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A Systematic Review of Project Finance and Public Private Partnership Structures for Infrastructure Development

[1] Olaniyi Oluwaseun Oladepo, [2] Kehinde Oyediji
[1] Pike Industries Inc., a CRH PLC Company, USA
[2] Owen Graduate School of Management, Vanderbilt University, Nashville, TN, USA

Corresponding Author: Olaniyi Oluwaseun Oladepo

Abstract
This systematic review examines project finance and public–private partnership (PPP) structures as critical mechanisms for delivering infrastructure in developed and developing economies. Infrastructure financing gaps, fiscal constraints, and rising demand for resilient assets have increased reliance on private capital, risk sharing, and long-term contractual arrangements. The review synthesizes peer-reviewed journal articles, policy reports, and multilateral development institution publications published between 2000 and 2024, applying PRISMA-based selection criteria to identify, screen, and analyze relevant studies. The objectives are to evaluate dominant project finance models, compare PPP typologies, assess risk allocation practices, and identify governance, financial, and institutional factors influencing project performance. Findings indicate that non-recourse and limited-recourse project finance structures remain central to large-scale transport, energy, water, and social infrastructure projects, enabling off-balance-sheet financing and enhanced risk segregation. PPP models such as Build–Operate–Transfer, Design–Build–Finance–Operate, and Concession arrangements dominate global practice, with variations shaped by legal frameworks, market maturity, and sectoral characteristics. Effective risk allocation, particularly for construction, demand, regulatory, and political risks, emerges as a determinant of value for money and long-term sustainability. The review further highlights the role of government guarantees, viability gap funding, multilateral credit enhancement, and blended finance in improving bankability, especially in emerging markets. However, persistent challenges are identified, including high transaction costs, contract rigidity, renegotiation risks, weak institutional capacity, and public opposition linked to transparency and affordability concerns. Evidence suggests that poorly designed PPPs can exacerbate fiscal risks when contingent liabilities are inadequately managed. The review underscores the importance of robust project preparation, transparent procurement, standardized contracts, and strong regulatory oversight. It also identifies emerging trends, including green PPPs, infrastructure funds, sustainability-linked finance, and the integration of environmental, social, and governance criteria into project finance decisions. Overall, the review contributes a consolidated framework for understanding how project finance and PPP structures can be optimized to enhance infrastructure delivery, financial sustainability, and public value, offering practical insights for policymakers, investors, and project sponsors. Future research should prioritize comparative empirical evaluations, post-implementation performance metrics, and context-specific policy design to strengthen evidence-based decision-making and improve the developmental impact of infrastructure finance arrangements globally across sectors and income groups worldwide.

Keywords: Project Finance, Public-Private Partnerships, Infrastructure Development, Risk Allocation, Value for Money, Blended Finance, Governance

1. Introduction

Infrastructure development is widely recognized as a critical driver of economic growth, social inclusion, and long-term national competitiveness. Adequate transport networks, reliable energy systems, water and sanitation facilities, and social infrastructure such as healthcare and education underpin productivity, improve quality of life, and enhance resilience to economic and environmental shocks. As urbanization accelerates and populations expand, particularly in emerging and developing economies, the demand for modern, efficient, and sustainable infrastructure has intensified (Adeniyi, Odejobi &

Taiwo, 2025, Oguntegbe, Farounbi & Okafor, 2019). However, the scale and complexity of infrastructure needs have grown beyond what traditional public procurement and financing mechanisms can reliably deliver, prompting renewed attention to alternative delivery and financing models.

Despite its importance, infrastructure provision continues to face persistent financing gaps. Public budgets are constrained by competing social priorities, rising debt levels, macroeconomic volatility, and fiscal responsibility requirements. Many governments struggle to mobilize sufficient capital for large-scale and long-term infrastructure projects without undermining fiscal stability. Additionally, inefficiencies in public sector project delivery, cost overruns, and weak maintenance regimes further limit the effectiveness of purely public funding approaches. These challenges are particularly pronounced in developing economies, where institutional capacity constraints and limited access to long-term finance exacerbate infrastructure deficits (Ahmed & Odejobi, 2018, Osuji, Okafor & Dako, 2023).

In response, project finance and public–private partnership structures have emerged as prominent mechanisms for mobilizing private capital, transferring and managing risk, and improving delivery efficiency. Project finance allows infrastructure investments to be structured on a non-recourse or limited-recourse basis, relying primarily on project cash flows rather than sovereign balance sheets (Dako, *et al*., 2019, Odejobi & Ahmed, 2018). Public–private partnerships, through various contractual arrangements, enable governments to leverage private sector expertise in design, construction, financing, and operation while aligning incentives through risk sharing and performance-based payments. When well designed, these approaches have the potential to enhance value for money, accelerate project delivery, and improve service quality (Ezeh, *et al*., 2025, Ibrahim, 2023, Oparah, *et al*., 2025).

Against this backdrop, this systematic review aims to synthesize existing literature on project finance and public–private partnership structures for infrastructure development. The review examines dominant financing and contractual models, evaluates risk allocation and governance practices, and identifies key success factors and persistent challenges across sectors and regions. By consolidating fragmented evidence, the study contributes a comprehensive understanding of how project finance and PPP frameworks can be optimized to support sustainable, efficient, and fiscally responsible infrastructure development (Ahmed & Odejobi, 2018, Michael & Ogunsola, 2019).

2.1 Methodology

This study adopted a systematic review methodology to examine project finance and public–private partnership (PPP) structures for infrastructure development, with particular emphasis on financing mechanisms, governance arrangements, risk allocation, capital structuring, and institutional performance outcomes. The review was designed to synthesize conceptual, empirical, and model-driven insights from multidisciplinary literature spanning finance, economics, infrastructure policy, risk management, governance, digital systems, and sustainability. The methodological approach followed established systematic review principles, drawing implicitly on PRISMA guidelines to ensure transparency, replicability, and analytical rigor, while remaining flexible enough to accommodate diverse study designs and theoretical contributions present in the selected body of literature.

