
SYSTEMIC FAILURES AND INEFFICIENCIES IN LARGE-SCALE INFRASTRUCTURE EXECUTION: A CRITICAL APPRAISAL OF THE KANO–KATSINA ROAD DUALIZATION PROJECT

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ABSTRACT

Time overrun remains a severe and chronic problem in the construction sector of developing nations, turning infrastructure investments into inadequately documented expenditure. This paper critically examines the execution of the 74km Kano–Katsina Road Dualization Project, carried out by CCECC, drawing on project documents, progress reports, and interim payment certificates. The analysis exposes gross inadequacies in project initiation, financial management, and institutional coordination. By April 2025, the finding was that the project had consumed 163.33% of its planned time allocation, yet achieved only a 90.13% completion rate. This paper delivers a harsh but necessary critique of operational and administrative blunders that drove the project's contract sum from ₦14 billion to ₦68 billion, and offers constructive, priority recommendations for future infrastructure management.

Keywords: Systemic failure; Infrastructure inefficiency; Large-scale projects; Road dualization; Project execution; Kano–Katsina Road; Construction management; Cost overrun; Time overrun; Quality assurance; Contractor performance; Procurement process; Project delivery; Nigeria

1. INTRODUCTION

Nigeria's infrastructure deficit remains a major impediment to economic growth, and public spending falls far short of the scale of investment required (Akpör & Ransome, 2025), pushing policymakers toward public-private partnerships (PPP) and development finance instruments. The failure of infrastructure delivery in Nigeria is not merely a technical problem; it is a governance problem. Nigeria's large-scale infrastructure agenda has repeatedly been constrained by governance failures, financing gaps, weak institutional coordination, participation, and implementation failures that erode value for money. A road project study in Kenya reports that leadership style and corporate governance were positively associated with project performance, while resource availability was a significant influence on success, underscoring that project outcomes depend on management quality as much as on engineering design (Mrongo, 2024). In the same vein, a study of public participation in Nigerian road EIAs reports failures across procedural, substantive, normative, and transactive dimensions, including weak consultation, poor feedback, limited access to information, and unequal collaboration (Aliyu, 2024). The Federal Government of Nigeria has consistently identified road infrastructure as a developmental priority. The gap between contractual schedules and actual delivery timelines reveals deep dysfunction across procurement, finance, and project management.

Time overrun has become so endemic in construction that it is often treated as an expected outcome rather than a preventable failure (Assaf & Al-Hejji, 2006). A qualitative study of Nigerian highway projects indicates that cost overruns are driven by “delay in work progress, political instability, adverse weather, social issues, delay in progress payment to contractors, and modification of project scope,” showing that the project-delivery problem is both contextual and managerial (Mahmud et al., 2021). The 74 km Kano–Katsina Road Dualization Project is instructive precisely because it is not atypical. Contracted in 2013 with an initial sum of ₦14 billion, subsequently revised to ₦24 billion following a ministerial scope change, and inflated further to approximately ₦68 billion through cumulative inflationary adjustments, the project's financial trajectory alone constitutes a research subject of significance. Over a decade after contract award, the project remained incomplete, with

90.13% physical progress against 163.33% of elapsed time. The project can be read as more than a single delayed works contract; it is a case through which to examine structural weaknesses in Nigeria's infrastructure execution model. This paper, therefore, argues that persistent overruns, delays, and contested implementation patterns reflect systemic failures in planning, governance, stakeholder engagement, and budgetary discipline rather than isolated site-level problems.

The paper proceeds as follows: Section 2 reviews the relevant literature on the causes of construction delay. Section 3 describes the research methodology. Section 4 presents and critically analyses findings. Section 5 draws conclusions and offers targeted recommendations.

2. LITERATURE REVIEW

2.1 The Taxonomy Problem in Construction Delay Research

The available literature lacked a standard method or framework for identifying critical causes of delay, and the use of ambiguous and unstructured phrasing had undermined the effectiveness of prior findings. Amarkhil et al. (2023) extracted 335 distinct critical causes of delay, condensed them into 14 groups, and summarized them into 48 major causes, just to make the literature comparable. The proposed solution illustrates the scale of the fragmentation that the authors were responding to from prior studies. Yet newer studies continue to propose entirely different top-level schemes rather than adopting this or any other standard. A delay-analysis study sorts causes into just three buckets (Contractors' Delays, Owners' Delays, and External Factor Delays) (Amoah et al., 2024). A systematic review of office-building delays organizes 74 papers' worth of causes into three different categories: Input Delay Factors (4 factors), Internal Delay Factors (18 factors), and External Factors (5 factors) (Aldammak et al., 2025). Derakhshanfar et al. (2019) developed another structure from 46 articles using grounded theory coding and identified 26 delay risks grouped into 10 categories, forming a risk breakdown structure.

