ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

Evaluating the Role of Public-Private Partnerships (PPPs) in Financing Large-Scale Infrastructure Projects: Implications for Economic Growth and Risk Allocation

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Publication Date: 2025/11/15

Abstract: Public-Private Partnership's (PPPs) have assumed an increasing significance as a means to finance large-scale infrastructure projects in developed and developing economies in the face of growing infrastructure deficits and fiscal pressures. The role of PPPs in developing infrastructure finance is critically examined in this study, focusing specifically on their impact on financial sustainability, economic development, and risk sharing. The main objectives are long term financial feasibility of PPP models, macroeconomic impacts of the models, and the risk allocation between public and private parties.

Utilizing a review-based method guided by the PRISMA 2020 approach, the scoping review synthesizes peer-reviewed literature (between 2018-2025), and compares among others global comparative reflections from cross-case studies (highlighting the United Kingdom, India, Nigeria, Chile and the United Arab Emirates). The study finds that successful PPPs are characterized by equitable risk sharing regimens, robust regulatory regimes and flexible contractual arrangements. Financial sustainability is closely interconnected with robust life cycle costing, VGF and PBIs. Furthermore, where they are well aligned with national development strategy, PPPs can deliver real economic growth benefits, in terms of jobs and productivity.

The paper adds to the academic debate by reconciling the gap between literature and practice, while it identifies the institutional and contractual sizing of PPP success, and putting forward a number of concrete policy advices for governments and supranational organizations. It also identifies limitations or not enough risk management and capacity in AI and digital technologies in contract monitoring and governing that need further research.

Keywords: *Public-Private Partnerships, Infrastructure Financing, Risk Allocation, Economic Growth, Financial Sustainability, Global Case Studies.*

How to Cite: Olugbenga F. Akomolehin (2025) Evaluating the Role of Public-Private Partnerships (PPPs) in Financing Large-Scale Infrastructure Projects: Implications for Economic Growth and Risk Allocation. *International Journal of Innovative Science and Research Technology*, 10(11), 522-536. https://doi.org/10.38124/ijisrt/25nov396

I. INTRODUCTION

Infrastructure is widely considered the base of economic progress and social welfare. Nonetheless, systemic and worsening infrastructure gaps continue to represent a hallmark issue for developed and developing countries alike. The global investment gap in infrastructure is projected to amount to USD 15t by 2040, assuming a business-as-usual scenario, putting at risk the attainment of the Sustainable Development Goals and climate resilience as well as equitable development (World Bank, 2020). This investment shortfall is particularly acute in developing countries, where ageing infrastructure systems, rapid urbanisation and weak government balance sheets limit the capacity of governments to meet the needs for critical new infrastructure services. In the face of this increasing pressure, PPPs have emerged as a new and practical financing mechanism that uses private sector resources, efficiency, and risk management skills to narrow the infrastructure development gap (OECD, 2021; Asian Development Bank, 2023).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

PPPs provide a model that marries the public and private sector to share the budget, responsibility, liability, management and risk to deliver infrastructure assets, often over the lifecycle of long-term projects. This model is being welcomed for its ability to create fiscal space, improve service delivery and crowd in private investment in priority sectors like transport, energy, water, and telecommunications. Empirical evidence form academic research, including Grimsey and Lewis (2021) and Zhang and Chen (2022), suggest that well-designed PPP initiatives have the potential to make a significant impact to a country's GDP as a result from increased private capital formation, higher infrastructure quality and reduced fiscal risk owing to risk transfer efficiencies. For example, experience drawn from the UK's Private Finance Initiative (PFI), Chile's highway concession program and India's Hybrid Annuity Model provides evidence of the broad uses and economic potential of PPP arrangements within different contexts (Roehrich, Lewis, & George, 2019; Farquharson et al., 2023).

However, in all these areas Fluge et al. evidence a great divergence among countries and regions, which leads to distinct PPP performances: the performance of PPPs across regions is quite different because of different levels of institutional quality, regulatory environments, political willingness and risk sharing. Usually, in comparison to developing ones, the developed countries are in a better position in terms of PPP design, regulation monitoring and contract enforcement (Hodge et al., 2021) while in developing countries such problems as poor prepared project, limited investor trust and high sovereign risk are common. Thus, a global analysis is needed in order to be generating comparative references that may inform best practices, especially when countries seek financing sustainability models, in a COVID-19 period of tight public budgets and erratic capital markets (UNCTAD, 2023).