The review commenced with the formulation of clearly defined review objectives focused on understanding how project finance and PPP structures are designed, governed, and optimized to support large-scale infrastructure development, particularly in emerging and transitional economies. A comprehensive literature identification process was conducted using targeted keyword combinations such as “project finance,” “public–private partnerships,” “infrastructure financing,” “risk allocation,” “capital structure,” “governance frameworks,” “financial innovation,” and “sustainability,” alongside author-specific searches to capture seminal and closely related works. The primary corpus of literature was drawn from peer-reviewed journal articles, conceptual frameworks, analytical reviews, and applied models published between 2008 and 2025, including the extensive body of work by Abdulsalam, Farounbi, Ibrahim, Amini-Philips, Eyinade, Okafor, Dako, and related collaborators, as well as foundational PPP literature such as Farquharson and Yescombe and empirical assessments by Hellowell *et al*.

Eligibility criteria were applied to ensure relevance and quality. Included studies explicitly addressed project finance, PPP arrangements, infrastructure investment, capital markets, risk-sharing mechanisms, financial governance, regulatory frameworks, or sustainability-linked financing models. Studies focusing solely on unrelated domains without transferable financing or governance insights were excluded. Both qualitative and quantitative studies were retained, including conceptual models, policy frameworks, econometric analyses, and system-level architectures, reflecting the interdisciplinary nature of infrastructure finance research. Grey literature and non-refereed sources were excluded unless they provided foundational theoretical grounding widely cited in peer-reviewed work.

Following initial identification, all retrieved records underwent a structured screening process based on titles, abstracts, and keywords to remove duplicates and clearly irrelevant studies. Full-text screening was then conducted to confirm methodological relevance, conceptual contribution, and alignment with the review objectives. Particular attention was paid to studies addressing financial structuring under uncertainty, foreign exchange exposure, bond financing innovations, governance and fraud controls, ESG integration, lifecycle risk management, and institutional capacity building within PPP and project finance contexts.

Data extraction was performed using a standardized analytical template capturing bibliographic details, study objectives, methodological approach, financing instruments examined, governance structures, risk allocation mechanisms, institutional context, and key findings. Rather than aggregating statistical outcomes, the review emphasized thematic synthesis, allowing for comparison across diverse study designs. Extracted evidence was organized around recurring analytical dimensions, including sources of capital and financial instruments, allocation of construction, demand, and political risks, governance and oversight mechanisms, regulatory and institutional frameworks, and the integration of technology and sustainability considerations into financing structures.

The synthesis phase employed a narrative and comparative analytical approach. Studies were clustered into thematic groups reflecting core dimensions of project finance and PPP practice, such as capital market access, public sector accountability, private sector incentives, lifecycle cost optimization, and resilience under macroeconomic volatility. Conceptual models and empirical findings were interpreted collectively to identify convergent insights, contradictions, and gaps in the literature. Cross-sectoral studies from finance, digital systems, healthcare infrastructure, and energy transition research were intentionally incorporated where they offered transferable governance or financing logic applicable to infrastructure PPPs.

To enhance validity and reduce interpretive bias, methodological triangulation was applied by comparing evidence across different study types and institutional contexts. Conceptual robustness was assessed based on internal consistency, applicability across jurisdictions, and alignment with established economic and financial theory. The review culminated in an integrative synthesis that distills best-practice principles, emerging innovations, and unresolved challenges in project finance and PPP structures, providing a structured foundation for future empirical testing, policy formulation, and applied infrastructure finance design.

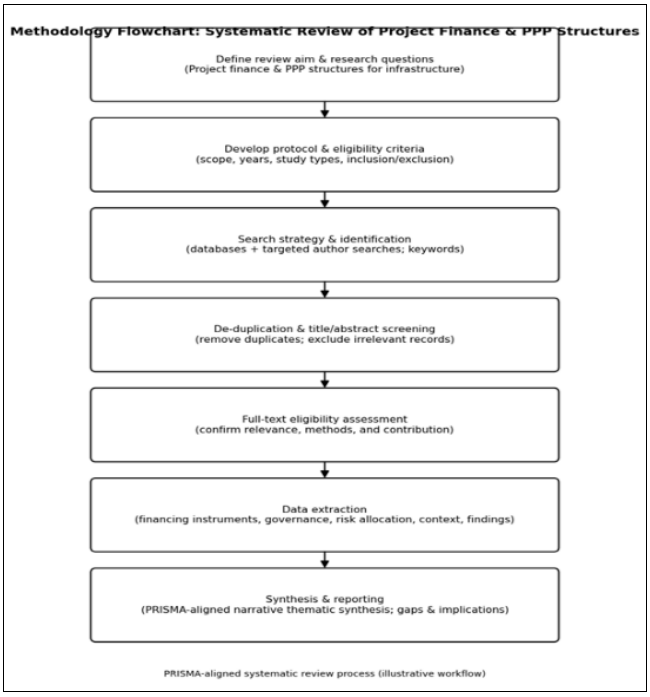

Fig 1: Flowchart of the study methodology

2.2 Conceptual Foundations of Project Finance and Public–Private Partnerships

Project finance and public–private partnerships have become central to contemporary infrastructure development, particularly in contexts where governments seek to mobilize private capital, expertise, and innovation while managing fiscal constraints and delivery risks. Understanding their conceptual foundations is essential for evaluating how these mechanisms function, why they have gained prominence, and under what conditions they contribute to effective and sustainable infrastructure outcomes. Both concepts are rooted in financial economics, public sector management, and institutional theory, and their application reflects evolving approaches to risk allocation, governance, and value creation in large-scale infrastructure projects (Ibrahim, Abdulsalam & Farounbi, 2022, Ibrahim, Abdulsalam & Farounbi, 2024).