These taxonomies are descriptively useful but analytically limited. They treat all causal categories as structurally equivalent, which prevents identification of the mechanism by which dysfunction in one category propagates delay through others. Yet subsequent literature has not consistently given financial dysfunction its appropriate analytical prominence.

2.2 Financial Constraints and Payment Delays

Rabbet's 2024 Construction Payments Report found payment delays cost the U.S. construction industry an estimated \$280 billion in 2024 alone, with 82% of contractors reporting payment waits exceeding 30 days, up from 49% two years earlier (Rabbet, 2024). A regression-based study of 138 clients, contractors, and consultants across Enugu and Anambra States found that contractor-related factors emerged as the most severe delay category overall, while delay in progress payment ranked first among individual factors, with difficulties in financing the project ranking a close second (Nzubechukwu & Precious, 2026). Zagia et al. (2026) synthesized 92 studies from 35 countries using a PRISMA-based review and concludes that owner-side financial problems and delayed contractor payments are the most widespread drivers of delay. The review further argues that delay is a context-specific problem, but financing failures, weak planning, and poor execution management are the common backbone across countries and project types.

Haseeb et al. (2011) demonstrated that delays in payment to contractors disrupt cash flow and create a cascading effect across procurement, labour, and equipment deployment. In government-funded infrastructure, this problem is compounded by bureaucratic approval requirements, Treasury Single Account restrictions, and politically driven funding allocations (Olawale & Sun, 2010). Zagia et al. (2026) further discovered that corruption and government bureaucracy were the leading causes of delays in Nigeria, followed by inadequate funding and price fluctuations/inflation, pointing to a governance-and-funding cause chain rather than a purely contractual payment-processing one. A conceptual framework study on federal highway cost overruns in Southeast Nigeria uses the Second Niger Bridge as a documented case: the ₦11.79 km bridge project, originally contracted at approximately ₦206.15 billion, was revised upward to approximately ₦300.98 billion (Okpan Agara, 2025). The Nigerian SUKUK bond financing model, introduced to supplement traditional budgetary funding, improved short-term liquidity on several projects but did not resolve the underlying structural

problem of delayed interim certificate certification and payment. In large-scale road projects where contractor working capital requirements are substantial, the combined effect of retention and payment delay can effectively paralyze construction for extended periods.

2.3 Technical and Design-Related Delay Factors

Orya and Calahorra-Jimenez (2025) conducted a systematic review and discovered that 80% of delay reasons occur in the construction phase, while only 20% are associated with the design and procurement phases combined. Design changes after construction commencement are well-documented as significant delay drivers (Assaf & Al-Hejji, 2006), (Oladapo, 2007). The design-related delay salience is not uniform but varies meaningfully by infrastructure type (Devi & Sindhu, 2025).

Oshin (2025) evaluated the effects of design errors directly and found them to be a recurring source of delays, cost overruns, and quality problems across the sampled firms. An RII-based study of building construction delays in Osun State found that incomplete drawings ranked among the most significant delay factors, with an RII of 0.84, alongside cash flow problems (0.89), improper planning and scheduling (0.91), and financial incapability (0.89) (Egwim et al., 2023). Ebekozi et al. (2015) found that consultants, contractors, and clients contribute to design errors, with the most prevalent causes being late or inadequate client instructions, client interference, inadequate site investigation, and unclear documentation. They further identified that project delays, cost overruns, rework, accidents, and contract disputes were the most significant resulting impacts. Zhang et al. (2025) found that the major factors leading to design errors are design input information error, unreasonable intervention on design, noncompliance with standard requirements, and error in site geological survey documentation, and importantly noted a disconnection in understanding among stakeholders about the causes of design errors.

