate these risks by reducing waste and maximizing value through improved inventory management (Berawi et al., 2023). Theoretically, the Theory of Constraints identifies shortages as system-limiting points that reduce throughput and generate idle time; however, resilience can be enhanced through flexible contracts, diversified sourcing, and time buffers (Kouvelis et al., 2023). In constrained geographies like Baguio City, transport inefficiencies and limited storage further amplify delivery uncertainty, necessitating adaptive procurement and logistics strategies tailored to the city's unique topography and climate (Gui et al., 2022).

Inadequate Planning as a Root Cause of Delays. Material shortages function as identifiable project bottlenecks, yet inadequate planning, which encompasses poor coordination, deficient risk analysis, and scope mismanagement, remains the systemic root cause that transitions project execution from strategic to reactive (Shabbir et al., 2023; Ahmed, 2022). Institutional inefficiencies during preconstruction, such as delayed permit acquisition, right-of-way (RROW) issues, and late-stage design changes, are cited globally and within the Philippines as primary drivers of time overruns (Layno & Famadico, 2024; Youssef et al., 2025; Kardiani et al., 2025). These deficiencies violate the Project Management Triangle by making realistic scheduling and cost forecasting impossible, while Lean Construction perspectives categorize the resulting idle labor and rework as preventable waste. Despite the availability of advanced tools like CPM, a gap persists between theory and practice due to technical or institutional obstacles (Sobieraj et al., 2022). In geographically constrained environments like Baguio City, the Theory of Constraints suggests that failing to plan for predictable logistical hurdles, such as narrow mountain roads and weather, inevitably creates system-wide bottlenecks. Ultimately, planning gaps and unmanaged scope creep disrupt resource

allocation and extend the critical path, proving that early coordination and disciplined change control are essential to project stability (Layno & Famadico, 2024; Ahmed, 2022).

Mitigation Strategies and Management Tools.

Modern project management literature suggests that inadequate logistics and execution can be overcome by integrating practical tools like the Critical Path Method (CPM), Building Information Modeling (BIM), and Earned Value Management (EVM) to stabilize the Project Management Triangle (Ibrahim, et. al., 2024). CPM addresses unrealistic scheduling by visualizing task dependencies and identifying non-flexible activities, allowing managers in geographically constrained areas like Baguio City to prioritize realistic sequencing and buffer long-lead deliveries (Kadang, et. al., 2024; Mayouf, et. al., 2024).

Complementing this, BIM utilizes a digital environment for clash detection and real-time coordination, linking design data with construction logistics to minimize rework and manage late procurement (Akhmetzhanova, et. al., 2022; Bitaraf, et. al., 2024; Doukari et. al., 2022). Finally, EVM provides a quantitative feedback system that integrates cost and schedule performance to detect variances before they become irreversible (Proaño-Narváez et al., 2022). Empirical evidence from the Philippines highlights that while CPM is superior for forecasting delays, an integrated CPM-EVM approach yields the highest performance rating (4.8/5.0) for mitigating both time and cost risks (Rimando & de la Iglesia, 2025). Collectively, these tools formalize a robust system where CPM realisticizes timelines, BIM optimizes coordination, and EVM enforces performance discipline, providing a vital early warning layer for high-risk urban environments.

METHODS

Research Design. This study employed a qualitative research design to investigate the causes and consequences of construction project delays in private projects in Baguio City. A case study approach was adopted, focusing

on a sample of delayed and mismanaged city-based construction projects. Data collection was carried out through semi-structured interviews with key participants, including project managers, contractors, and project owners, to obtain in-depth insights into the underlying reasons for delays, material shortages, and inadequate planning, as well as potential mitigation strategies. Supplementary records such as project documentation, including timelines, budgets, and correspondence, were also examined to triangulate and support the interview findings. All data were systematically analyzed using thematic analysis, which facilitated the identification of recurring patterns and provided a structured explanation of the factors contributing to delays in the private construction sector of Baguio City.

Key Participants. The study engaged 23 purposively selected stakeholders who were actively involved in private construction projects in Baguio City. The sample was determined according to the principle of data saturation, ensuring sufficient depth and diversity of perspectives. Participants included project managers, contractors, and project owners, each playing complementary roles in project implementation, management, and financing. Eligibility required at least five years of industry experience and direct involvement in a project delay exceeding 20 percent within the past three years. To reduce bias, participants were drawn from residential, commercial, and mixed-use projects of varying scales, thereby capturing a broad range of operational contexts and enhancing the validity of findings.

