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IMPROVING ROAD INFRASTRUCTURE DELIVERY EFFICIENCY THROUGH PERFORMANCE-BASED ROAD CONTRACTS: A COMPARATIVE ANALYSIS AND LESSONS FROM DEVELOPED AND DEVELOPING ECONOMIES

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ABSTRACT

Performance-Based Road Contracts (PBCs) have been adopted globally as a more sustainable and efficient alternative to traditional input-based road procurement, yet outcomes vary considerably across countries, with some nations building durable programmes that deliver improved road quality and lower life-cycle costs while others experience persistent underperformance and early programme collapse. This paper presents a comparative analysis of PBC implementation across developed and developing economies, drawing on a systematic review of 27 empirical studies covering 22 countries and supplemented by illustrative evidence from Ghana's pilot Output and Performance-Based Road Contracts under the World Bank-supported Transport Sector Improvement Project (TSIP). The analysis is grounded in four theoretical frameworks, namely Institutional Theory, Stakeholder Theory, the Resource-Based View, and Principal-Agent Theory, and is structured across five dimensions covering institutional readiness, financial sustainability, contractor capacity, monitoring systems, and contextual adaptation. The findings demonstrate that PBC success depends on the simultaneous presence of strong governance, reliable financing, capable contractors, robust monitoring, and contextually adapted contract design, and the paper distils six cross-cutting lessons drawn from global evidence that are applicable to any economy considering PBC adoption or scale-up. The paper is directed at policymakers, road agency managers, and development partners seeking evidence-based guidance on the conditions for sustainable performance-based road infrastructure delivery.

Keywords: *Procurement; Performance-Based Road Contracts; Road Asset Management; Comparative Analysis; Developing Economies; Infrastructure Governance; Institutional Theory; Sustainability.*

LIST OF ABBREVIATIONS

Abbreviation	Full Form
ADB	Asian Development Bank
CAREC	Central Asia Regional Economic Cooperation
CREMA	Contrato de Rehabilitación y Mantenimiento (Argentina's performance-based road maintenance contract programme)
DFR	Department of Feeder Roads
DUR	Department of Urban Roads

Abbreviation	Full Form
GHA	Ghana Highway Authority
GIS	Geographic Information System
IMF	International Monetary Fund
IRI	International Roughness Index
JSTOR	Journal Storage (academic database)
LMIC	Low- and Middle-Income Country
MMAT	Mixed Methods Appraisal Tool
OECD	Organisation for Economic Co-operation and Development
OPBRC	Output and Performance-Based Road Contract
PBC	Performance-Based Road Contract
PPP	Public-Private Partnership
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
QCA	Qualitative Comparative Analysis
RBV	Resource-Based View
SD	Standard Deviation
TSIP	Transport Sector Improvement Project
US$	United States Dollar (currency denomination)

BACKGROUND

Traditional procurement models, primarily the design-bid-build and unit-rate approaches, define contractor obligations in terms of inputs, specifying the materials, methods, and quantities associated with construction activities rather than the condition of the road network over time (Al-Kathairi et al., 2014; Sultana et al., 2012). A contractor who places bituminous pavement to the required depth fulfils contractual obligations regardless of how the road performs in subsequent years, creating a structural misalignment between contractor incentives and the public interest in durable, well-maintained infrastructure. Esperilla-Nino-de-Guzman et al. (2024) document the characteristic consequences of this misalignment, including fragmented accountability, cost overruns, time delays, and systematic neglect of long-term maintenance. In developing economies, these problems are compounded by chronic underfunding, weak institutional capacity, and political interference, creating road networks that deteriorate far faster than they are repaired (Nguyen & Pham, 2023; Zumrawi & Margani, 2017). In Ghana, institutional fragmentation across multiple road management agencies and a Road Fund covering only approximately 45% of maintenance needs produced a road network in which only 39% of the 72,381 kilometre classified network was in good condition as of 2017, with particularly poor conditions in rural and feeder road categories (Curto et al., 2025; World Bank, 2017).

Performance-Based Road Contracts represent a fundamental departure from input-based contracting by shifting the basis of payment from activities completed to service levels achieved over multi-year periods. Under a PBC, the contractor maintains specified road condition standards defined through measurable performance indicators such as the International Roughness Index (IRI), pavement condition indices, and drainage functionality, typically over five to ten years (Gericke et al., 2014; Hughes & Kabiri, 2013). Payment is made when compliance is demonstrated through independent monitoring, and deductions are applied when standards are not met, creating financial incentives for preventive maintenance. Sultana et al. (2012) identify five fundamental limitations of input-based contracting encompassing poor contractor motivation, inadequate risk sharing, and a systematic focus on maximising input volumes rather than optimising road performance, while Gelderman, Semeijn and Vries (2019) confirm that contractors without performance-based incentives rationally minimise maintenance effort to the minimum compliant level. The theoretical foundations of PBCs draw on Principal-Agent Theory, which analyses how road agencies can structure contracts to align contractor behaviour with public objectives under information asymmetry (Jensen & Meckling, 1976). Argentina's CREMA programme, launched in 1995, achieved an economic rate of return of approximately 60% and deferred rehabilitation works by 30% relative to traditional contracts, stimulating widespread global adoption (Mladenovic & Queiroz, 2018).

Ghana introduced Output and Performance-Based Road Contracts in 2018 through the World Bank-supported Transport Sector Improvement Project (TSIP), with total co-financing of approximately

200 million US dollars covering road asset preservation, road safety improvement, and institutional strengthening across the Ghana Highway Authority, Department of Urban Roads, and Department of Feeder Roads (World Bank, 2026). The TSIP produced documented road condition improvements on targeted trunk and feeder road corridors in three regions in Ghana. The performance on both trunk and feeder roads corridors are classified as moderately successful given the shared contractor pool, monitoring arrangements, and institutional framework (Anthony et al., 2024).

THEORETICAL FRAMEWORK

This paper is grounded in four complementary theoretical frameworks that together provide an integrated analytical lens for examining the conditions required for PBC sustainability. Institutional Theory, Stakeholder Theory, the Resource-Based View, and Principal-Agent Theory were selected because they address different but interdependent dimensions of the PBC implementation challenge, and their integration provides a better comprehensive analytical architecture in comparison to any single theory could provide.

Institutional Theory

Institutional Theory holds that the behaviour of organisations is shaped primarily by formal rules, informal norms, and enforcement mechanisms that constitute their operating environment. In the road infrastructure context, this theory explains why PBC programmes succeed in some countries and fail in others by examining the institutional conditions that enable or obstruct performance-based incentive mechanisms. Countries with robust institutional environments, characterised by clear policy frameworks, autonomous road agencies, and consistent legal enforcement, create conditions in which contractor behaviour can be effectively shaped through performance-based payment structures, while countries with fragmented structures and high political volatility systematically undermine the performance logic of PBCs regardless of contract design quality (Brown et al., 2012; Coffie et al., 2025). The theory also illuminates a dynamic that standard PBC analyses frequently overlook: institutional readiness is not a static precondition but a dynamic outcome that must be co-produced with programme implementation through sustained investment, a principle directly reflected in the TSIP's Component 3 on institutional strengthening.

Stakeholder Theory

Stakeholder Theory, developed by Freeman and extended by Dmytriyev and Phillips (2021), holds that the success of any organisational initiative depends on identifying, engaging, and managing the interests of all parties affected by its outcomes. Applied to PBC programmes, this theory reveals that the relevant stakeholder landscape extends far beyond the road agency and contractor relationship to encompass development partners, ministries of finance, local communities, and political executives, each exercising material influence through channels that formal contract documents do not fully capture (Ozdemir et al., 2023; Gumbu, 2024). In developing economies where power asymmetries are pronounced and informal influence frequently exceeds formal authority, Stakeholder Theory provides analytical tools that purely contractual frameworks cannot supply.

Resource-Based View

The Resource-Based View, established by Barney (1991) and extended by McGahan (2021), holds that sustained performance advantage derives from possessing and deploying resources and capabilities that are valuable, rare, difficult to imitate, and non-substitutable. RBV explains why some road agencies and contractors consistently outperform others within the same environment: they possess specialised capabilities in contract management, performance monitoring, and financial analysis that cannot be rapidly replicated (Ozdemir et al., 2023). Road agency capacity and private sector expertise are consistently identified as the highest improvement priorities in practitioner surveys, directly confirming the RBV prediction that resource scarcity is the primary determinant of sustained performance differences. Freeman, Dmytriyev and Phillips (2021) demonstrate that stakeholder relationships themselves function as strategic resources, highlighting the complementarity between all three frameworks.