A gap that remains largely unaddressed in the literature is the precise mechanism by which ministerially-directed scope changes, a recurring feature of Nigerian federal infrastructure delivery, override the contract documents governing a project rather than operate through them. Unlike formally issued variation orders, which are processed under the contract's change-management provisions and carry corresponding adjustments to time and cost, ministerial directives frequently originate outside this framework altogether: they are issued as administrative instructions rather than contractual instruments, yet are treated on-site as binding. The result is a structural asymmetry. The redesign obligation is transmitted immediately, while the contractual mechanisms that would normally protect the time and cost implications of that redesign are either bypassed or invoked only after the fact, if at all. This dynamic has significant practical consequences for project delivery, yet the specific pathway by which it occurs, how a ministerial instruction acquires practical authority over a signed contract, and why the usual safeguards fail to activate in response, has received little direct scholarly attention.

2.4 Research Gap

The existing literature on delays in Nigerian road construction projects is relatively limited compared to that in building construction research. More critically, no study has applied documentary financial analysis, specifically, systematic examination of interim payment certificates alongside progress reports, to empirically link financial disbursement patterns to physical progress trajectories on a major Northern Nigerian Road project (Akpor & Ransome, 2025), (Aliyu, 2024), (Mahmud et al., 2021). This study addresses that gap.

3. RESEARCH METHODOLOGY

3.1 Research Design and Justification

This study employs a qualitative case study design, as recommended by Yin (2015) for research that requires an in-depth examination of a phenomenon within its real-world context. The Kano–Katsina Road Dualization Project was selected as the case study because it combines strategic national significance, documented cost and schedule overruns, and accessible key stakeholders and project records.

A mixed-methods approach integrating qualitative interviews and quantitative document analysis was adopted to enable triangulation, improving the reliability and internal validity of findings

(Creswell & Creswell, 2017). The quantitative component is descriptive rather than inferential; it provides objective benchmarks that support and contextualize the interpretation of qualitative data, rather than aiming for statistical generalization.

3.2 Data Collection

Primary data were collected through semi-structured interviews with 11 purposively selected participants: 4 site engineers, 3 Federal Ministry of Works officials, 1 CCECC personnel manager, and 3 skilled and semi-skilled site workers. Purposive selection ensured depth of information and diversity of roles, consistent with qualitative case study norms (Saunders et al., 2018). All eleven participants provided complete, usable responses (100% response rate).

Secondary data comprised two official project documents: (i) the project progress report documenting physical completion percentages at six time points between October 2021 and April 2025, and (ii) Interim Payment Certificate No. 113809, providing a structured financial record of gross valuation, retention deductions, previous payments, and net payable amounts.

3.3 Analytical Approach

Qualitative interview data were analyzed using thematic analysis, with codes grouped into financial, technical, environmental, and institutional themes. Documentary data were analyzed using schedule performance comparison (percentage completion vs. percentage of elapsed time) and financial structure analysis (examining the composition and magnitude of IPC deductions). Triangulation across these three data streams, interviews, progress data, and financial data, formed the basis of causal inference.

3.4 Limitations

The study is limited to a single project case, constraining statistical generalisability. Access to the full IPC register was unavailable; analysis was confined to IPC No. 113809. The small interview sample, while appropriate for qualitative case study research, may not capture the full range of stakeholder perspectives. These limitations should inform the interpretation of findings.

4. FINDINGS AND DISCUSSION

4.1 Themantic Analysis

Table 1 accounts for how many separate points fall under each theme. For example, under "Financial dysfunction," 6 distinct issues are counted (delayed payments, insufficient mobilization funds, IPC delays, "no pay, no work" stoppages, SUKUK/inflation offset, BEME cost escalation). The sentences in the last column are paraphrased and combined by the interviewers, not verbatim.

Table 1: Thematic Summary

Theme	Distinct sub-issues raised in the narrative	Illustrative characterization (paraphrased from findings, not verbatim)
Financial dysfunction	6 (delayed payments; insufficient mobilization funds; IPC processing delays; "no pay, no work" stoppages; SUKUK financing offset by inflation/accumulated delay; BEME revision cost escalation)	Respondents linked payment delay directly to work stoppages, describing a "no pay, no work" posture by the contractor during funding gaps. All 11 interviewers confirmed.
Technical/design inadequacy	6 (cost-driven original design; FMW directive for full dual-carriageway reconstruction; design creep/redesign; groundwater-induced settlement near Bichi; inadequate EIA; extended remedial works)	Respondents attributed the redesign disruption to a late directive requiring full reconstruction of both carriageways, including sub-base replacement, rather than the originally scoped partial rehabilitation. Confirmed by the 7 interviewers.
Environmental factors	4 (rainfall; continued earthworks against advice; washouts/rework from carriageway height mismatch; unanticipated seasonal hydrology)	Respondents noted that earthworks continued through peak rainy periods despite recommendations to suspend, resulting in washouts and repeated compaction rework. Confirmed by the 5 interviewers.
Institutional/administrative factors	4 (bureaucratic/approval delays; overlapping client-consultant-contractor responsibilities; "protected works only" payment restriction; late-discovered 7 km measurement discrepancy)	Respondents described payment certification limited to "protected works" (e.g., asphalt, drainage), excluding subgrade and pavement layers, as a disincentive to continuous progress. Confirmed by the 6 interviewers.