Instrumentation. This study utilized a qualitative approach centered on semi-structured interviews and document analysis to investigate construction delays and material shortages in Baguio City. The interview guide explored stakeholder experiences regarding planning failures and situational mitigation, while the document analysis provided a systematic review of project schedules, progress reports, and meeting minutes to triangulate interview data and increase validity. While an AI language

model assisted in the initial organization of qualitative data and pattern identification, the researcher conducted all final coding and interpretation to preserve contextual depth. To ensure trustworthiness, the study adhered to the criteria of credibility, transferability, dependability, and confirmability through methods such as member checking, thick description of the Baguio context, audit trails, and reflexive journaling (Lincoln & Guba, 1985). The data collection process involved selecting key stakeholders, obtaining informed consent, conducting recorded interviews, and methodically screening project documents using a standardized checklist. All interviews were transcribed verbatim and stored securely alongside extracted document data to facilitate a comprehensive analysis of the local construction environment.

Data Gathering Procedure. Data collection in this study was grounded in a qualitative case study approach, emphasizing the constructivist view that delays are socially constructed realities shaped by stakeholder experiences. Semi-structured interviews were conducted with purposively selected participants, including project managers, contractors, and project owners, who met the criteria of at least five years of industry experience and direct involvement in delayed projects exceeding a 20 percent time overrun. To enhance validity, project documentation such as schedules, budgets, and correspondence was systematically reviewed to triangulate interview findings. All interviews were recorded, transcribed verbatim, and securely stored, while thematic analysis was employed to organize, code, and interpret the data, ensuring that recurring patterns and contextual insights were rigorously identified and explained.

Data Analysis. The study employed a systematic qualitative thematic analysis to interpret the collected data. Interview transcripts were transcribed verbatim and repeatedly reviewed to ensure immersion and familiarity with the content. Preliminary codes were then developed to capture recurring ideas aligned

with the research objectives, which were subsequently organized into broader thematic categories. While an AI language model assisted in the preliminary organization by sorting repetitive phrases and streamlining initial coding, the researcher manually conducted all final coding and interpretation to preserve contextual depth. These categories underwent iterative refinement to maintain consistency across the dataset, after which final themes were defined and named to reflect their relevance to material shortages, planning deficiencies, and stakeholder perspectives. Triangulation with project documentation further enhanced credibility, ensuring that findings were firmly grounded in the realities of Baguio City's construction environment.

Ethical Considerations. The study adhered to established ethical standards to ensure the integrity and protection of participants throughout the research process. Informed consent was obtained from all stakeholders prior to participation, with clear communication regarding the study's objectives, procedures, and their voluntary involvement. Confidentiality was strictly maintained by anonymizing interview transcripts and securely storing both audio recordings and project documentation. Participants were assured that their responses would be used solely for academic purposes and that no identifying information would be disclosed in published findings. While an AI language model assisted in the preliminary organization of qualitative data, the researcher retained full responsibility for final coding and interpretation, thereby safeguarding contextual accuracy and human oversight. These measures collectively upheld the principles of credibility, dependability, and respect for participant rights in qualitative inquiry.

RESULTS

Extent of Supply-Side and Demand-Side Contributions to Material Shortages in Baguio's Private Construction Sector. Supply-side constraints rooted in Baguio's rigid, mountainous topography and winding road networks serve as the primary drivers of

material shortages (Table 1). This high-risk logistical environment, characterized by unpredictable weather and rough terrain, frequently renders supply paths inaccessible and necessitates sourcing materials from outside the city, which increases both costs and transport risks (P12, P4, P10). These findings align with research by Xie et al. (2025), who note that the highland Philippines experiences natural supply chain disruptions and escalating delivery costs due to terrain inaccessibility. Similarly, Ahmadi et al. (2024) describe these logistics networks as complex and multifaceted, where geographical inefficiencies predispose operations to infrastructural vulnerability. The current data confirms that reliance on narrow roads and susceptibility to landslides and typhoons undermines the stability and availability essential for project efficiency (P12, P11).