Principal-Agent Theory

Principal-Agent Theory, originally formulated by Jensen and Meckling (1976), is grounded in three core assumptions. First, the principal and agent have divergent interests, meaning the agent will pursue self-interest rather than the principal's objectives unless constrained by the contract structure. Second, information asymmetry exists between the two parties, with the agent possessing more operational knowledge than the principal, creating conditions for moral hazard and opportunistic behaviour (Braun & Guston, 2003). Third, the principal cannot perfectly monitor agent

behaviour at zero cost, so any governance arrangement must balance the cost of monitoring against the risk of agent deviation from agreed performance standards (Shrestha et al., 2019).

Applied to PBC programmes, road agencies act as principals who design performance-based payment mechanisms to align contractor behaviour with the public interest in sustained road quality, using measurable service level indicators and financial deductions to reduce the information asymmetry that traditional input-based contracts leave unaddressed (Jensen & Meckling, 1976). In the developing economy context, the theory also illuminates a dimension that standard contract analyses frequently overlook: the credibility of the principal's own commitment to the payment mechanism is as important as the structure of the agent's incentives, because where road funds are structurally inadequate and payment flows unreliable, contractors rationally reduce maintenance investment regardless of how performance obligations are specified in the contract (Braun & Guston, 2003; Shrestha et al., 2019).

LITERATURE REVIEW

Sustainability in Road Asset Management

The concept of sustainability in road asset management has expanded over the past two decades beyond technical performance and cost efficiency to encompass economic, environmental, and social dimensions that must be addressed simultaneously for durable outcomes (Mikolaj, Remek & Kozel, 2022; Vijayakumar et al., 2023). Economic sustainability requires that investment decisions minimise total lifecycle costs rather than upfront construction expenditure alone, a distinction with profound implications for how road maintenance contracts are designed and evaluated (Gaspar & Bencze, 2024). Environmental sustainability encompasses climate resilience, minimisation of construction emissions, and management of ecological impacts across the asset lifecycle, dimensions increasingly incorporated into PBC performance specifications in developed economies (Kissi et al., 2023). Social sustainability addresses equity of access, community safety, and user comfort, factors particularly salient in developing economies where road networks serve as the primary connectors between rural communities and economic opportunity (Kapatsa et al., 2024). Dokyi et al. (2025) found that Ghanaian road professionals recognise the importance of climate-responsive design but that economic and resource considerations consistently dominate planning decisions at the expense of social and environmental goals, reflecting a pattern common across developing economies with limited fiscal capacity.

The integration of these sustainability dimensions requires a systems-thinking approach that understands road infrastructure as an interconnected socio-technical system shaped by governance, finance, climate, and community dynamics rather than as an isolated technical asset (Suprayoga, 2020). Martyniuk et al. (2024) demonstrate that lifecycle cost assessment approaches, when extended to incorporate social and environmental externalities, provide a more robust foundation for infrastructure investment decisions than conventional financial accounting. Sustainable PBC outcomes therefore require not just well-designed contracts but the alignment of governance institutions, financing mechanisms, contractor capabilities, and monitoring systems around shared performance objectives, and the performance-based contract is best understood as one component of a broader sustainability governance system whose effectiveness depends on the alignment and quality of all its elements.

Critical Sustainability Success Factors

A systematic review of 15 empirical studies by Nyoagbe and Evdorides (2025) identified 21 critical PBC sustainability success factors organised into two categories. The first encompasses legal, political, economic, social and environmental enabling conditions outside the contract, including policy and legal frameworks, political support, economic feasibility, road agency capacity, private sector expertise, and training schemes. The second encompasses technical, operational and contractual factors internal to the contract, including performance indicators, monitoring, risk management, incentive and penalty systems, and payment model design. Effective monitoring and communication was the most consistently evidenced factor, cited in all 15 studies, confirming that PBC sustainability is fundamentally an information and governance challenge as much as a technical contracting challenge, requiring investment in data infrastructure and accountability mechanisms alongside contract design.

METHODOLOGY

This paper draws on two complementary evidence bases. The first is a systematic comparative review of 27 empirical studies covering PBC implementation in 22 countries, conducted following PRISMA guidelines as established by Moher et al. (2009). Studies were sourced from

Scopus, Web of Science, ScienceDirect, JSTOR, and Google Scholar, supplemented by grey literature from the World Bank, Asian Development Bank, and the OECD, covering publications from 2000 to 2025. Inclusion criteria required that studies document PBC implementation at national or sub-national levels, provide empirical results, and address at least one of the five analytical dimensions. Methodological quality was assessed using the Mixed Methods Appraisal Tool, and studies scoring below 50% were excluded, resulting in 27 studies from an initial pool of 1,140 records following two-stage screening. Countries are classified as Successful, Moderately Successful, or Unsuccessful on each dimension using a qualitative comparative analysis approach.

The second evidence base is illustrative field evidence from Ghana's TSIP, drawn from the

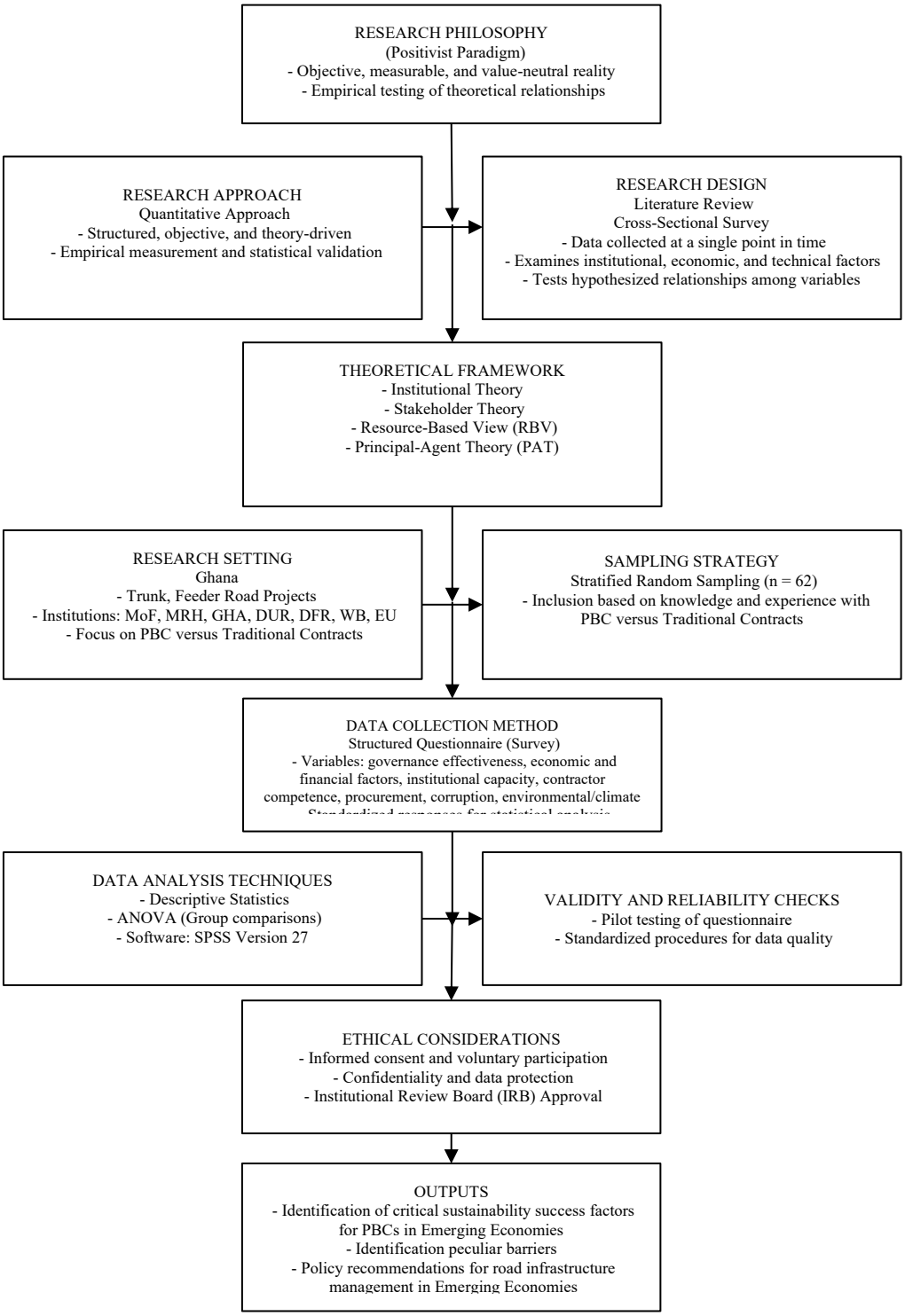

Figure 1: Schematic Diagram of the Research Methodology

doctoral thesis from which this paper is derived.