4.2 Extent and Trajectory of Schedule Overrun

The progress report data, presented in **Table 2**, provide the clearest quantitative evidence of the project's performance failure. At every recorded time point, the percentage of project time elapsed materially exceeded the percentage of physical work completed. Critically, this disparity was not the result of a single acute disruption; it reflects a progressive, cumulative deterioration in schedule performance spanning more than 3 years of documented data.

Several features of this trajectory warrant particular attention. First, the project had already exceeded its planned duration by the time the earliest recorded data point was reached (October 2021, 104.44% time elapsed). This is not a project that started well and collapsed; it was in arrears before the observation window even opened, indicating that delays were systemic from the outset. Second, the period from January to June 2022 shows complete stagnation: physical progress did not advance by a single percentage point over five months, while time continued to accumulate. This is not a slowdown; it is a construction halt. Third, between June 2022 and March 2025, a gap of nearly three years in the

recorded data, physical progress advanced by only 5.49 percentage points (from 82.97% to 88.46%), while time elapsed increased by 48.89 percentage points. Whatever happened in this interval, the project was producing work at a rate catastrophically below what time and resources should have permitted.

Table 2: Schedule Performance Comparison (October 2021 – April 2025)

Date	Physical Completion (%)	Time Elapsed (%)	Schedule Gap (pp)
October 2021	81.70	104.44	22.74
January 2022	82.97	107.78	24.81
May 2022	82.97	112.22	29.25
June 2022	82.97	113.33	30.36
March 2025	88.46	162.22	73.76
April 2025	90.13	163.33	73.20

Note: No progress reports were available to the authors for the period June 2022 to February 2025; this gap reflects a documentation limitation in the project records accessed, not a pause in construction activity

4.3 Financial Dysfunction: The Interim Certificate as Evidence

Analysis of IPC No. 113809 reveals the financial structure underlying this schedule failure. The certificate demonstrates that the contractor's effective working capital was substantially constrained by three compounding mechanisms: (i) gross valuation falling below actual work value due to 'protected works only' certification policies; (ii) retention deductions reducing the certified amount; and (iii) previous payment adjustments further reducing net disbursements. These findings should be read as indicative of a documented instance rather than as a representative average across the project's full payment history, given the single-certificate limitation acknowledged in Section 3.4.

The 'protected works only' policy whereby the Ministry certified payment only for completed, weatherproof elements such as asphalt and drainage, while excluding subgrade and pavement layers awaiting further work, is particularly consequential. This policy creates a perverse incentive structure: contractors must invest in early-stage work without financial recognition until that work is fully enclosed by later-stage activities. In a road project where earthworks and subgrade preparation precede and enable all subsequent paving operations, this policy effectively means the contractor must finance weeks or months of high-intensity activity before receiving any payment.

The cumulative effect of these mechanisms is a structural cash flow deficit that, in the interview data, was directly linked to the 'no pay, no work' operational posture adopted by CCECC during periods of payment delay. This posture is rational from the contractor's perspective but catastrophic for project continuity. It transforms temporary financial disruption into an extended construction suspension, exactly the pattern observed during the 2022 stagnation period.

4.4 The Redesign Disruption: A Ministerially-Generated Delay

The original contract scope included the rehabilitation of the existing carriageway and the construction of a new one. A subsequent directive from the Federal Ministry of Works required full reconstruction of both carriageways, including complete replacement of the sub-base. This change was not a contractor decision; it was imposed by the client mid-execution.