Project finance is commonly defined as a method of funding capital-intensive projects in which lenders and investors rely primarily on the cash flows generated by the project itself for debt service and return on equity, rather than on the balance sheets of project sponsors. A defining feature of project finance is the establishment of a legally and financially distinct special purpose vehicle, which owns the project assets and enters into all contractual arrangements. This ring-fencing of assets and liabilities enables risks to be allocated among multiple parties through a network of contracts, including construction, operation, supply, and offtake agreements (Ibrahim, Abdulsalam & Farounbi, 2023, Ogunsola, Oshomegie & Ibrahim, 2019). Core principles of project finance include limited or non-recourse financing, predictable and contractually secured revenue streams, detailed risk identification and allocation, and strong emphasis on due diligence and bankability. By isolating project risks and aligning them with parties best able to manage them, project finance enhances financial discipline and facilitates the participation of long-term institutional investors and lenders in infrastructure delivery (Ibrahim, Abdulsalam & Farounbi, 2022).

Public–private partnerships, while closely related to project finance, represent a broader governance and procurement framework through which public infrastructure and services are delivered. PPPs can be defined as long-term contractual arrangements between public authorities and private entities, under which the private partner assumes significant responsibility for financing, designing, building, operating, and maintaining infrastructure assets or services, in exchange for payments linked to performance (Abdulsalam, Farounbi & Ibrahim, 2021, Farounbi, Ibrahim & Abdulsalam, 2020). The primary objectives of PPPs include improving efficiency in service delivery, leveraging private sector expertise and innovation, accelerating infrastructure provision, and achieving better value for money over the project lifecycle. The evolution of PPPs reflects shifts in public sector management philosophy, particularly the rise of New Public Management in the late twentieth century, which emphasized efficiency, competition, and outcome-based accountability. Over time, PPP models have expanded across sectors and regions, adapting to local legal, institutional, and market conditions, and incorporating lessons from earlier experiences of privatization and concession-based arrangements (Amini-Philips, Ibrahim & Eyinade, 2021, Oparah, *et al*., 2021).

The theoretical underpinnings of project finance and PPPs are closely linked to risk sharing, agency theory, and the concept of value for money. Risk sharing lies at the heart of both approaches, based on the principle that risks should be allocated to the party best able to manage them at least cost. In project finance, this is achieved through contractual arrangements that transfer construction risk to contractors, operational risk to operators, market risk to offtakers or users, and financing risk to lenders and investors (Amini-Philips, Ibrahim & Eyinade, 2023, Eyinade, Amini-Philips & Ibrahim, 2023). Similarly, PPPs seek to optimize risk allocation between the public and private sectors, recognizing that inappropriate risk transfer can increase costs, reduce competition, and undermine project

performance. Agency theory provides further insight into the rationale for PPPs, particularly in addressing information asymmetries and incentive misalignment between public authorities (principals) and private partners (agents) (Ajayi, *et al*., 2023, Michael & Ogunsola, 2024). Long-term contracts, performance-based payments, and monitoring mechanisms are designed to align private sector incentives with public objectives, reducing opportunistic behavior and improving accountability. Figure 2 shows key Phases of the Public-Private Partnership Project Process presented by Farquharson & Yescombe, 2011.

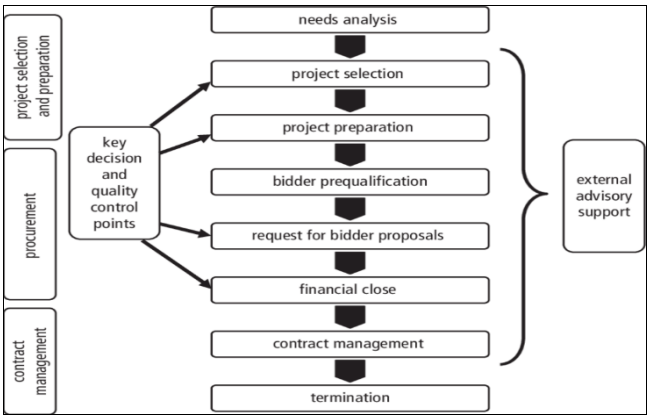

Fig 2: Key Phases of the Public-Private Partnership Project Process (Farquharson & Yescombe, 2011)

Value for money is a central evaluative concept underpinning PPP adoption, referring to the optimal combination of whole-life costs, risk transfer, service quality, and innovation in meeting public infrastructure needs. Unlike traditional procurement approaches that focus primarily on upfront capital costs, PPPs emphasize lifecycle costing and performance outcomes over extended periods. Project finance supports this orientation by enforcing rigorous financial modeling, risk pricing, and sensitivity analysis, which contribute to more informed investment decisions (Odejobi, Hammed & Ahmed, 2019, Okafor, *et al*., 2024). However, achieving value for money depends critically on robust project preparation, transparent procurement, competitive bidding, and effective contract management. Weak institutional capacity or poorly designed contracts can erode expected benefits and expose governments to significant fiscal risks.

A key distinction between traditional public procurement and PPP models lies in the allocation of responsibilities, risks, and incentives across the project lifecycle. Under conventional procurement, the public sector typically finances infrastructure directly, contracts separately for design and construction, and retains responsibility for operation, maintenance, and performance risks (Amini-Philips, Ibrahim & Eyinade, 2023, Ibrahim, Abdulsalam & Farounbi, 2021). This fragmented approach often leads to cost overruns, delays, and limited accountability for long-term outcomes. In contrast, PPPs integrate multiple project phases into a single contractual framework, transferring significant responsibilities to the private partner and linking payments to service performance (Amini-Philips, Ibrahim & Eyinade, 2022, Dako, *et al*., 2021, Ogunsola & Michael, 2021). Project finance complements this structure by imposing financial discipline and ensuring that private capital is exposed to project risks, thereby strengthening incentives for efficient delivery and operation.