Table 1
Logistical and Environmental Constraints (Theme 1)

Key Point	Narrative Summary
Topographic and Logistical Barriers	Mountainous terrain and limited, landslide-prone road access create unavoidable transport delays. Materials often cannot reach sites on time regardless of planning (P12).
Geographic Supply Gaps	Baguio's location discourages franchises from operating locally due to high overheads (manpower/transport), leading to chronic material unavailability (P10).
Meteorological Disruptions	Unpredictable weather and heavy rainfall during the wet season cause abrupt changes to task scheduling and interrupt material delivery windows (P4).

To mitigate these inevitable constraints, stakeholders must treat logistical and environmental risks as predetermined variables rather than unforeseen obstacles. The objective shifts from eliminating restrictions to minimizing their impact through proactive measures. Proposed strategies include "smart outsourcing of materials" (P9) and "early procurement and staged scheduling" (P12) to create necessary inventory buffers. Furthermore, adapting delivery logistics by utilizing smaller trucks (P18) is identified as a more effective approach for navigating the

difficult terrain of the region, ensuring a more resilient and reliable flow of essential construction inputs.

Specific Planning Deficiencies Perceived by Stakeholders as the Most Prevalent and Impactful Causes of Project Delays in Baguio City. As shown in Table 2, inadequate planning serves as the foundation for time and cost mismanagement in Baguio City, as stakeholders frequently utilize lowland scheduling templates that fail to account for the region's rugged terrain and logistical complexity. This misalignment leads to systemic delays when realistic hauling times and the necessity for specialized upland equipment are underestimated. Furthermore, inaccurate cost estimations that omit weather-related contingencies and transport surcharges quickly drain project budgets, illustrating the high interdependence of time and cost failures in mountainous developments. These findings validate the Project Management Triangle, which posits that the inability to control one constraint inevitably disturbs the others (Cheng, 2022).

Table 2
Inadequate Scheduling & Financial Forecasting (Theme 2)

Key Point	Narrative Summary
Unrealistic Timeframes	Initial schedules frequently ignore the geographical reality of mountain transport, failing to account for two- to three-week material delays common during the rainy season (P7).
Budgetary Inaccuracy	Cost estimations often fail because they do not include Baguio-specific transport surcharges or account for rapid price spikes from local suppliers (P15).
Flawed Benchmarking	Using Manila-based delivery timelines is a fundamental error; insufficient buffers for local terrain leads to necessary project re-phasing after the first rainfall (P9).

Empirical research supports the conclusion that unrealistic scheduling and poor financial forecasting are leading internal causes of project stagnation, particularly in unpredictable environmental conditions (Castaneda et al., 2025; Abdelalim et al., 2025). In developing countries, improper estimation procedures further damage contractor validity and the

overall development process (Yap et al., 2021). To address these systemic weaknesses, planners must shift from standard templates to context-adaptive methods grounded in empirical travel-time data for upland terrains. By implementing localized cost modeling and dynamic schedule recalibration, projects can achieve significant gains in resilience against site-specific logistical disruptions (Abdelalim et al., 2025).

Table 3
Insufficient Risk Assessment and Stakeholder Communication (Theme 3)

Key Point	Narrative Summary
Deficient Risk Assessment	Planning often lacks a formal risk matrix, failing to account for predictable local hazards such as landslides on Kennon Road that can block access for weeks (P20).
Underfunded Contingencies	Weather-related stoppages are consistently underestimated; insufficient contingency budgets often force total project halts during periods of sustained rainfall (P11).
Information Silos	Poor coordination between design and procurement teams leads to unmanaged scope changes; delayed notifications regarding design updates can result in month-long lags for specialty materials (P19).

In Table 3, contingency planning and stakeholder coordination loopholes manifest as a failure to integrate high-impact regional risks, such as landslides and road closures, into the project baseline. This lack of location-specific risk assessment renders contingency budgets insufficient and leaves projects without alternative supply channels during disruptions. Such failures align with the Theory of Constraints (TOC), which identifies poor communication and overlooked constraints as the weakest links in project performance (Udom & Waribugo, 2022). Research indicates that unassessed environmental and logistical uncertainties lead to systemic overruns, often because generic risk assessment tools fail to account for terrain and seasonal weather conditions (Enrica et al., 2021; Abu Qalbin et al., 2023). Furthermore, a lack of effective communication among actors creates decision

bottlenecks and fragmented responses to emergent hazards (Khahro et al., 2023).