The consequences were threefold: a revised Bill of Engineering Measurement and Evaluation (R-BEME) was required, increasing the contract sum by ₦10 billion; redesigned work disrupted the established construction programme; and scope creep created ambiguity about what was included in existing valuations. The residual increase from ₦24 billion to approximately ₦68 billion, beyond the ₦10 billion attributable to the R-BEME redesign, is described in project correspondence as arising from cumulative inflationary adjustments; however, an itemized breakdown of this escalation was not available within the documentary record accessed for this study, and this is acknowledged as a limitation of the financial analysis presented. What is absent from the documentary record is any evidence that the time implications of this redesign were formally incorporated into an extended contract programme. The contractor absorbed the schedule impact without contractual relief due to contract administration failures that directly contributed to the growing schedule gap.

4.5 Geotechnical Failure and the Cost of Inadequate Pre-Construction Assessment

Interview data identified geotechnical instability along approximately one kilometer of roadway traversing Bichi town, where rising groundwater caused surface settlement. This problem was attributed to inadequate Environmental Impact Assessment at the planning stage and the inadvertent removal of natural geological barriers during initial earthworks.

The remediation of this failed excavation, the installation of a drainage layer, and recompaction consumed time and resources without advancing the recorded percentage completion in the progress report. It represents a category of ‘invisible work’: labour and materials expended on rectifying avoidable problems rather than constructing new infrastructure. The absence of a thorough pre-construction geotechnical investigation is a planning failure with compounding consequences. It not only caused direct delays but also imposed costs that reduced the contractor’s already-constrained working capital.

4.6 The Seven-Kilometer Measurement Error

A further factor reportedly identified by interviewees, though not independently verifiable from the documentary record available to this study, concerns an approximately seven-kilometre discrepancy in the project’s defined scope. In the absence of full supporting documentation, this is treated here as a tentative, anecdotal observation warranting future documentary confirmation, rather than as an established causal factor. While the full documentation of this discrepancy was not available for analysis, its existence raises serious questions about the adequacy of the original site investigation and contract documentation. A 9.5% error in the fundamental physical parameter of a road contract is not a minor administrative oversight; it represents a failure at the earliest stage of project definition that propagated uncertainty in cost and schedule throughout execution.

4.7 Synthesis: Financial Dysfunction as Systemic Amplifier

The four causal factors identified: financial dysfunction, ministerially-imposed redesign, geotechnical inadequacy, and measurement error, are not independent (see **Table 3**). They interact through a common mechanism: financial constraint. Technical problems require financial resources to remedy. Redesign disruptions generate contractor claims that must be financially resolved. Measurement errors create cost uncertainty, delaying financial settlement. In each case, the financial system’s inability to process and pay claims in a timely manner transforms a solvable technical problem into an extended delay.

This is the central analytical contribution of this study: financial dysfunction is not merely one causal factor among several. It is the transmission mechanism through which all other delay factors propagate into extended schedule overrun. A project with robust, timely payment systems would still face technical challenges, but those challenges would be remedied within weeks rather than allowed to fester into months of construction suspension.

Table 3: Causal Factor Assessment and Financial Interaction

Causal Category	Specific Factor	Assessed Impact	Interaction with Finance
Financial	Delayed IPC payment; reduced net payable; protected works policy	Critical	Primary driver; directly halts site operations
Technical / Design	Ministerially-directed full reconstruction; scope creep; R-BEME preparation	High	Generates unresolved claims; delays financial settlement
Geotechnical	Groundwater-induced settlement at Bichi; inadequate EIA	High	Remediation costs exhaust constrained working capital
Institutional	Measurement error (7 km discrepancy); bureaucratic approval delays	Moderate–High	Creates cost uncertainty; delays certificate processing
Environmental	Seasonal rainfall; washout and rework on the initial carriageway	Moderate	Exacerbates delays when financial resources to remediate are absent

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study has demonstrated, through a triangulated analysis of interviews, progress documentation, and financial records, that the Kano–Katsina Road Dualization Project experienced a schedule overrun of approximately 73.20 percentage points relative to its planned completion trajectory as at April 2025 (163.33% planned physical progress against 90.13% actual physical progress; see Table 1), underscoring the scale of delay accumulated over the review period. It is a failure that was neither sudden nor confined to a single causal source, but progressive, systemic, and rooted fundamentally in financial dysfunction.

The study advances three principal conclusions. First, delayed and structurally reduced interim payments are the primary causal driver of schedule overrun on this project, operating both directly (through construction suspension) and indirectly (by reducing the contractor’s capacity to respond to technical challenges). Second, a mid-construction redesign imposed by the client without corresponding contractual time relief is a distinct and significant source of delay that existing literature has underexamined in the Nigerian federal infrastructure context. Third, inadequate pre-construction investigation (geotechnical, environmental, and physical) created avoidable problems that consumed resources, inflated costs, and extended the project duration.