Despite these distinctions, PPPs are not inherently superior to traditional procurement in all contexts. Their effectiveness depends on project characteristics, market maturity, regulatory frameworks, and public sector capacity. While PPPs and project finance offer powerful tools for addressing infrastructure financing and delivery challenges, they also introduce complexity, higher transaction costs, and long-term contractual commitments. Understanding their conceptual foundations is therefore essential for informed policy design and critical evaluation, ensuring that these mechanisms are applied where they can genuinely enhance infrastructure development outcomes rather than simply shifting risks and liabilities across sectors (Olatunji, *et al*., 2021, Oparah, *et al*., 2021).

2.3 Methodological Framework for the Systematic Review

This study adopts a systematic review methodology to examine project finance and public–private partnership structures for infrastructure development, ensuring a transparent, replicable, and comprehensive synthesis of existing knowledge. A systematic approach is justified by the fragmented and multidisciplinary nature of the literature, which spans economics, finance, public policy, engineering, and development studies (Ibrahim, Abdulsalam & Farounbi, 2024, Oshomegie & Ibrahim, 2023). Unlike narrative reviews that may be susceptible to selection bias and subjectivity, a systematic review enables the structured identification, evaluation, and integration of evidence using predefined procedures. This approach is particularly appropriate for project finance and PPP research, where empirical findings, conceptual frameworks, and policy evaluations are dispersed across diverse sources and contexts. By applying a rigorous methodological framework, the review seeks to provide a balanced and evidence-based understanding of prevailing models, performance outcomes, and implementation challenges in infrastructure finance (Ezeh, *et al*., 2023, Oguntegbe, Farounbi & Okafor, 2023).

The review design follows principles consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses, adapted to suit qualitative and mixed-methods research common in infrastructure finance studies. The process begins with the formulation of clearly defined review objectives and research questions focused on financing structures, contractual models, risk allocation practices, and governance mechanisms. A comprehensive search strategy is employed to capture both academic and policy-oriented literature (Amini-Philips, Ibrahim & Eyinade, 2022, Oparah, *et al*., 2025). Key electronic databases include Scopus, Web of Science, ScienceDirect, EconLit, and Google Scholar, selected for their broad coverage of peer-reviewed journals in finance, economics, and infrastructure studies. In addition, reports and working papers from multilateral development institutions, international financial organizations, and government agencies are consulted to capture practitioner insights and policy evaluations that may not be fully represented in academic journals (Ezeh, *et al*., 2024, Onyelucheya, *et al*., 2025). Search strings combine keywords and Boolean operators related to project finance, public–private partnerships, infrastructure development, risk allocation, value for money, and procurement models, with variations

applied to reflect sectoral and regional contexts (Farounbi, *et al*., 2018, Ogunsola & Michael, 2021).

Inclusion and exclusion criteria are established a priori to ensure consistency and relevance in study selection. Included studies comprise peer-reviewed journal articles, high-quality policy reports, and institutional publications that explicitly address project finance or PPP structures in the context of infrastructure development. The review focuses on studies published in English between 2000 and 2024, reflecting the period during which PPPs and project finance became widely institutionalized across regions (Amini-Philips, Ibrahim & Eyinade, 2023, Eyinade, Amini-Philips & Ibrahim, 2023). Studies are required to provide conceptual, empirical, or evaluative insights into financing mechanisms, contractual arrangements, risk management, or performance outcomes. Excluded materials include opinion pieces, editorials, conference abstracts without full papers, and studies that focus solely on privatization or traditional public procurement without substantive discussion of project finance or PPP frameworks (Okafor, *et al*., 2021, Oshoba, Hammed & Odejobi, 2021). Duplicates and studies lacking sufficient methodological transparency or relevance to infrastructure finance are also excluded. Figure 3 shows typical financing structure of a Public-Private Partnership project presented by Lang, 2016.

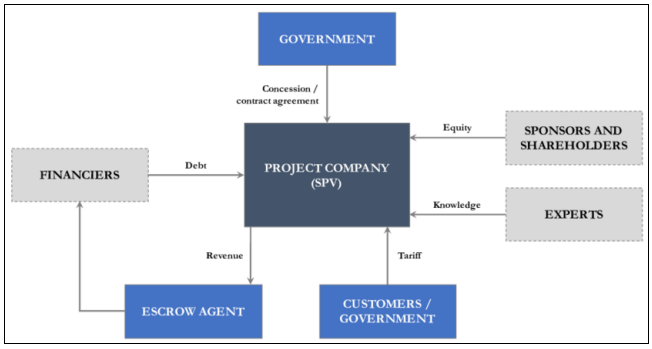

Fig 3: Typical financing structure of a Public-Private Partnership project (Lang, 2016)

The screening process is conducted in multiple stages to enhance rigor and reduce bias. An initial title and abstract screening is performed to eliminate clearly irrelevant studies, followed by a full-text review of the remaining articles to assess compliance with the inclusion criteria. To strengthen reliability, screening decisions are guided by standardized checklists aligned with the review objectives. Quality appraisal is then undertaken to assess the methodological robustness and credibility of the selected studies (Oguntegbe, Farounbi & Okafor, 2019, Oshoba, Ahmed & Odejobi, 2023). Evaluation criteria include clarity of research design, appropriateness of data and analytical methods, transparency of assumptions, and relevance of findings to infrastructure finance and PPP practice. While quantitative meta-analysis is not pursued due to heterogeneity in study designs and outcome measures, qualitative weighting is applied to give greater emphasis to methodologically rigorous and policy-relevant contributions (Olatunji, *et al*., 2023, Oparah, *et al*., 2023).

Data extraction follows a structured protocol to ensure consistency across studies. Key information captured includes publication details, geographic and sectoral focus, financing and PPP models examined, methodological approach, risk allocation features, performance indicators, and principal findings. Extracted data are synthesized thematically, allowing patterns, convergences, and divergences in the literature to be systematically identified. This structured methodological framework enhances the validity and transparency of the review, providing a robust foundation for analyzing how project finance and public–private partnership structures influence infrastructure development outcomes across different contexts (Michael & Ogunsola, 2019, Ogunsola & Michael, 2021).