The study adopted a positivist philosophical paradigm and employed a quantitative, cross-sectional survey design. A structured questionnaire was administered to 62 purposively selected expert stakeholders with direct TSIP involvement in August and September 2024, covering all 21 critical sustainability success factors, improvement requirement ratings, and peculiar barrier assessments on a five-point Likert scale. Respondents included government agency officials, private contractors, consultancy firm representatives, development partner officials, and academic and independent experts. Data were analysed using descriptive statistics in SPSS Version 28, with validity and reliability assured through pilot testing, Cronbach's Alpha confirmation above the 0.7 threshold, and standardised procedures throughout. The study adhered to ethical standards of informed consent, confidentiality, data protection, and Institutional Review Board approval. Figure 1 presents the schematic diagram of the full research methodology.

FINDINGS

Overview of Respondent Profile and Survey Reliability

The questionnaire survey engaged 62 purposively selected expert stakeholders with direct experience of Ghana's Transport Sector Improvement Project, providing an empirically grounded basis for assessing critical sustainability success factors and peculiar barriers to PBC implementation. The sample was predominantly male at 80.6%, reflecting the gender composition of Ghana's road construction and infrastructure sector. The majority of respondents occupied middle-level (54.8%) or top-level (35.5%) management positions, ensuring that the data captured decision-making perspectives rather than operational observations alone. Educational attainment was high, with 75.8% holding at least a Master's degree and a further 6.5% holding doctoral qualifications. Experience levels were substantial, with 27.4% reporting 16 to 20 years of professional experience and 21.0% reporting 21 to 25 years, confirming that respondents possessed the depth of sectoral knowledge required to provide reliable assessments. Knowledge of PBCs was rated medium or higher by 83.9% of respondents, further validating the appropriateness of the purposive sampling strategy for this specialist population.

Critical Sustainability Success Factors: Mean Score Rankings

All 21 critical sustainability success factors presented in the survey received mean scores exceeding 4.0 on a five-point Likert scale, demonstrating a high level of consensus among expert stakeholders that each factor is important for sustainable PBC implementation in Ghana.

Table 1: Demographic profile of respondents

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	50	80.6
	Female	12	19.4
	Total	62	100
Position	Middle-level management	34	54.8
	Top-level management	22	35.5
	Low-level management	2	3.2
	Consultant	1	1.6
	Top-level management (but resigned)	1	1.6
	Grievance Redress Officer	2	3.2
	Total	62	100
Education Level	Master's Degree	47	75.8
	Bachelor's Degree	8	12.9
	Doctor of Philosophy (PhD)	4	6.5
	Chartered Accountant	3	4.8
	Total	62	100

Variable	Category	Frequency (n)	Percentage (%)
Years of Experience (Q1.5)	0 – 5 years	7	11.3
	6 – 10 years	8	12.9
	11 – 15 years	9	14.5
	16 – 20 years	17	27.4
	21 – 25 years	13	21.0
	26 or more years	8	12.9
	Total	62	100
Knowledge of PBCs (Q1.6)	Low	10	16.1
	Medium	22	35.5
	High	20	32.3
	Very High	10	16.1
	Total	62	100

This universal endorsement is itself analytically significant, confirming that sustainability success in PBCs is genuinely multi-dimensional and that no single factor can be safely deprioritised in programme design. Effective monitoring and communication received the highest mean score of 4.548 (SD=0.592), followed by political and executive support at 4.521 (SD=0.763) and procurement and contract negotiation at 4.511 (SD=0.504). Payment model and cash flow was rated fourth at 4.468 (SD=0.646) and capacity of road agencies fifth at 4.452 (SD=0.670), indicating that both financial and institutional capacity dimensions are perceived as equally foundational to programme sustainability. The relative consistency of standard deviations below 0.90 across all 21 factors reflects a high level of respondent agreement, with the lowest SD of 0.504 for procurement and contract negotiation indicating the strongest convergence of expert opinion around this factor.

Figure 2: Mean Scores of Critical Sustainability Success Factors for PBCs in Ghana

The pattern of factor rankings aligns closely with findings from the broader global literature, while also reflecting Ghana-specific contextual priorities. The primacy of effective monitoring and communication, ranked first at M=4.548, is consistent with Stankevich et al. (2005), Gericke et al. (2014), and Umar, Okwandu and Akande (2024), all of whom identify monitoring as the operational foundation of the performance payment mechanism and the primary instrument for preventing contractor opportunism under information asymmetry conditions. Political and executive support ranked second at M=4.521, reinforcing the finding of South et al. (2019) and Brown et al. (2012) that institutional and political commitment from executive leadership determines whether the governance conditions for PBC implementation can be sustained across government transitions. The high ranking of procurement and contract negotiation at M=4.511 reflects the specific context of Ghana's TSIP, where procurement delays of up to 49 months between project approval and contract signing were documented as a primary implementation challenge, confirming Esperilla-Nino-de-Guzman et al. (2024) on the structural importance of procurement quality for PBC programme outcomes.

Factors Requiring Improvement: Institutional and Technical Priorities

The improvement requirements section of the survey asked respondents to assess the degree of additional support or reform needed for each of the 21 factors. Capacity and competence of road agencies received the highest improvement requirement rating at M=4.53 (SD=0.69), followed closely by expertise and capacity of the private sector at M=4.48 (SD=0.64) and economic and financial feasibility at M=4.43 (SD=0.73). The fact that road agency capacity received the highest improvement requirement while also ranking fifth in the success factor importance rankings reflects a specific gap between current capacity levels and the levels required for sustainable PBC management, a finding directly consistent with the RBV prediction that scarce organisational capabilities are the binding constraint on performance in developing economy contexts (Barney, 1991; McGahan, 2021). Training and capacity building and market sounding schemes received a mean improvement requirement score of M=4.39 (SD=0.73), confirming that the development of contractor market depth through deliberate investment is understood by practitioners as a necessary precondition for

programme sustainability. Traffic management and axle load enforcement received the lowest improvement requirement mean at M=3.98 (SD=0.99), the only factor below 4.0, suggesting that this operational factor is perceived as relatively better served by existing institutional arrangements compared to the higher-priority governance and capacity dimensions.

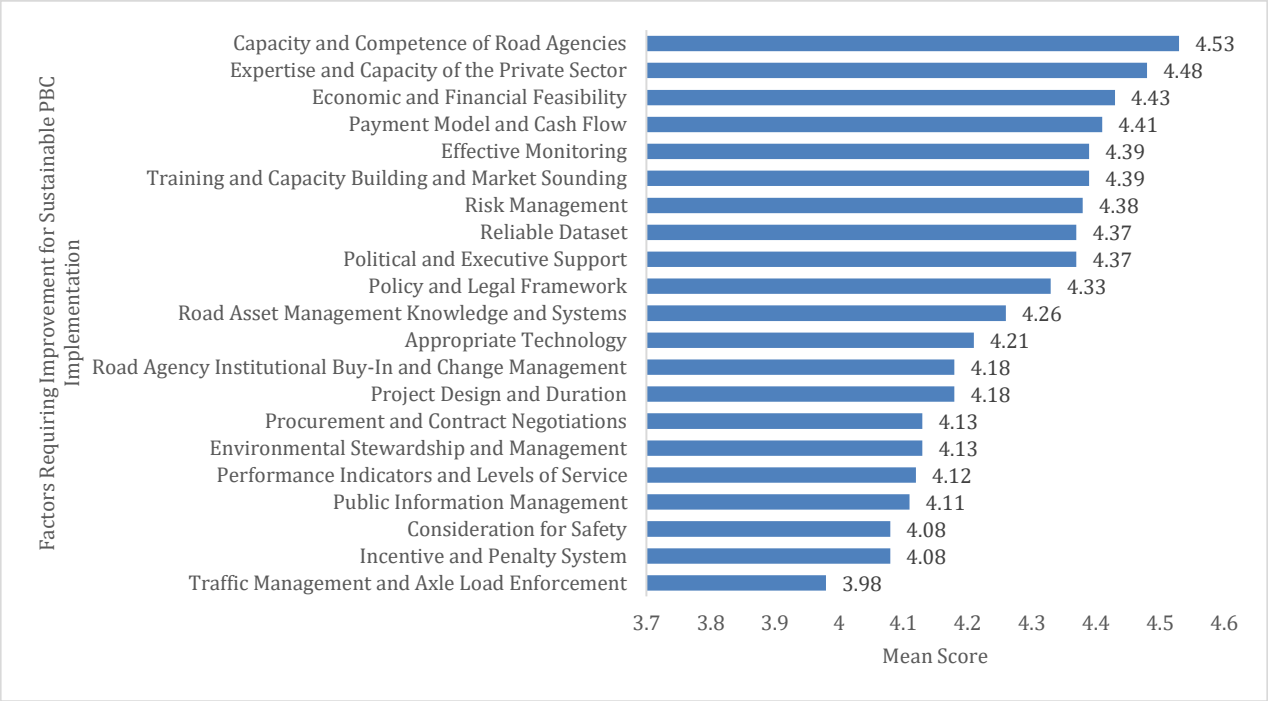

Figure 3: Mean Scores for Factors Requiring Improvement for Sustainable PBC Implementation