5.2 Recommendations

The following recommendations are advanced based on these conclusions:

- **Payment Mechanism Reform:** The Federal Government should institute mandatory payment timelines for interim certificates on infrastructure contracts, with automatic interest accrual on delayed payments. The 'protected works only' certification policy should be reviewed to ensure that subgrade and pavement layer works are certifiable in proportion to their completion, rather than only upon enclosure by subsequent works.
- **Pre-Construction Investigation Standards:** Mandatory geotechnical and hydrological surveys should be completed and independently reviewed prior to contract award. Environmental Impact Assessments should be conducted to a standard sufficient to identify seasonal groundwater behaviour, not merely surface conditions.
- **Contractual Provisions for Client-Directed Scope Changes:** Standard government road contracts should include explicit clauses requiring that ministerially-directed scope changes be accompanied within 30 days by a formal variation order specifying additional cost and time allowances. Scope changes unaccompanied by such orders should be subject to suspension by the contractor.

- **Physical Quantity Verification:** Independent physical surveys verifying project length and scope should be completed and documented before contract execution. The seven-kilometer measurement discrepancy identified in this project would have been avoidable through basic pre-award verification.
- **Progress Monitoring Reform:** Progress reports should be submitted monthly and should include earned value metrics (not merely percentage completion vs. time elapsed) to enable early identification of emerging schedule deviations.

5.3 Contribution to Knowledge

This study contributes to construction delay literature in three ways. It provides empirical evidence linking financial disbursement structure, as revealed by interim certificate analysis, directly to physical progress outcomes on a major Nigerian road project. It advances a hierarchical causal model that positions financial dysfunction as the systemic amplifier of other delay factors, rather than one equivalent variable among many. It provides a documented analysis of a large-scale Northern Nigerian Road dualization project, a category that is underrepresented in existing delay research.

Financial disbursement dysfunction does not act as an independent delay factor but as an amplifier that increases the schedule impact of co-occurring technical and environmental delay factors (refer to **Fig. 1**). The magnitude of schedule overrun on a project is better explained by the interaction between financial dysfunction and technical/environmental factors than by any single factor category in isolation. Contrary to Amarkhil et al. (2023) taxonomy, they categorize delay factors as a flat, non-hierarchical list grouped by source (e.g., client-related, contractor-related, external), the hierarchical causal model proposed here explicitly nests categorical delay factors beneath a systemic financial driver, offering a mechanism (amplification) rather than only a classification, and is thus positioned as complementary to, rather than a replacement for, existing taxonomies.

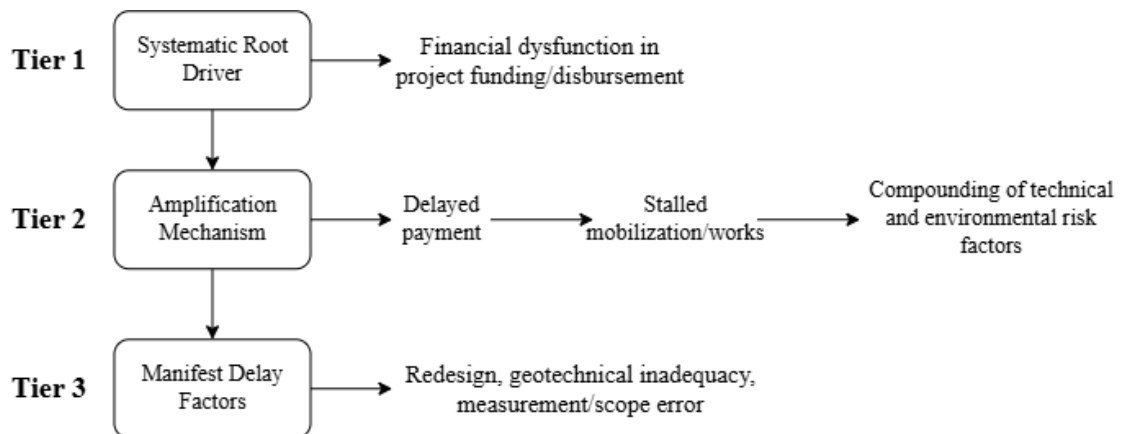


Figure 1: Theoretical Contribution of the Study

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