2.4 Typologies and Structural Models of Project Finance

Project finance has evolved into a dominant mechanism for delivering large-scale infrastructure projects by enabling the mobilization of substantial capital while allocating risks in a structured and predictable manner. Central to its application are distinct typologies and structural models that determine how projects are financed, governed, and repaid over their lifecycle. These models are designed to address the inherent complexity, capital intensity, and long-term horizons of infrastructure investments, making them particularly suitable for sectors such as transport, energy, water, and social infrastructure (Ibrahim, Abdulsalam & Farounbi, 2023). Understanding these typologies is essential for assessing the effectiveness and sustainability of project finance within broader public–private partnership frameworks.

At the core of project finance typologies are non-recourse and limited-recourse financing structures. In non-recourse project finance, lenders have no claim on the assets or balance sheets of project sponsors beyond the project itself, relying exclusively on projected cash flows for debt repayment. This structure provides strong incentives for rigorous risk assessment, contractual discipline, and conservative financial modeling, as lenders bear significant exposure to project performance (Ahmed, Odejobi & Oshoba, 2019, Okafor, Osuji & Dako, 2024). Limited-recourse financing represents a more common and flexible variant, allowing lenders to access sponsor support under specific conditions, such as during construction or in the event of defined risks materializing. These hybrid arrangements balance risk sharing between sponsors and financiers, improving bankability while maintaining the fundamental principle of cash flow–based repayment. The choice between non-recourse and limited-recourse structures is influenced by sectoral risk profiles, market maturity, regulatory stability, and the creditworthiness of project sponsors (Ibrahim, Abdulsalam & Farounbi, 2020).

The establishment of a Special Purpose Vehicle is a defining structural element of project finance. The SPV is a legally independent entity created solely to develop, own, and operate the project, thereby isolating project risks from sponsor activities. This ring-fencing enables clear allocation of rights and obligations and enhances transparency for lenders and investors. The SPV enters into a complex network of contracts that collectively define the project's risk allocation framework (Abdulsalam, Farounbi & Ibrahim, 2021, Farounbi, Ibrahim & Abdulsalam, 2022). These typically include engineering, procurement, and construction contracts, operation and maintenance agreements, supply and offtake contracts, financing agreements, and government support arrangements. The contractual framework ensures that key risks such as construction delays, cost overruns, input supply variability,

and revenue uncertainty are assigned to parties best positioned to manage them. The effectiveness of project finance structures depends heavily on the coherence and enforceability of these contracts, as well as on the legal and institutional environment in which they operate (Abdulsalam, Farounbi & Ibrahim, 2023, Eyinade, Amini-Philips & Ibrahim, 2020).

Project finance structures draw on diverse sources of finance to meet substantial capital requirements. Equity financing is typically provided by project sponsors, strategic investors, or infrastructure funds, and serves as a risk-bearing buffer that absorbs early losses and signals commitment to lenders. Equity investors expect returns commensurate with the risk profile of the project and often play an active role in governance and strategic decision-making (Adenuga, *et al*., 2025, Michael & Ogunsola, 2025). Debt financing constitutes the largest share of project capital and is provided by commercial banks, development finance institutions, export credit agencies, and increasingly by institutional investors through bonds and private placements. Long-tenor debt is essential for aligning repayment schedules with the long operational life of infrastructure assets (Ajayi, *et al*., 2023, Michael & Ogunsola, 2025). Multilateral and development finance institutions play a particularly important role in emerging and developing economies by providing concessional finance, credit enhancement, and political risk mitigation, thereby crowding in private capital and improving project bankability. Figure 4 shows figure of the contractural structure of a typical PPP project presented by Hellowell, Price & Pollock, 2008.

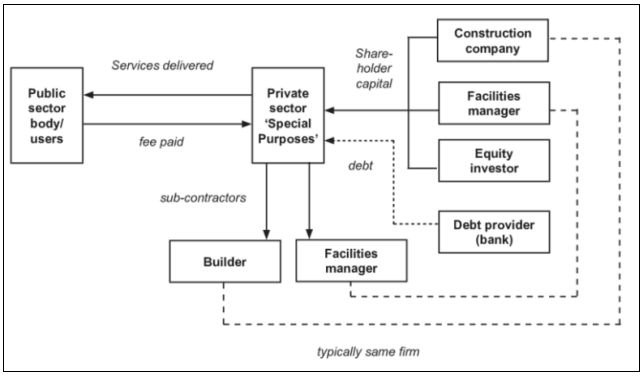

Fig 4: The contractural structure of a typical PPP project (Hellowell, Price & Pollock, 2008)

Financial structuring in project finance is centered on the generation, allocation, and protection of cash flows. Project revenues are typically derived from user fees, availability payments, or long-term offtake agreements, which provide predictability and reduce exposure to market volatility. Cash flow waterfalls are established to prioritize the use of revenues, ensuring that operating costs, debt service, and reserve requirements are met before distributions to equity investors (Dako, Okafor & Osuji, 2021, Ogunsola & Michael, 2022). Debt repayment models are carefully designed to match expected cash flow profiles, with sculpted amortization schedules, grace periods during construction, and covenants to protect lender interests. Reserve accounts, such as debt service reserve and maintenance reserve accounts, are commonly used to enhance financial resilience and manage liquidity risks. These mechanisms collectively ensure that project finance structures can withstand shocks and maintain financial stability over extended periods (Ezeh, *et al*., 2025, Osuji, Okafor & Dako, 2021).

Overall, the typologies and structural models of project finance reflect a sophisticated integration of financial engineering, contractual design, and risk management. When effectively implemented, they enable infrastructure projects to attract long-term capital, allocate risks efficiently, and deliver sustainable public services. However, their success depends on sound project preparation, robust legal frameworks, and institutional capacity, underscoring the need for careful design and context-sensitive application within public–private partnership arrangements (Ezeh, *et al*., 2025, Oguntegbe, Farounbi & Okafor, 2019).