Peculiar Barriers: Frequency and Mean Score Rankings

The peculiar barriers section of the survey identified the contextual, macroeconomic, and governance-specific obstacles most likely to undermine PBC sustainability in Ghana. Currency depreciation and price volatility was identified as a barrier by the highest proportion of respondents at 80.6%, reflecting Ghana's severe macroeconomic instability during 2022 and 2023 when inflation exceeded 40% and the cedi experienced substantial depreciation against major currencies. Climbing debt burden was identified by 77.4% of respondents, directly reflecting Ghana's IMF Extended Credit Facility programme initiated in 2023 and the Ministry of Finance disbursement caps that disrupted TSIP contractor payment flows. Weak business climate and lack of access to finance was identified by 75.8%, reflecting the structural challenge for local contractors who cannot access affordable credit to finance the working capital requirements of multi-year performance-based contracts. Macroeconomic risk was identified by 72.6% and corruption by 67.7%, confirming that the governance and fiscal environment in which PBCs operate is perceived by practitioners as constituting the primary threats to programme sustainability, consistently above contractor capacity and technical factors in this ranking.

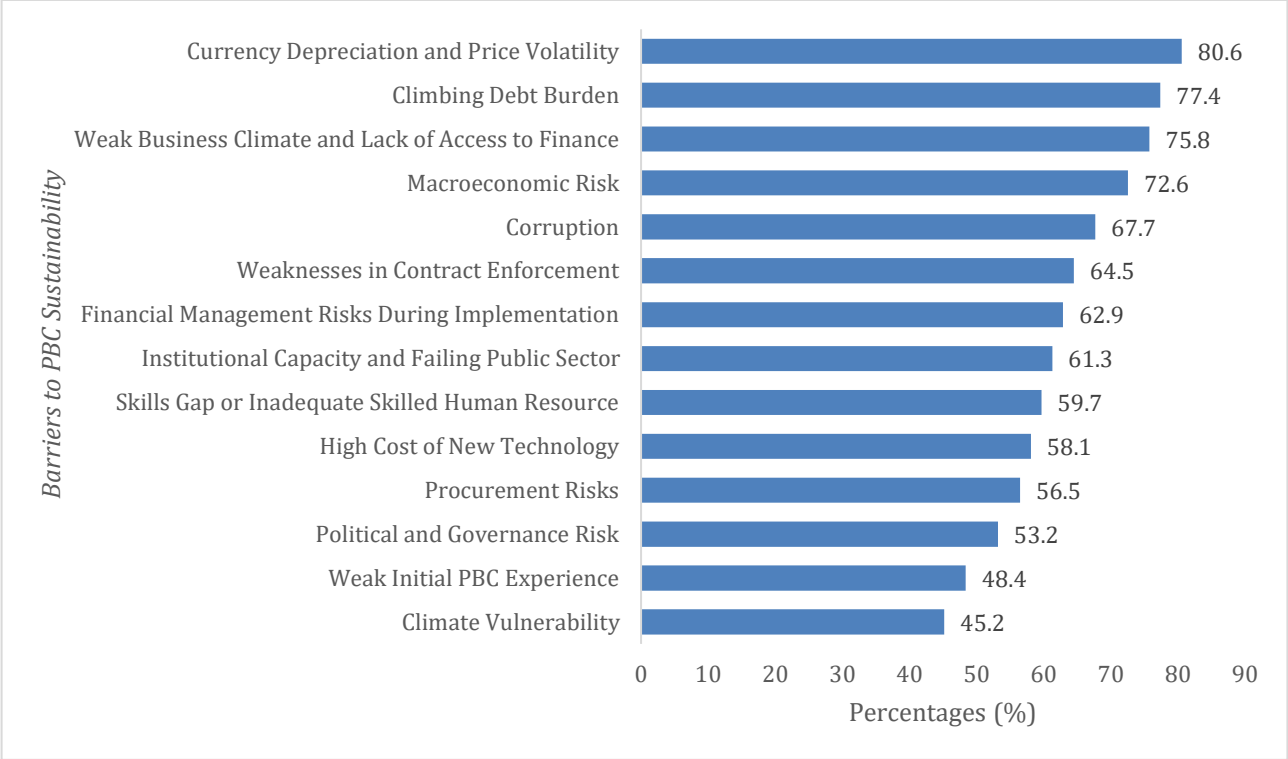

Figure 4: Frequency of Peculiar Barriers to PBC Sustainability

The mean score ranking of barriers provides additional granularity on the perceived severity of each obstacle. Currency depreciation and price volatility received the highest mean barrier score at M=4.10 (SD=1.19), confirming its primacy as the most severe structural constraint on PBC sustainability among Ghana's expert practitioners. The climbing debt burden ranked second at M=4.00 (SD=1.16), directly reflecting the documented disruption to TSIP payment flows caused by fiscal austerity measures. Weak business climate ranked third at M=3.93 (SD=1.11), followed by macroeconomic risk at M=3.84 (SD=1.13) and corruption at M=3.72 (SD=1.25). The pattern of mean scores and standard deviations reveals that macroeconomic and fiscal barriers, which cluster in the 3.84 to 4.10 range with moderate standard deviations, attract more consistent high ratings than governance and institutional barriers, which show greater inter-respondent variance reflected in higher standard deviations. Climate vulnerability received the lowest mean barrier score at M=3.08 (SD=1.14), suggesting that while climate risk is acknowledged as a structural challenge, it is perceived as less immediately threatening to PBC sustainability than fiscal and governance factors in the current Ghanaian context.