To address these deficiencies, project planning must adopt proactive risk assessment models that quantify the financial and time impacts of specific Baguio hazards. Stakeholders emphasize that unrealistic scheduling and non-local timeline assumptions are critical triggers for early re-phasing once mountainous constraints become evident (P7, P9). While flawed cost estimation remains a major driver of budget collapse (P15), the absence of a site-specific risk matrix leaves projects unprepared for predictable disruptions like prolonged rainfall (P20, P11). Implementing collaborative schemes such as Lean Construction and Integrated Project Delivery (IPD) can facilitate real-time digital workflows minimizing information waste and ensuring coordinated responses to risk. This transition from routine procurement to strategic risk management is essential for managing client expectations and preventing routine changes from escalating into unmanaged scope shifts (P19).

Differences in the Perceptions of Project Managers, Contractors, and Project Owners Regarding the Primary Causes and Mitigation of Delays, and Areas of Misalignment. Theme 1 (as shown Table 4) is owner-induced financial and scope instability. The project owner represents the most significant risk on the demand side, as funding disbursement lapses or budgetary deficits immediately halt procurement and site operations. Owner-driven change orders and project variations frequently induce scope creep, causing costly design and procurement rework, particularly for specialty materials. This instability aligns with the Project Management Triangle, which posits that inadequate cost control inevitably derails time and scope (Baratta, 2006, as cited in Panchal & Khokrale, 2024). In the Philippines, research indicates that changes in quantity and scope adjustment are primary delay drivers (Pedron et al., 2025), while stakeholder-related issues, such as inconsistent communication and prolonged decision-making, severely compromise logistical and financial efficiency (Batin &

Llobrera-Diamse, 2025). These factors underscore a persistent lack of coordinated budgeting and planning that threatens project accountability (Dimaculangan, 2023).

Table 4
Owner-Induced Financial and Scope Instability (Theme 1)

Key Point	Narrative Summary
Financial Instability	Delays or total project suspensions frequently stem from the slow release of funds or an overall insufficient budget provided by the owner (P14).
	Frequent client-driven variations and change orders disrupt established procurement schedules and stall material ordering (P6).
Scope Volatility	Owners' late-stage design changes, such as switching special fixtures, force emergency redesigns and order cancellations that contractors cannot easily accommodate (P23).
Technical Misalignment	

To mitigate these risks, the relationship between the owner's financial capacity and the project timeline must be formally governed by contracts and rigorous processes. Stringent contractual clauses should address late disbursements and after-design alterations, especially following major procurement thresholds. Implementing a design freeze protocol or engaging in value engineering during the planning phase can effectively prevent unjustified variations and maintain cost control. By aligning owner financial liabilities with the operational timetable, project managers can ensure procurement stability and protect the critical path from ambivalent decision-making. Such measures foster accountability and reduce the demand-side derailments common in the Baguio construction sector.

Theme 2 is siloed execution and accountability gaps (Table 5). Internal process gaps are primarily driven by the siloed nature of operations, where disconnected architectural, engineering, and procurement teams disrupt project workflows. Design teams often specify

materials based on non-local markets, such as Metro Manila, failing to account for Baguio's unique logistical constraints, which forces contractors into reactive procurement cycles. This lack of integration mirrors the silo effect described in literature, where autonomous functional departments contribute to fragmented communication and systemic inefficiency (Luthan et al., 2024; Kim & Bilbao, 2023). Albtoush et al. (2024) and Kardiani et al. (2025) note that such disconnections lead to untimely design clarifications and incorrect material specifications, triggering rework and waste that destabilize the balance between time and cost within the Project Management Triangle (Baratta, 2006, cited in Panchal & Khokrole, 2024).

Table 5
Siloed Execution and Accountability Gaps (Theme 2)

Key Point	Narrative Summary
Stakeholder Disconnection	Inadequate planning and a lack of coordination among stakeholders lead to poorly prepared schedules and inaccurate forecasting of material requirements (P1).
Specification Misalignment	Architects often fail to specify locally available material sizes, forcing contractors to source from Manila and incurring multi-week delays (P10).
Information Bottlenecks	Communication breakdowns, such as failing to inform procurement teams of design changes in a timely manner, can result in month-long delays for specialty supplies (P19).