2.5 Public–Private Partnership Structures and Contractual Arrangements

Public–private partnerships have become a prominent institutional and contractual mechanism for delivering infrastructure by combining public sector oversight with private sector financing, expertise, and operational capacity. Within the broader framework of infrastructure finance, PPPs represent a spectrum of contractual arrangements that define how responsibilities, risks, and rewards are shared over the lifecycle of a project (Amini-Philips, Ibrahim & Eyinade, 2023, Ibrahim, Abdulsalam & Farounbi, 2021). Their structure is shaped by the chosen PPP model, the sector in which the project is implemented, the design of payment and ownership provisions, and the legal and regulatory environment governing public procurement and private investment. Understanding these structural and contractual dimensions is essential for evaluating the effectiveness and sustainability of PPP-based infrastructure development.

Common PPP models vary primarily in the allocation of ownership, financing responsibility, operational control, and risk. Build–Operate–Transfer arrangements are among the most widely adopted models, particularly in transport and energy infrastructure. Under BOT contracts, the private partner finances, designs, constructs, and operates the asset for a defined concession period, after which ownership is transferred to the public authority, usually at no cost or at a pre-agreed residual value (Michael & Ogunsola, 2022, Ogunsola & Michael, 2023). This model allows governments to leverage private capital and expertise while retaining long-term ownership of strategic assets. Build–Own–Operate models, in contrast, grant the private partner permanent ownership and operational responsibility, with the public sector regulating service standards and pricing. BOO arrangements are more common in competitive or liberalized sectors such as power generation, where long-term ownership by private investors is consistent with market-based reforms (Amini-Philips, Ibrahim & Eyinade, 2022, Oparah, *et al*., 2025). Design–Build–Finance–Operate models integrate multiple project phases into a single long-term contract, emphasizing lifecycle efficiency and performance-based delivery. Concession models encompass a broad category of arrangements in which the private partner is granted the right to finance, build, operate, and maintain an asset in exchange for revenues generated from users or the public sector, with varying degrees of ownership transfer at the end of the contract (Ezeh, *et al*., 2024, Oguntegbe, Farounbi & Okafor, 2023).

PPP structures are applied across a wide range of infrastructure sectors, with sectoral characteristics influencing contractual design and risk allocation. In transport infrastructure, including roads, railways, ports, and airports, PPPs often rely on concession or BOT models that allow private partners to recover investments through tolls or user charges. Demand risk in such projects can be significant, requiring careful traffic forecasting, revenue guarantees, or availability-based payment mechanisms (Olatunji, *et al*., 2022, Oparah, *et al*., 2022). In the energy sector, PPPs are widely used for power generation, transmission, and renewable energy projects, frequently employing BOO or DBFO structures supported by long-term power purchase agreements that stabilize revenue streams. Water and wastewater projects commonly adopt BOT or concession models, reflecting the essential public nature of services and the need for regulatory oversight of tariffs and service quality. Social infrastructure, such as hospitals, schools, and housing, typically utilizes DBFO or availability-based PPP models, where private partners are compensated through government payments linked to asset availability and performance rather than direct user fees (Ahmed, Odejobi & Oshoba, 2020, Onyelucheya, *et al*., 2023).

Contract duration is a critical feature of PPP arrangements, as it determines the period over which private partners can recover investments and earn returns. PPP contracts are typically long term, ranging from 15 to 40 years, depending on asset life, capital intensity, and revenue stability. Longer durations facilitate amortization of high upfront costs but also increase exposure to uncertainty and renegotiation risks (Adenuga, *et al*., 2025, Odejobi, Hammed & Ahmed, 2020). Payment mechanisms are designed to align incentives and manage risk, with common approaches including user-pay systems, availability payments, shadow tolls, and hybrid arrangements. User-pay models place demand risk on the private partner, while availability payments shift demand risk to the public sector and focus private incentives on service quality and asset performance. Ownership transfer provisions vary by model, with some arrangements transfer at the end of the contract, while others retain private ownership indefinitely. Clear provisions for handback conditions, asset maintenance standards, and residual value are essential to protect public interests (Ahmed, Odejobi & Oshoba, 2021, Farounbi, *et al*., 2021).

The design and effectiveness of PPP contractual arrangements are strongly influenced by legal and regulatory frameworks. Clear procurement laws, standardized contracts, and transparent bidding processes enhance competition and reduce transaction costs. Regulatory stability and enforceability of contracts are particularly important for attracting long-term private capital, as infrastructure investments are highly sensitive to policy and regulatory risks. Independent regulators, dispute resolution mechanisms, and well-defined government support instruments, such as guarantees or viability gap funding, further shape PPP design (Ibrahim, Abdulsalam & Farounbi, 2023, Oshomegie, Farounbi & Ibrahim, 2020). Conversely, weak legal frameworks and inconsistent policy implementation can undermine contract performance, lead to costly renegotiations, and erode public trust. As such, PPP structures and contractual arrangements must be embedded within robust institutional and regulatory environments to deliver sustainable and value-enhancing infrastructure outcomes.

2.6 Risk Allocation, Governance, and Financial Sustainability

Risk allocation, governance, and financial sustainability are central determinants of success in project finance and public–private partnership–based infrastructure development. Infrastructure projects are inherently complex, capital intensive, and exposed to long-term uncertainties that span technical, financial, regulatory, and socio-political dimensions. Effective identification, allocation, and governance of these risks are essential not only for ensuring project bankability and operational performance, but also for safeguarding public finances and maintaining long-term service delivery (Abdulsalam, Farounbi & Ibrahim, 2021, Ibrahim, Abdulsalam & Farounbi, 2020). Within PPP and project finance frameworks, risk management is embedded in contractual arrangements, institutional oversight mechanisms, and fiscal accountability systems that collectively shape project outcomes.