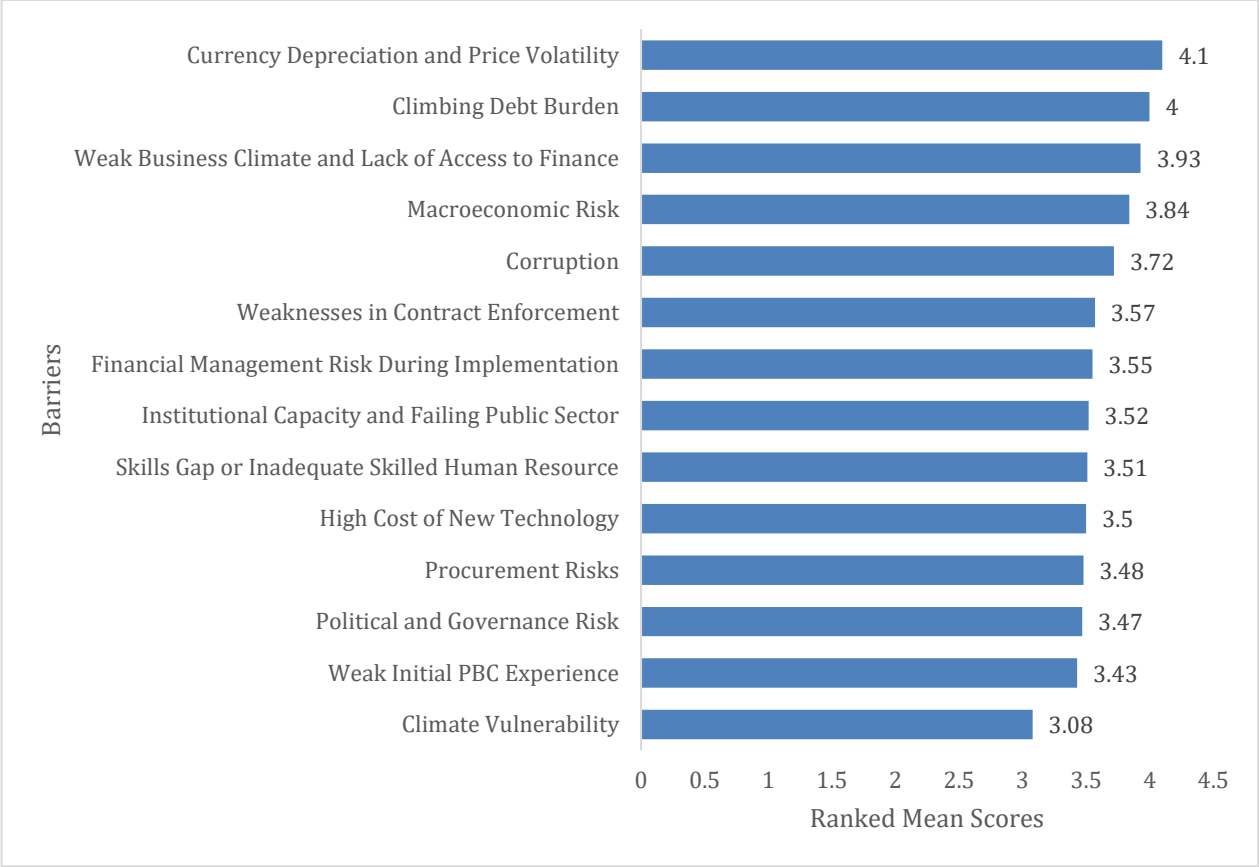

Figure 5: Ranked Mean Scores of Peculiar Barriers to PBC Sustainability

COMPARATIVE ANALYSIS ACROSS FIVE DIMENSIONS

Institutional and Policy Readiness

Institutional and policy readiness encompasses the regulatory framework governing road procurement, the organisational capacity and mandate clarity of road agencies, the consistency of legal enforcement, and the degree of political stability in infrastructure governance. This dimension is most directly addressed by Institutional Theory's emphasis on how formal rules and informal norms shape organisational behaviour in procurement systems, and it is the dimension most consistently associated with PBC success across the global evidence. Countries with strong policy frameworks, high institutional coordination, and effective legal enforcement consistently create the enabling conditions for performance-based incentives to function as intended, while countries with fragmented mandates, weak enforcement, and political interference systematically obstruct PBC implementation regardless of contract design quality (Scott, 2014; Brown et al., 2012).

Table 2 confirms the Institutional Theory prediction with striking consistency across 16 countries. Chile, Colombia, Mexico, Peru, the Philippines, and Vietnam represent the strongest performers, each with centrally mandated or semi-autonomous road agencies, clear dispute resolution mechanisms, and political commitment to performance-based road management embedded in legislation rather than dependent on project-specific alignment. India achieves a successful outcome despite only moderate institutional coordination, reflecting the compensating role of effective legal enforcement in maintaining contractor accountability when governance is fragmented. Nepal, Nigeria, and Tanzania confirm the opposite proposition: where institutional structures are weak and enforcement is ineffective, performance incentive mechanisms cannot operate regardless of contract quality, and PBC programmes consistently fail to achieve sustainable outcomes (Iimi, 2020). Ghana's intermediate position reflects both the genuine progress achieved through the TSIP's institutional strengthening component and the persistent coordination gaps between the three road management agencies that the project did not fully resolve, placing Ghana on a trajectory toward stronger institutional readiness but not yet at the level required for fully self-sustaining PBC programmes.

Table 2: Institutional and policy readiness across countries

Country	Policy Framework	Institutional Coordination	Legal Enforcement	Outcome
Chile	Strong	High	Effective	**Successful**
Colombia	Strong	High	Effective	**Successful**
Mexico	Strong	High	Effective	**Successful**
Peru	Strong	High	Effective	**Successful**
Philippines	Strong	High	Effective	**Successful**
Vietnam	Strong	High	Effective	**Successful**
Argentina	Strong	High	Effective	**Successful**
India	Moderate	Moderate	Effective	**Successful**
Indonesia	Moderate	Moderate	Partially Effective	**Moderately Successful**
Kenya	Moderate	Moderate	Partially Effective	**Moderately Successful**
Rwanda	Moderate	Moderate	Partially Effective	**Moderately Successful**
South Africa	Moderate	Moderate	Partially Effective	**Moderately Successful**
Ghana (TSIP)	Moderate	Low to Moderate	Partially Effective	**Moderately Successful**
Nepal	Weak	Low	Ineffective	**Unsuccessful**
Nigeria	Weak	Low	Ineffective	**Unsuccessful**
Tanzania	Weak	Low	Ineffective	**Unsuccessful**

Source: Compiled from ADB (2018); World Bank (2018); Iimi (2020); Panya and Awuor (2023); Uwimpeta and Akims (2025)

Financial Sustainability and Funding Mechanisms

Financial sustainability encompasses the availability, reliability, and structural design of the financing mechanisms that support multi-year PBC payment commitments. This dimension connects to Principal-Agent Theory through the mechanism of principal credibility: contractors invest in quality maintenance only when they are confident of receiving reliable payment for performance, and where fiscal conditions are unstable or payment flows unpredictable, the performance incentive breaks down regardless of contract quality (Jensen & Meckling, 1976). The dimension also connects to Institutional Theory because the fiscal architecture of road financing is determined by institutional arrangements, including Road Fund governance, ministry budget approval processes, and donor financing frameworks, that are themselves subject to the institutional quality factors discussed in the preceding section.

Table 3: Financial sustainability and funding mechanisms across countries

Country	Funding Mechanism	Payment Reliability	Outcome
Argentina	PPP-Based	Very High	**Successful**
Australia	PPP-Based and Public Budget	Very High	**Successful**
Chile	Blended Public and PPP	High	**Successful**
India	Public Budget	High	**Successful**
Indonesia	PPP-Based	Very High	**Successful**
Mexico	Public Budget	High	**Successful**
Philippines	Blended	High	**Successful**
South Africa	PPP-Based	Very High	**Successful**
Uruguay	Stable Public Funding	High	**Successful**
Vietnam	Blended	High	**Successful**

Country	Funding Mechanism	Payment Reliability	Outcome
Rwanda	Blended Public and Donor	High	**Moderately Successful**
Kenya	Donor-Supported	Moderate	**Moderately Successful**
Ghana (TSIP)	Donor-Supported via World Bank	Moderate	**Moderately Successful**
Malawi	Donor Dependent	Low	**Unsuccessful**
Tanzania	Donor Dependent	Low	**Unsuccessful**
Zambia	Donor Dependent	Low	**Unsuccessful**

Source: Compiled from Mladenovic, Glavic and Milenkovic (2021); Santos (2019); Kamanga and Amos (2019); Sekasi et al. (2024)

Table 3 reveals that financing mechanism reliability is among the most consistent determinants of PBC sustainability in the global evidence. Every successful PBC programme built its financing on mechanisms providing stable, predictable, multi-year payment flows to contractors, whether through public road funds, PPP arrangements, or blended financing models. Every unsuccessful programme depended on donor financing with irregular disbursements, structurally inadequate public road funds, or both. Rwanda's achievement of moderately successful outcomes through a blended public and donor financing mechanism illustrates that developing economies can improve financing stability through institutional design of the funding mechanism even when domestic fiscal capacity is limited. Ghana's position reflects the structural vulnerability of TSIP-era PBC sustainability: World Bank co-financing provided temporary fiscal stability that the Road Fund could not independently guarantee, but this does not address the structural underfunding that will determine whether OPBRCs remain viable after donor support ends. Malawi, Tanzania, and Zambia's consistent unsuccessful outcomes demonstrate what occurs when structural financing reform does not accompany PBC programme design, confirming that Road Fund reform is a necessary rather than optional component of sustainable PBC strategy.

Contractor and Technical Capacity

Contractor and technical capacity encompass the readiness of the domestic construction industry to fulfil long-term performance obligations, including technical expertise in road maintenance and asset management, financial management capability for sustained multi-year performance, risk management systems for long-term contracts, and access to appropriate equipment and certification infrastructure. This dimension is most directly addressed by the Resource-Based View, which identifies rare and difficult-to-replicate organisational capabilities as the binding constraints on sustained performance (Barney, 1991). In developing economies with shallow contracting markets, the scarcity of performance-based contracting capabilities is often the single most important structural constraint on PBC sustainability, yet it is also the dimension that receives the least attention in programme design relative to its importance in determining outcomes.