To counter these deficiencies, the industry must transition from sequential workflows to real-time collaborative models like Early Contractor Involvement (ECI) and Integrated Project Delivery (IPD). ECI allows for situational feedback during the design phase, enhancing constructability and aligning material requirements with actual supply chain realities (Sholeh et al., 2020), while IPD models promote shared accountability and eliminate decision bottlenecks (Jimenez et al., 2024). While contractors often attribute delays to owner-driven scope changes and owners view such changes as necessary refinements, project managers emphasize the need for managerial controls like design freezes and milestone-linked disbursements. Implementing these

collaborative frameworks fosters transparency and shared risk management, which are critical for bridging the gap between technical planning and field execution in the Baguio construction context.

Context-Specific Mitigation Strategies Recommended by Stakeholders to Address the Challenges Unique to the Baguio City Environment. Theme 1 in the mitigation strategies is the context-specific planning and data-driven forecasting (Table 6). The primary planning deficiency in Baguio construction stems from a reliance on generic, lowland-centric data that fails to account for the region's distinct logistical and environmental constraints. Stakeholders advocate for a transition toward data-driven, context-specific scheduling that replaces optimistic assumptions with historical data on actual delivery times from Manila or foreign suppliers. This adaptive approach aligns with Agile Project Management (APM) principles, which favor iterative planning and dynamic re-optimization over rigid, upfront scheduling (Kadang et al., 2024; Kim & Bilbao, 2023). Furthermore, the Theory of Constraints (TOC) emphasizes that mountainous terrain and transport bottlenecks must be identified and managed as primary system constraints to prevent downstream inefficiencies (Udom & Waribugo, 2022).

The primary planning deficiency in Baguio construction stems from a reliance on generic, lowland-centric data that fails to account for the region's distinct logistical and environmental constraints. Stakeholders advocate for a transition toward data-driven, context-specific scheduling that replaces optimistic assumptions with historical data on actual delivery times from Manila or foreign suppliers. This adaptive approach aligns with Agile Project Management (APM) principles, which favor iterative planning and dynamic re-optimization over rigid, upfront scheduling (Kadang et al., 2024; Kim & Bilbao, 2023). Furthermore, the Theory of Constraints (TOC) emphasizes that mountainous terrain and transport bottlenecks must be identified and managed as primary

system constraints to prevent downstream inefficiencies (Udom & Waribugo, 2022).

Table 6
Context-Specific Planning and Data-Driven Forecasting (Theme 1)

Key Point	Narrative Summary
Data-Driven Forecasting	Planning should utilize historical data on purchasing and delivery lead times—especially for Manila or overseas shipments—to create realistic construction timelines (P3, P2).
Environmental Phasing	Major building work should be scheduled during the dry season, utilizing weather forecasts and incorporating specific "buffer days" to account for inevitable mountain rainfall (P22).
Systematized Management	Firms must develop customized management systems that include formal risk assessments, proper scheduling techniques, and daily material audits to ensure timely resupply (P4, P25).

To institutionalize these improvements, a Baguio-adjusted Planning Protocol is proposed, requiring preliminary timelines to be benchmarked against historical logistical repositories with mandatory two- to three-week buffers for material transit. Research by Berawi et al. (2023) and Jimenez et al. (2024) supports using data-driven decision systems and feedback-driven frameworks to reduce waste and adapt to environmental uncertainty. This protocol should incorporate explicit risk premiums in financial plans and mandate digital inventory tracking to enable real-time resupply decisions. By shifting from assumption-based planning to flexible, data-driven systems, projects can achieve the operational resilience necessary to navigate the complex construction landscape of Baguio.

The next generated theme (Theme 2) is enhancing stakeholder collaboration and contingency. Mitigating demand-side instability requires a structural reorientation toward collaborative contracting (Table 7) to address project owner inconsistencies, such as late fund

releases and frequent design changes. Stakeholders recommend early consensus-building and the establishment of contingency mechanisms, including reserved funding and buffer stock allocations, to prevent late-stage scope shifts. This proactive approach aligns with the Integrated Project Delivery (IPD) paradigm, which emphasizes shared responsibility and risk-sharing to minimize expensive variations (Sholeh et al., 2020). By forming a unified team of the owner, architect, and contractor at the project's inception, joint decisions in design and procurement can eliminate non-value-added processes, material waste, and re-order delays, adhering to the core tenets of Lean Construction philosophy (Berawi et al., 2023).