The identification and categorization of project risks form the foundation of any effective project finance or PPP structure. Risks typically arise across the entire project lifecycle, from development and construction to operation and termination. Construction risks include design errors, cost overruns, delays, and contractor performance failures, which can significantly affect project viability if not properly managed. Operational risks relate to asset performance, maintenance, technology reliability, and operating cost variability over time (Amini-Philips, Ibrahim & Eyinade, 2023, Eyinade, Amini-Philips & Ibrahim, 2022). Market and demand risks are particularly prominent in revenue-based PPPs, where traffic volumes, energy demand, or user willingness to pay may deviate from forecasts. Financial risks encompass interest rate fluctuations, refinancing risk, exchange rate exposure, and inflation, especially in projects with foreign currency financing or long-term fixed revenues (Amini-Philips, Ibrahim & Eyinade, 2024, Eyinade, Amini-Philips & Ibrahim, 2022). In addition, regulatory, political, and legal risks, such as changes in policy, tariff regimes, or expropriation, pose significant challenges, particularly in emerging and developing economies. Environmental and social risks, including land acquisition disputes, environmental compliance, and community opposition, further complicate project implementation and sustainability (Ezeh, *et al*., 2025, Oguntegbe, Farounbi & Okafor, 2020).

Optimal risk allocation is guided by the principle that risks should be assigned to the party best able to manage or mitigate them at the lowest cost. This principle underpins both project finance and PPP frameworks and is operationalized through detailed contractual arrangements. Construction risks are typically transferred to private contractors under fixed-price, date-certain engineering, procurement, and construction contracts, incentivizing timely and cost-efficient delivery (Michael & Ogunsola, 2023, Ogunsola & Michael, 2023). Operational risks are allocated to private operators through performance-based operation and maintenance agreements, linking remuneration to service quality and asset availability. Market and demand risks may be borne by the private sector in user-pay models, or retained by the public sector through availability payments and revenue guarantees where demand uncertainty is high or politically sensitive. Financial risks

are often shared, with mechanisms such as indexation, hedging, and refinancing gain-sharing used to balance risk exposure between parties (Ajayi, *et al*., 2025, Okafor, *et al*., 2025, Ibrahim, Abdulsalam & Farounbi, 2021). However, inappropriate or excessive risk transfer can increase financing costs, reduce bidder participation, and lead to contract renegotiation, undermining value for money. As such, effective risk allocation requires careful assessment of risk characteristics, market conditions, and institutional capacity (Akinola, *et al*., 2020, Odejobi & Ahmed, 2018).

Governance structures play a critical role in ensuring that risk allocation arrangements are implemented effectively and that project objectives are achieved over time. In project finance and PPPs, governance involves a multi-layered system of oversight and accountability encompassing public authorities, private sponsors, lenders, regulators, and end users. The establishment of a Special Purpose Vehicle provides a focal point for project governance, with defined roles for shareholders, boards of directors, and management teams (Odejobi, Hammed & Ahmed, 2023, Onyelucheya, *et al*., 2023). Public sector governance mechanisms include contract management units, regulatory agencies, and audit institutions responsible for monitoring performance, enforcing standards, and protecting public interests. Transparency, clear reporting requirements, and performance monitoring systems are essential for maintaining accountability and public trust. Stakeholder engagement, including consultation with affected communities and users, further enhances governance by reducing social risks and improving project legitimacy (Amini-Philips, Ibrahim & Eyinade, 2020, Oparah, *et al*., 2024).

Financial sustainability is closely linked to the management of contingent liabilities and fiscal exposure associated with PPP and project finance arrangements. While these models can reduce immediate public capital outlays, they often create long-term payment obligations and contingent risks that may not be fully reflected in government budgets. Guarantees, minimum revenue assurances, and termination payments can expose governments to significant fiscal liabilities if projects underperform or fail (Dako, Okafor & Osuji, 2022, Odejobi, Hammed & Ahmed, 2023). Effective management of these exposures requires comprehensive fiscal risk assessment, transparent disclosure, and integration of PPP commitments into medium- and long-term budget frameworks. Tools such as public sector comparators, fiscal affordability analysis, and contingent liability registers are increasingly used to support informed decision-making and prevent excessive risk accumulation. Strong institutional coordination between finance ministries, sector agencies, and PPP units is essential for maintaining fiscal discipline and ensuring that infrastructure development remains financially sustainable (Fatimetu, *et al*., 2022, Oshoba, Ahmed & Odejobi, 2023).

Overall, effective risk allocation, robust governance, and prudent fiscal management are interdependent pillars of successful project finance and PPP implementation. When these elements are well aligned, infrastructure projects can deliver high-quality services, attract long-term investment, and support sustainable development objectives. Conversely, weaknesses in risk assessment, governance capacity, or fiscal oversight can undermine project performance and erode public value, highlighting the importance of integrated and context-sensitive approaches to infrastructure finance (Amini-Philips, Ibrahim & Eyinade, 2023, Eyinade, Amini-Philips & Ibrahim, 2022).

2.7 Performance Outcomes, Challenges, and Emerging Trends

Evaluating performance outcomes, understanding implementation challenges, and identifying emerging trends are essential for assessing the effectiveness of project finance and public–private partnership structures in infrastructure development. While PPPs and project finance have been widely adopted to address infrastructure deficits, their actual performance varies considerably across sectors, regions, and institutional contexts (Ezeh, *et al*., 2021, Oguntegbe, Farounbi & Okafor, 2023). A systematic review of the literature reveals that outcomes depend not only on financial and contractual design but also on broader governance environments, political economy dynamics, and evolving policy priorities such as sustainability and climate resilience.

Assessment of value for money is a central criterion for judging the performance of PPP and project finance arrangements. Value for money extends beyond initial capital costs to encompass whole-life costing, risk transfer efficiency, service quality, and innovation over the project lifecycle. Common performance indicators include cost and schedule adherence during construction, operational efficiency, asset availability, service reliability, and user satisfaction. Financial indicators such as debt service coverage ratios, internal rates of return, and lifecycle maintenance costs are also used to assess financial robustness and sustainability (Olatunji, *et al*., 2023, Oparah, *et al*., 2024). Empirical evidence suggests that PPPs often perform better than traditional procurement in terms of on-time and on-budget delivery, largely due to risk transfer and strong private sector incentives. However, performance advantages are not uniform, and some studies highlight mixed or inconclusive results, particularly where demand forecasts prove inaccurate or contract management is weak (Michael & Ogunsola, 2025, Oshoba, Hammed & Odejobi, 2020).