Table 4: Contractor and technical capacity across countries

Country	Industry Readiness	Training and Certification	Equipment Availability	Outcome
Argentina	High	Standardised	Adequate	**Successful**
Chile	High	Standardised	Adequate	**Successful**
Philippines	High	Standardised	Adequate	**Successful**
South Africa	High	Standardised	Adequate	**Successful**

Country	Industry Readiness	Training and Certification	Equipment Availability	Outcome
Uruguay	High	Standardised	Adequate	**Successful**
India	Moderate	Standardised	Adequate	**Successful**
Vietnam	Moderate	Standardised	Adequate	**Successful**
Brazil	Moderate	Intermittent	Adequate	**Moderately Successful**
Indonesia	Moderate	Standardised	Adequate	**Moderately Successful**
Peru	Moderate	Standardised	Adequate	**Moderately Successful**
Ghana Trunk Roads	Moderate	Limited	Adequate	**Moderately Successful**
Ghana Feeder Roads	Low to Moderate	Minimal	Limited	**Moderately Successful**
Ethiopia	Low	Minimal	Inadequate	**Unsuccessful**
Nigeria	Low	Minimal	Limited	**Unsuccessful**
Tanzania	Low	Absent	Inadequate	**Unsuccessful**

Source: Compiled from Ates et al. (2020); Comas and Santos (2021); Wang (2021); TSIP case study evidence

Table 4 confirms the RBV prediction consistently across the global evidence. Countries with well-developed domestic contracting industries equipped with standardised training, certification systems, and adequate equipment consistently achieve successful PBC outcomes regardless of their specific financing mechanisms or institutional arrangements. Argentina, Chile, South Africa, and Uruguay all invested systematically in contractor development alongside their PBC programmes. South Africa's structured contractor support framework, combining technical training, equipment access, and financial management capacity-building, enabled local contractors to develop the capabilities required for sustained PBC delivery, demonstrating that contracting market depth is buildable through deliberate investment rather than simply inherited. Ghana's within-programme variation between trunk road and feeder road OPBRC performance is analytically instructive because both contract types operated under the same national institutional framework, financing arrangements, and contractor pool, and are accordingly both classified as moderately successful. The difference in relative performance reflects contractor capacity calibration at the contract-type level, directly consistent with the RBV prediction. Tanzania, Nigeria, and Ethiopia demonstrate the same dynamic at the national scale: the absence of any adequate contractor base produces universal underperformance across all contract types, confirming contractor capacity as a non-substitutable prerequisite for PBC programme success.

Data and Monitoring Systems

Data and monitoring systems encompass the technological infrastructure, data management capacity, and governance arrangements for performance measurement that PBC payment mechanisms depend on. Monitoring is the operational core of the payment mechanism in PBC programmes because PBCs pay for outcomes that must be reliably measured for payment to be defensible, and without monitoring infrastructure the performance incentive cannot be translated into financial accountability. From a Stakeholder Theory perspective, monitoring systems are also the primary instrument through which road agencies demonstrate accountability to political principals, communities, and development partners, making monitoring infrastructure a governance asset as important as a technical one (Stankevich et al., 2005; Hughes & Kabiri, 2013).

Table 5: Data and monitoring systems across countries

Country	Monitoring Tools Used	Data Reliability	Outcome
Argentina	Automated systems and third-party audits	High	**Successful**
Australia	Automated and real-time dashboards	High	**Successful**
Chile	Digital tools and GIS mapping	High	**Successful**
India	Automated systems	High	**Successful**
Indonesia	Automated systems	High	**Successful**
Mexico	Real-time dashboards	High	**Successful**
Philippines	Digital tools and GIS mapping	High	**Successful**
South Africa	Automated and third-party audits	High	**Successful**
Uruguay	Real-time dashboards	High	**Successful**
Vietnam	Digital tools and GIS mapping	High	**Successful**
Rwanda	Digital tools and GIS mapping	Moderate	**Moderately Successful**
Kenya	Mixed manual and digital	Moderate	**Moderately Successful**
Ghana Trunk Roads	Partially digital	Moderate	**Moderately Successful**
Ghana Feeder Roads	Predominantly manual	Low	**Moderately Successful**
Malawi	Manual and paper-based	Low	**Unsuccessful**
Tanzania	Manual and paper-based	Low	**Unsuccessful**
Zambia	Manual and paper-based	Low	**Unsuccessful**

Source: Compiled from Mladenovic, Glavic and Milenkovic (2021); Umar, Okwandu and Akande (2024); Kamanga and Amos (2019)

Table 5 demonstrates that the relationship between monitoring technology and programme outcomes is absolute in the comparative evidence: all ten countries that achieved successful PBC outcomes relied on digital, automated, or GIS-based monitoring systems, and no country that relied exclusively on manual paper-based inspection achieved successful programme outcomes. This is a functional relationship rather than a correlation: the volume, frequency, and consistency of performance data required to manage a multi-year PBC across a road network cannot be reliably produced through manual systems at scale, creating systematic data gaps that undermine payment decisions, enforcement actions, and contractor accountability (Caetano & Cabral, 2025). Rwanda's achievement of moderately successful outcomes through donor-supported digital monitoring demonstrates that developing economies can adopt digital monitoring infrastructure when it is treated as a core programme investment with dedicated financing rather than a project expense. Ghana's within-programme experience, with both trunk road and feeder road contracts classified as moderately successful given the shared monitoring framework, confirms that monitoring system quality shapes relative performance at the contract-

type level. Digital monitoring investment is identified as the primary area for improvement in future trunk and feeder road programme cycles.

Contextual Adaptation and Localisation

Contextual adaptation encompasses the degree to which PBC frameworks, performance standards, contract durations, risk allocation provisions, and dispute resolution mechanisms have been modified to reflect the specific institutional, climatic, geographic, and market conditions of the host context. The global PBC literature consistently identifies direct transplantation of PBC models without contextual adaptation as a reliable predictor of failure, reflecting the Institutional Theory insight that formal contractual structures which are misaligned with the informal norms, enforcement realities, and operational conditions of the host environment cannot produce the behaviours they are designed to incentivise (Kundu et al., 2023; Scharpff et al., 2020). Contextual adaptation is not a compromise on performance-based principles but rather the practical precondition for those principles to produce the intended contractor behaviours in specific national and sub-national settings.

Table 6: Contextual adaptation and localisation across countries

Country	Adaptation Approach	Degree of Localisation	Outcome
Peru	Performance thresholds adjusted for mountain terrain and seasonal rainfall variability	Very High	**Successful**
Chile	Phased implementation with standards calibrated to road network typology and contractor profiles	High	**Successful**
Vietnam	Performance criteria and payment periods modified to fit local administrative and environmental context	High	**Successful**
Philippines	Tiered contract design matched to road category and contractor capacity profile	High	**Successful**
South Africa	Contractor development framework adapted to local market conditions and empowerment requirements	High	**Successful**
Indonesia	Payment structures adapted to local governance and climate conditions	High	**Moderately Successful**
Rwanda	Performance standards calibrated to limited local contractor capacity with phased introduction	Moderate	**Moderately Successful**
Ghana Trunk Roads	Contract design adapted to Northern Ghana context with broadly appropriate trunk road standards	Moderate	**Moderately Successful**
Ghana Feeder Roads	Standards calibrated at programme level; contract-type adaptation identified as improvement priority	Low to Moderate	**Moderately Successful**
Malawi	Standardised PBC template applied without adjustment leading to poor compliance and disputes	Low	**Unsuccessful**

Country	Adaptation Approach	Degree of Localisation	Outcome
Tanzania	Foreign PBC model applied without adaptation with unrealistic performance criteria	Low	**Unsuccessful**
Nepal	Rigid contract clauses with limited stakeholder engagement and inflexible performance indicators	Low	**Unsuccessful**

Source: Compiled from Kundu et al. (2023); Iimi (2020); Namakula (2024); Scharpff et al. (2020); TSIP case study evidence

Table 6 confirms that contextual adaptation is as consequential for PBC outcomes as institutional readiness and financial sustainability. Peru's modification of performance thresholds for mountainous terrain and seasonal flooding, Vietnam's adaptation of payment periods to local administrative cycles, and the Philippines' development of tiered contract complexity frameworks demonstrate that substantive adaptation of both the architecture and the specifications of PBC contracts is necessary for performance incentives to function in specific local conditions (Kundu et al., 2023). Malawi, Tanzania, and Nepal's failures stemmed directly from applying standardised templates with minimal adaptation, producing performance standards misaligned with contractor capabilities, climate conditions, and enforcement realities that generated disputes rather than performance improvement. Ghana's within-programme divergence on this dimension provides a natural experiment confirming that adaptation must occur at the contract-type level, not just the national programme level. Trunk road OPBRCs, adapted to the characteristics of Ghana's main road network and larger contractor base, achieved moderate success. Feeder road OPBRCs, sharing the same programme-level institutional framework and accordingly classified as moderately successful, are identified as requiring further contract-type adaptation in future programme cycles to better reflect the feeder road contractor profile and infrastructure environment.

CROSS-COUNTRY PERFORMANCE SUMMARY

Table 7 presents an integrated performance heatmap consolidating the five-dimensional analysis across 18 countries, providing visual confirmation of the multi-dimensional conditions that differentiate sustained success from persistent underperformance. The heatmap enables simultaneous comparison of country profiles, revealing the patterns of dimensional strength and weakness that characterise each outcome category. The figure makes three analytically important patterns immediately visible that are difficult to discern from individual dimension tables alone.