Table 7
Enhancing Stakeholder Collaboration and Contingency (Theme 2)

Key Point	Narrative Summary
Integrated Communication	Preventing information lags requires formalizing communication among owners, designers, and procurement teams regarding all possible project delays and changes (P6).
Proactive Contingency	Proactive preparation involves creating multiple backup plans and working closely with trusted suppliers to leave room for unexpected mountain-specific setbacks (P1, P20).
Pre-Construction Discipline	To minimize late-stage volatility, teams must prioritize thorough pre-construction planning, which includes early selection of finishing materials and buffer stock allocations (P21).
Administrative Agility	Effective mitigation relies on experienced "quick thinkers" in administration and engineering who can discourage late client-driven design changes and manage changes efficiently (P15).

Empirical research suggests that integrating financial planning and risk contingencies into contractual arrangements significantly enhances cost-effectiveness and project stability (Rimando & de la Iglesia, 2025). To achieve this in Baguio, project teams should adopt a contractual Design Freeze Protocol that finalizes specifications after the pre-construction phase, alongside formalized weekly coordination meetings to synchronize fund releases and procurement schedules.

Replacing transactional contracting with strategic alliances with dependable suppliers provides localized knowledge and price stability during logistical disruptions. Furthermore, establishing a dedicated Contingency Fund for emergency material purchases ensures that projects remain resilient against weather or transportation shocks, ultimately minimizing schedule deviations caused by managerial or financial uncertainties.

Table 8
Advanced Procurement and Local Supply Diversification (Theme 3)

Key Point	Narrative Summary
Inventory Buffering	Implementing bulk purchasing and early material storage on-site acts as a critical buffer against unpredictable road closures and weather-related disruptions (P13, P19).
Regional Diversification	To mitigate local shortages, firms should establish reliable sourcing alternatives in neighboring provinces like La Union and Pangasinan (P7).
Local Relationship Building	Developing partnerships with local hardware owners and mapping supply locations within or near the city facilitates faster, more flexible transactions (P24, P10).
Downsized Transport	Adapting to mountainous terrain by planning material take-offs in smaller quantities allows for the use of more maneuverable delivery vehicles (P17).

Table 8 presents Theme 3 - advanced procurement and local supply diversification. De-risking the Baguio construction supply chain requires transitioning from Just-in-Time (JIT) to Just-in-Case (JIC) strategies, emphasizing high-volume early procurement and secure on-site warehousing to buffer against logistical volatility (Liang, 2025). Stakeholders advocate for regional supplier networks involving neighboring provinces like La Union and Pangasinan to mitigate the risks of mountain road closures and adverse weather. This multi-tiered sourcing approach aligns with literature suggesting that regional redundancy and localized sourcing enhance resilience in geographically constrained environments (Khan et al., 2021). Furthermore, implementing logistical network optimization through flexible transport and situation-specific procurement ensures that projects remain shielded from transportation and procurement shocks (Banyai et al., 2025).

Achieving long-term stability necessitates a Baguio-Adjusted Planning Protocol that shifts from conventional lowland management to a triple-pronged approach: stabilizing demand through data-driven forecasting and contractual design freezes; regionalizing supply with JIC inventory models; and institutionalizing cross-functional coordination between owners, architects, and contractors. Project managers stress the importance of using historical lead-time data for scheduling (P3, P20), while contractors and engineers emphasize shipping-time allowances, seasonal phasing, and daily material tracking to manage risk (P2, P22, P4, P25). By finalizing finishing material selections early and establishing formal contingency plans (P6, P21, P15, P1), project teams can eliminate the silo effect and ensure that financial and logistical resources are aligned with the unique realities of mountain construction.

Table 9
Decision Matrix for Delay Mitigation in Baguio City

Priority Level	Actionable Strategy	Target Stakeholder	Impact
Priority 1 (Immediate)	Implement Design Freeze Protocol	Owners & Architects	High
Priority 1 (Immediate)	Data-Driven Scheduling (3-week buffer)	Project Managers	High
Priority 2 (Strategic)	On-Site Warehousing (Buffer Stock)	Contractors	High
Priority 2 (Strategic)	Regional Supplier Diversification	Procurement Teams	High

Table 9 outlines the proposed Mitigation Decision Matrix based on the research findings. To enhance project resilience in Baguio, Project Owners must secure ring-fenced funds for early bulk procurement and implement strict Design Freeze protocols to curb scope-related delays. Architects and engineers must mandate pre-design vetting of local material availability and incorporate a three-week lead-time buffer into schedules to account for regional logistical challenges. Simultaneously, contractors should shift to a Just-In-Case (JIC) inventory model with on-site storage and utilize terrain-appropriate delivery vehicles for narrow mountain roads. Project Managers should institutionalize a Baguio-Adjusted Planning

Protocol that integrates historical data and daily material audits for real-time supply chain control. Finally, government and industry associations should collaborate to develop a Standardized Logistical Index and Seasonal Hazard Map, providing the empirical data necessary for evidence-based planning and the identification of high-risk corridors during the wet season.