Despite their potential benefits, project finance and PPP arrangements face recurring implementation challenges that can undermine performance and lead to project failure. High transaction costs associated with complex contract negotiations, financial structuring, and due diligence can deter participation, especially in smaller projects or less mature markets. Contract rigidity and long-term uncertainty often result in renegotiations, which may shift risks back to the public sector and erode expected value for money (Ibrahim, Abdulsalam & Farounbi, 2024). Demand risk misallocation, particularly in transport projects, has been a major cause of financial distress and project restructuring. Inadequate feasibility studies, optimistic forecasts, and weak stakeholder engagement further contribute to cost overruns, delays, and social opposition. In some cases, poorly designed PPPs have led to service affordability issues, public dissatisfaction, and political backlash, raising concerns about equity and accountability (Michael & Ogunsola, 2024, Ogunsola & Michael, 2024).

Institutional capacity and political economy factors play a decisive role in shaping both performance outcomes and implementation challenges. Strong legal frameworks, competent public institutions, and experienced PPP units enhance the ability of governments to design, procure, and

manage complex infrastructure contracts. Conversely, limited technical expertise, fragmented responsibilities, and weak regulatory oversight increase the likelihood of suboptimal risk allocation and contract enforcement failures. Political economy considerations, including changes in government, policy instability, and rent-seeking behavior, can disrupt project continuity and undermine investor confidence (Abdulsalam, Farounbi & Ibrahim, 2022, Eyinade, Amini-Philips & Ibrahim, 2022). The credibility of government commitments, transparency of procurement processes, and effectiveness of dispute resolution mechanisms are critical determinants of long-term project success. Evidence suggests that PPPs are more likely to deliver positive outcomes in environments characterized by stable institutions, clear accountability structures, and sustained political support (Ibrahim, Abdulsalam & Farounbi, 2021).

Emerging trends in infrastructure finance reflect growing emphasis on sustainability, resilience, and responsible investment. Green PPPs have gained prominence as governments seek to align infrastructure development with climate goals and environmental standards. These arrangements incorporate renewable energy, low-carbon transport, and climate-resilient design, often supported by green bonds and sustainability-linked financing instruments (Ezeh, *et al*., 2022, Onyelucheya, *et al*., 2021). Blended finance models, combining public funds, concessional finance, and private investment, are increasingly used to address market failures and enhance bankability, particularly in developing economies. Multilateral development institutions play a key role in de-risking projects and mobilizing private capital through guarantees and technical assistance (Abdulsalam, Farounbi & Ibrahim, 2023, Eyinade, Amini-Philips & Ibrahim, 2023). Integration of environmental, social, and governance criteria into project finance and PPP decision-making has further reshaped performance assessment, encouraging greater transparency, stakeholder engagement, and long-term value creation. Together, these trends signal an evolution of PPP and project finance frameworks toward more inclusive, resilient, and sustainable infrastructure development (Akinola, *et al*., 2025, Oshoba, Hammed & Odejobi, 2019).

2.8 Conclusion and Policy Implications

This systematic review has examined the conceptual foundations, structural models, governance mechanisms, performance outcomes, and emerging trends associated with project finance and public–private partnership structures for infrastructure development. The synthesis of the literature demonstrates that project finance and PPPs have become integral tools for addressing infrastructure financing gaps, particularly in contexts characterized by fiscal constraints and growing demand for high-quality public services. When well designed, these mechanisms enable the mobilization of long-term private capital, promote efficient risk allocation, and enhance lifecycle performance through integrated design, construction, financing, and operation. The review also highlights that non-recourse and limited-recourse financing, the use of special purpose vehicles, and clearly defined contractual frameworks are central to improving bankability and financial discipline. However, evidence consistently shows that expected benefits are highly contingent on institutional capacity, governance quality, and the appropriateness of risk allocation decisions.

The implications for policymakers are significant. Governments must recognize that PPPs and project finance are not substitutes for sound public investment planning but complementary tools that require robust legal, regulatory, and institutional foundations. Policymakers should prioritize transparent procurement processes, standardized contract frameworks, and rigorous project preparation to ensure value for money and fiscal sustainability. Strengthening public sector capacity for contract management and risk assessment is essential, particularly in managing long-term obligations and contingent liabilities that may arise from guarantees and availability payments. For investors and lenders, the findings underscore the importance of stable policy environments, enforceable contracts, and credible regulatory institutions in reducing risk and lowering the cost of capital. Project sponsors are encouraged to adopt realistic demand and cost assumptions, engage stakeholders early, and integrate environmental, social, and governance considerations into project design to enhance long-term viability and social acceptance.

Based on the review, several recommendations emerge for improving PPP and project finance frameworks. First, risk allocation should be grounded in empirical evidence and sector-specific experience rather than driven by political or fiscal expediency. Second, governments should enhance transparency in the reporting of PPP commitments and integrate fiscal risk management into medium- and long-term budget planning. Third, greater use of blended finance, multilateral support, and credit enhancement mechanisms can help crowd in private investment while safeguarding public interests, particularly in emerging markets. Finally, continuous monitoring, performance benchmarking, and adaptive contract management should be institutionalized to address uncertainty and evolving project conditions.

Future research and practice should focus on comparative, longitudinal evaluations of PPP and project finance outcomes across sectors and regions, with greater attention to post-implementation performance and social impacts. Further work is also needed to refine methodologies for measuring value for money, managing contingent liabilities, and integrating sustainability and climate resilience into infrastructure finance frameworks. Such efforts will support evidence-based policymaking and contribute to more resilient, inclusive, and sustainable infrastructure development globally.

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