The first pattern visible in Table 7 is that every country in the successful outcome category demonstrates at least moderate strength across all five dimensions simultaneously, confirming that PBC sustainability requires multi-dimensional enabling conditions rather than excellence in any single area. No country achieved successful outcomes while tolerating a significant weakness on any dimension, confirming the interdependence hypothesis central to the integrated theoretical framework. The second pattern is that the transition from moderately successful to unsuccessful outcomes is not a gradual decline across all dimensions but is associated with specific combinations of weakness, particularly simultaneous weakness in financial sustainability and institutional readiness. Countries in the unsuccessful category, including Malawi, Tanzania, Nepal, and Nigeria, consistently show weakness across both governance dimensions regardless of their specific performance on contractor capacity, monitoring, or contextual adaptation. The third pattern concerns Ghana's feeder road programme. Accordingly, Ghana's feeder road programme is classified as moderately successful, consistent with the trunk road programme.

LESSONS FROM ACROSS COUNTRIES

The comparative evidence across 22 countries and five analytical dimensions generates six cross-cutting lessons that are actionable across diverse national contexts. These lessons are derived from patterns observed across multiple countries and reflect the integrated insights of the three theoretical frameworks.

Lesson 1: Financing Reform Must Precede or Accompany PBC Scale-Up

The most consistent finding across the comparative evidence is that PBC sustainability depends on reliable and predictable multi-year financing, and no country in the global evidence base achieved sustained PBC success on a foundation of structurally inadequate road financing. Chile, Uruguay, Argentina, and Australia built their programmes on stable domestic road funds or PPP arrangements providing contractors with credible payment assurance across full contract periods, and the evidence from these countries demonstrates that financing reliability rather than financing volume is the critical variable (Mladenovic, Glavic & Milenkovic, 2021). Malawi, Tanzania, and Zambia's consistent programme failures share the common root of donor-dependent financing that creates payment fragility: when disbursements are delayed, contractors rationally reduce maintenance investment, and the performance incentive that PBCs depend on breaks down.

Table 7: Cross-Country PBC Performance Summary Across Five Dimensions

No.	Country / Programme	Institutional Readiness	Financial Sustainability	Contractor Capacity	Monitoring Systems	Contextual Adaptation	Overall Outcome
SUCCESSFUL PROGRAMMES (n=10)							
1	Chile	**Strong**	**Strong**	**Strong**	**Strong**	**Strong**	**Successful**
2	Uruguay	**Strong**	**Strong**	**Strong**	**Strong**	**Strong**	**Successful**
3	Argentina	**Strong**	**Strong**	**Strong**	**Strong**	**Moderate**	**Successful**
4	Philippines	**Strong**	**Strong**	**Strong**	**Strong**	**Strong**	**Successful**
5	Vietnam	**Strong**	**Strong**	**Moderate**	**Strong**	**Strong**	**Successful**
6	Australia	**Strong**	**Strong**	**Strong**	**Strong**	**Strong**	**Successful**
7	South Africa	**Moderate**	**Strong**	**Strong**	**Strong**	**Strong**	**Successful**
8	India	**Moderate**	**Strong**	**Moderate**	**Strong**	**Moderate**	**Successful**
9	Mexico	**Strong**	**Strong**	**Moderate**	**Strong**	**Moderate**	**Successful**
10	Peru	**Strong**	**Moderate**	**Moderate**	**Moderate**	**Strong**	**Successful**
MODERATELY SUCCESSFUL PROGRAMMES (n=8)							
11	Rwanda	**Moderate**	**Moderate**	**Weak**	**Moderate**	**Moderate**	**Moderately Successful**
12	Indonesia	**Moderate**	**Strong**	**Moderate**	**Strong**	**Moderate**	**Moderately Successful**
13	Kenya	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderately Successful**
14	Ghana – Trunk Roads	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderately Successful**
15	Ghana – Feeder Roads	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderately Successful**
16	Brazil	**Moderate**	**Strong**	**Moderate**	**Moderate**	**Moderate**	**Moderately Successful**
17	South Africa (Feeder)	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderately Successful**
UNSUCCESSFUL PROGRAMMES (n=6)							
18	Malawi	**Weak**	**Weak**	**Weak**	**Weak**	**Weak**	**Unsuccessful**
19	Tanzania	**Weak**	**Weak**	**Weak**	**Weak**	**Weak**	**Unsuccessful**
20	Nigeria	**Weak**	**Weak**	**Weak**	**Moderate**	**Weak**	**Unsuccessful**
21	Nepal	**Weak**	**Weak**	**Weak**	**Weak**	**Weak**	**Unsuccessful**
22	Zambia	**Moderate**	**Weak**	**Weak**	**Weak**	**Weak**	**Unsuccessful**
23	Ethiopia	**Weak**	**Weak**	**Weak**	**Weak**	**Weak**	**Unsuccessful**
Color key:	**GREEN = Strong / Successful**		**AMBER = Moderate**		**RED = Weak / Unsuccessful**		

Note: Ratings based on qualitative comparative analysis (QCA) of 27 studies covering 22 countries (2000–2025). Ghana's trunk and feeder programmes are listed separately to reflect within-programme variation; both are classified as Moderately Successful given shared contractor pool, monitoring arrangements, and institutional framework.

Rwanda's achievement of moderately successful outcomes through a carefully designed blended financing mechanism demonstrates that developing economies can improve payment reliability through institutional design even when domestic fiscal capacity is limited. For developing economies seeking to scale PBCs beyond donor-supported pilots, this lesson means that Road Fund reform, encompassing revenue diversification, ring-fenced performance payment reserves, and

multi-year budget commitment mechanisms, must be treated as a programme component rather than a parallel reform priority to be addressed separately from contract design.

Lesson 2: Match Contract Complexity to Contractor Market Capacity

Every country that applied uniform PBC standards across a contractor market with diverse capacity profiles experienced performance divergence, with stronger outcomes from larger and more experienced contractors and consistently weaker outcomes from smaller local ones. The Philippines, South Africa, and Chile addressed this structural challenge by developing tiered PBC frameworks that matched contract complexity to available contractor capacity, beginning with simpler output-based maintenance obligations and progressively increasing performance demands as the domestic contractor base developed the required capabilities (Ates et al., 2020; Comas & Santos, 2021). Ghana's within-programme divergence between trunk road and feeder road OPBRC performance is the most detailed natural experiment in the global evidence on this dimension, demonstrating that the same performance obligations produce markedly different outcomes depending on whether they are matched to the capacity profile of available contractors. The lesson for programme designers is that pre-tender contractor market assessment should determine the complexity of performance obligations rather than aspirational performance targets determined independently of market capacity, and that contractor development programmes providing training, equipment access, and financial management support should be treated as programme investments with direct impact on contract outcomes.

Lesson 3: Build Monitoring Systems as Permanent Programme Infrastructure

Figure 8 demonstrated that all successful PBC programmes relied on digital or automated monitoring systems and that all unsuccessful programmes relied on manual inspection, establishing what is effectively an absolute condition for programme success in the global evidence. Countries that treated monitoring infrastructure as a permanent programme asset, investing in digital systems, third-party inspection arrangements, and data management platforms as core programme components with explicit sustainability plans extending beyond project closure, consistently achieved better contract outcomes than countries treating monitoring as a project expense. Mexico's real-time dashboard system, Vietnam's GIS-based road asset management platform, and Australia's automated pavement condition monitoring illustrate the monitoring architecture that durable PBC programmes depend on (Caetano & Cabral, 2025). Rwanda demonstrates that developing economies can adopt digital monitoring when it is prioritised as core investment rather than overhead. For developing economy governments and their development partners, this lesson implies that monitoring infrastructure financing should be treated as equivalent in importance to road works financing, with dedicated long-term budget allocations, local technical capacity development, and explicit handover arrangements ensuring operational continuity beyond individual project cycles.

Lesson 4: Institutional Capacity Requires Investment Across Multiple Cycles

Countries with the most durable PBC programmes did not achieve the institutional capacities their programmes required in a single project cycle. Chile, Uruguay, and the Philippines invested continuously in road agency capacity development across multiple government administrations, embedding performance-based management principles in legislation, professional development systems, and institutional memory mechanisms that remained resilient to staff turnover and political transition. Countries that treated capacity building as a project-period activity consistently found that institutional gains dissipated after project closure through staff turnover, budget reductions, and the absence of continuing professional development investment. Institutional Theory explains this finding: behavioural change becomes institutionally embedded only through repeated reinforcement that transforms acquired skills into organisational norms and systems rather than remaining dependent on specific trained individuals. For developing economy governments and their development partners, the practical implication is that institutional development funding must extend beyond project timelines to address staff retention mechanisms, system-level knowledge management, and inter-cycle professional development in addition to initial training, treating institutional capacity building as a generation-long investment rather than a project output.