Table 10
Comparative Benchmark of Delay Drivers

Feature	Lowland / Standard Project Context	Baguio City High-Altitude Context
Primary Logistics Constraint	Traffic congestion and port congestion	Terrain accessibility and landslides
Material Lead Time	2-3 Days (Just-In-Time)	2-3 Weeks (Just-In-Case)
Critical Planning Failure	Late Permits / Right-of-Way	Using "Manila-based" pricing & schedules

Based on the comparative benchmark of delay drivers (Table 10), the participants identified the deviation between standard project schedules and the unique logistical realities of Baguio as the most significant discrepancy. Interview data revealed a stark contrast in procurement timelines: while typical planning templates allocate one week for material lead times, the actual environment in Baguio requires a minimum of three weeks to navigate mountainous terrain and seasonal disruptions. A simulation of this deviation demonstrates that applying lowland-centric scheduling leads to an immediate, direct and unavoidable schedule overrun.

This gap underscores the necessity of the Baguio-Adjusted protocols established in this research. By institutionalizing these context-specific buffers, project managers can align procurement expectations with the site's geographical constraints, moving from an imminent failure model toward a more resilient, data-driven planning framework. These visual analytics finding serves as empirical evidence that standard templates are insufficient for high-risk, mountainous construction environments.

DISCUSSION

The study analyzes construction delays in Baguio City's private sector through thematic analysis of 23 stakeholders, revealing that the delays are primarily driven by fixed supply-side constraints, such as mountainous topography, landslide-prone access roads, and unpredictable weather patterns. These structural risks act as a baseline disruptor, which is significantly amplified by internal management failures, particularly the reliance on generic, lowland-oriented planning templates that lack the necessary three-week lead-time buffers and local transport surcharges (P7, P15). While project owners often trigger scope volatility through late-stage design changes, contractors and design teams struggle with siloed communication regarding material availability, often specifying non-local supplies that incur multi-week lags (P10, P19). This misalignment validates the Theory of Constraints, as geographical and logistical bottlenecks become the system-limiting points that reduce throughput (Udom & Waribugo, 2022), as well as the Project Management Triangle, where failures in financial and scope control inevitably destabilize project timelines (Baratta, 2006, cited in Panchal & Khokrale, 2024).

In conclusion, project delays in Baguio City stem from a fundamental mismatch between rigid highland logistical challenges and the application of inflexible, non-contextual management models. The research demonstrates that while supply-side limitations establish the baseline for material shortages, inadequate planning, characterized by unrealistic scheduling and flawed financial forecasting, serves as the root cause that transitions project execution from strategic to reactive (Shabbir et al., 2023). The failure to integrate a site-specific risk matrix for predictable local hazards, such as landslides on Kennon Road, leaves contingency budgets underfunded and projects vulnerable to total halts during sustained rainfall (P20, P11). Ultimately, the study confirms that in a mountainous urban context, standard

procurement templates are insufficient, and the severity of delays is determined by how well stakeholders can bridge the gap between technical planning and the unique physical realities of the terrain.

To stabilize maritime-level logistics on land, the study recommends the adoption of a "Baguio-Adjusted Planning Protocol" that prioritizes data-driven scheduling anchored in historical lead-time data rather than lowland assumptions (P3). Key actionable strategies include implementing a "Design Freeze Protocol" to curb owner-induced scope creep and shifting from Just-in-Time to a "Just-in-Case" inventory model through on-site warehousing and early bulk procurement (P13, P19). Furthermore, the study suggests enhancing stakeholder collaboration via Early Contractor Involvement (ECI) to ensure material specifications align with local supply realities, thereby reducing the "silo effect" (Sholeh et al., 2020). By institutionalizing regional supplier diversification and using terrain-appropriate delivery vehicles, project managers can foster the operational resilience necessary to navigate the complex environmental and logistical landscape of Baguio City.

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