Lesson 5: Every Contract Must Be Adapted to Its Specific Context

Peru, Vietnam, Indonesia, the Philippines, and Chile each made substantive adaptations to their PBC frameworks reflecting local climate

conditions, contractor market profiles, administrative arrangements, and road network typologies, and each achieved successful or moderately successful outcomes. Malawi, Tanzania, and Nepal each applied standardised templates with minimal adaptation and experienced unsuccessful outcomes characterised by persistent non-compliance, contract disputes, and early programme collapse. The global evidence on this dimension confirms the principle that PBCs are a contracting philosophy requiring contextual engineering rather than a transferable product that can be implemented wholesale from one country to another (Kundu et al., 2023; Scharpff et al., 2020). Every new PBC programme requires feasibility assessment, performance indicator calibration, contractor market analysis, and climate risk assessment before contract specifications are finalised, and these assessments must occur at the contract-type level as well as the national programme level, as Ghana's within-programme divergence demonstrates. The adaptation process is not a compromise on performance ambition but the essential precondition for performance incentives to produce intended behaviours rather than contractual disputes.

Lesson 6: Principal Credibility Is as Important as Agent Incentives

Standard Principal-Agent Theory focuses on structuring contractor incentives to align their behaviour with the road agency's objectives, and the PBC payment mechanism is precisely such an incentive structure. The comparative evidence identifies a dimension of the principal-agent relationship that standard applications of the theory underemphasise in developing economy contexts. The credibility of the principal's commitment to the payment mechanism is as important as the structure of the agent's incentives, because contractors who are not confident of reliable payment for good performance will not invest in quality maintenance regardless of how the performance incentive is designed (Jensen & Meckling, 1976). In Chile, Uruguay, and Australia, transparent payment systems, consistent enforcement, and reliable disbursement mechanisms created conditions in which contractors could trust the payment mechanism and invest accordingly. In Ghana, Nigeria, and Tanzania, payment delays, weak enforcement, and fiscal uncertainty eroded contractor confidence, and contractors rationally reduced maintenance investment in response to payment uncertainty rather than as a deliberate choice to underperform. Building principal credibility through structural financing reform, transparent governance, and consistent enforcement is therefore a necessary complement to contractor incentive design, and for developing economy road agencies the most consequential investment they can make in PBC programme sustainability.

DISCUSSION

The survey findings, read in conjunction with the comparative global evidence and the four theoretical frameworks, reveal a consistent and reinforcing pattern across Ghana's practitioner community and the wider international literature. The primacy of effective monitoring and communication at M=4.548 directly confirms the finding across the 22-country comparative review that digital monitoring systems are an absolute precondition for successful PBC outcomes, a relationship observed by Stankevich et al. (2005) and Umar, Okwandu and Akande (2024), who identify monitoring as the mechanism through which the performance-payment linkage is operationalised and contractor accountability maintained. Caetano and Cabral (2025) further demonstrate that monitoring complexity must be balanced with appropriate technological infrastructure if it is to produce enforceable evidence rather than administrative burden. The improvement requirements data, placing road agency capacity at M=4.53 as the highest priority, confirms the RBV prediction established by Barney (1991) and extended by McGahan (2021) that scarce organisational capabilities are the binding constraints on sustained PBC performance, a finding consistent across Ghana and the broader developing economy literature reviewed by Ates et al. (2020) and Wang (2021).

Political and executive support, rated second at M=4.521, receives particular analytical weight in the Ghanaian context. Brown et al. (2012) and Coffie et al. (2025) both identify the co-production of institutional logic with reform initiatives as essential for PBC sustainability, arguing that performance-based management principles require sustained political commitment across electoral cycles rather than project-period training alone. Gumbu (2024) reaches a parallel conclusion in comparative analysis of Zimbabwe and South Africa, confirming that poor management of political stakeholder interests is a primary cause of infrastructure project failure in politically turbulent contexts.

The peculiar barriers findings reveal the macroeconomic and fiscal vulnerabilities distinguishing Ghana's PBC context from more successful global programmes. Currency depreciation and price volatility (80.6%; M=4.10)

and climbing debt burden (77.4%; M=4.00) received the highest barrier ratings, reflecting Ghana's IMF programme-induced fiscal constraints that disrupted TSIP contractor payment flows. Kamanga and Amos (2019) and Sekasi et al. (2024) identify donor-dependent financing fragility as the structural root of PBC failure across Sub-Saharan Africa, arguing that where road funds are structurally inadequate, the principal credibility that Jensen and Meckling (1976) identify as foundational to performance incentive alignment cannot be established. Institutional and governance barriers, including corruption (67.7%) and contract enforcement weaknesses (64.5%), connect directly to the Institutional Theory framework of Scott (2014) and DiMaggio and Powell (1983), and are corroborated by Nyoagbe and Evdorides (2025), Belay et al. (2021), and Abankwah (2020), who document how governance failures and inter-agency coordination gaps allow contractor underperformance to persist without consequence. Ghana's survey results, which consistently identify monitoring, political support, road agency capacity, and fiscal stability as the highest priority factors, map directly onto the pattern of moderate success documented in the five-dimensional comparative analysis, providing the kind of nationally grounded empirical assessment that Mugarura et al. (2020) identify as absent from most Sub-Saharan African PBC literature and that Iimi (2020) and Calahorra-Jimenez and Poythress (2024) confirm is essential for sustainable programme reform.

RECOMMENDATIONS AND IMPLICATIONS FOR PRACTICE

The findings of this paper have direct implications for governments, road agencies, and development partners designing or scaling PBC programmes in developing economies. First, Road Fund reform must be treated as a programme component rather than a background condition, with revenue diversification, ring-fenced maintenance payment reserves, and multi-year budget commitments established before OPBRCs are scaled beyond pilot phases. Second, pre-tender contractor market assessments should determine contract complexity, with graduated performance obligations matched to available contractor capacity and dedicated contractor development programmes treated as core programme investments. Third, digital monitoring infrastructure must be financed as a permanent institutional asset with explicit post-project sustainability arrangements, as manual inspection systems are consistently insufficient for evidencing performance-based payment decisions at scale. Fourth, institutional capacity building must extend across multiple project cycles through retained technical assistance, staff retention mechanisms, and system-level knowledge management that preserves institutional gains beyond individual government administrations. Fifth, every new PBC contract must undergo feasibility assessment, performance indicator calibration, and climate risk screening at the contract-type level before specifications are finalised, recognising that adaptation must occur below the national programme level. Finally, development partners should structure engagement to address structural financing and governance weaknesses rather than buffering them through project co-financing, as temporary donor solutions that do not resolve underlying institutional and fiscal constraints cannot produce self-sustaining PBC programmes.

CONCLUSIONS

This paper has presented a comparative analysis of PBC implementation across 22 countries and five analytical dimensions, grounded in Institutional Theory, Stakeholder Theory, Resource-Based View and Principal-Agent Theory and drawing on systematic review evidence from 27 empirical studies supplemented by Ghana's TSIP experience. The analysis demonstrates that PBC sustainability depends on the simultaneous presence of five enabling conditions: strong institutional and policy frameworks, reliable multi-year financing, a capable contractor and technical market, robust monitoring systems, and contextually adapted contract design. The interdependence between these conditions means that partial reform strategies concentrating investment in one or two dimensions while tolerating weaknesses in others are unlikely to produce sustainable outcomes at national scale.

Six cross-cutting lessons provide an actionable framework for policymakers and development partners: financing reform must precede or accompany PBC scale-up; contract complexity must match contractor market capacity; monitoring must be designed as permanent programme infrastructure; institutional capacity requires investment across multiple political cycles; every contract must be contextually adapted at the contract-type level; and principal credibility is as important as agent incentive design. These lessons are derived from patterns across 22 countries and are more generalisable than findings from any single national experience, though they must be adapted to specific national conditions rather than applied formulaically.

Several limitations deserve acknowledgement, including the potential over-representation of countries with active research infrastructure, the analytical judgements involved in qualitative comparative classification, and the illustrative rather than systematic use of Ghana's experience. Future research should include longitudinal tracking of PBC outcomes beyond individual project cycles, cross-country comparative studies using consistent outcome metrics, and development of a validated PBC Sustainability Index. Performance-based road contracting achieves sustainable outcomes when the enabling conditions are present, and the challenge for developing economy governments is the sustained political and fiscal commitment to build those conditions across multiple project cycles and government administrations.

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