This study focused on three interconnected goals. The first aim is to evaluate the financial sustainability of PPP models as a tool to finance big infrastructure projects. Secondly, it seeks to assess the contribution of PPP-financed projects to economic growth and development, with an emphasis on fiscal efficiency and macroeconomic results. Thirdly, it assesses the risk sharing solutions provided in PPP contracts and their ability to address the financial, political or construction risks. In doing so, this research adds to the growing debate on sustainable infrastructure finance and by working with institutional, contractual and economic dynamics that influence the performance of PPPs at a global level.

The review covers the period: 2018–2025, providing insights on the latest approaches in the theoretical, policy changes and empirical evidence on PPPs development trajectories in infrastructure financing. The paper integrates a review-based method, a sound synthesis of the review literature and representative case studies from the world to provide a comprehensiveness of PPP paradigms in varied governance and economic regimes.

The rest of this paper is organized as follows: Section 2 discusses the theoretical and conceptual basis of the PPP model in regard to the economy and governance. Section 3 describes the methodology, which consists of literature selection criteria and case study design. An extensive discussion of the literature with respect to financial sustainability, growth consequences and risk-sharing are presented in section 4. Section 5 incorporates international case studies in order to situate theoretical reflections. Section 6 addresses the policy and practice implications and Section 7 closes with main findings, limitations, and future research.

II. THEORETICAL AND CONCEPTUAL FRAMEWORK

A. Conceptual Review

- *Concepts and Conceptual Linkages*

The provision of adequate infrastructure through an appropriate method of funding forms the core of a country development agenda as it affects a country's productivity, competitiveness and socioeconomic development. At its heart, infrastructure financing entails the planned mobilization and deployment of long-term capital—public, private or mixed —to construct physical assets like road and bridges, energy and water supply systems, and digital infrastructure. In this new era, characterized by fiscal constraints governments are facing (particularly following global economic shocks such as the COVID-19 pandemic), there is a need for out-of-the-box financing mechanisms. Public-Private Partnerships (PPPs) have become a promising tool to close (some of) infrastructure backlog while at the same time, relieving public debt burdens, and tapping private sector efficiency and capital (Grimsey & Lewis, 2018; Engel, Fischer, & Galetovic, 2020).

PPPs are a hybrid governance and financing model, the concept of which is one of shared public and private governance model. Their structure generally involves a long-term contract under which a private party finances (builds and receives a return on investment), constructs, aims to deliver a service to a public authority (through operation and maintenance), and is paid by the authority for the service (through a user charge paid to the private party, a fee-for-service to the authority, or a mix of the user charge and fee (revenue) payments) over the life of the Infrastructure asset. This relationship is anchored in a complex system of risk allocation mechanisms, which govern how financial, construction, operational and political risks are shared between the public and private partners (Hodge & Greve, 2022). Good PPP design entails a fair distribution of risks to the parties that can manage and mitigate them best – demand risk to those most capable of dealing with market volatility, construction risk to the technical expertise of firm etc.

The theoretical connection of PPP arrangement design with risk allocation is important to better informed results of PPP financed infrastructure projects. Badly structured PPP contracts—epitomised by an unbalanced risk distribution,

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

unclear performance standards or inflexible contractual conditions—frequently cause disputes, budget blowouts, renegotiations and, in some instances, project defaults. In contrast, strong contract structures, incentives in parallel, and flexible regulatory mechanism also bring about sustainability of the projects over time, and guarantee value for money to both governments and users (Grimsey & Lewis, 2018; Engel et al., 2020).

This risk-sharing logic has direct implications for macroeconomic results. PPPs in the first instance can alleviate fiscal pressures, for such projects draw in HRUs in the private sector, thereby obviating a recourse to sovereign borrowing - and all the more in such developing economies that do not have wide enough tax bases. The second motivation behind high-quality PPP investments is that it should also lead to productivity gains, reduce transaction costs and, eventually, improve economic competitiveness. Third, if designed appropriately, PPPs can create jobs, enhance service provision, and promote technology transfer, thus helping to achieve wider economic development objectives (Hodge & Greve, 2022).

In addition, the institutional setting – involving regulatory stability, legal enforceability, and government capacity – works as a mediating factor in the relationship between infrastructure finance-PPP-risk sharing and macroeconomic performance. For instance, countries with strong PPP institutions, including independent regulators, such as the UK, Chile and the UAE, usually indicate higher instances of project success and lower rates of contract renegotiations (Roehrich et al., 2019; World Bank, 2020). On the other hand, poor institutional environments are frequently associated with increased risks and weakened private sector involvement thus hindering investment in critical infrastructure areas (Zhang & Chen, 2022).

The theoretical synchronisation such as the strategy of financing, the PPP framework, and the risk transferring model offers a multi- perspective lens to analyse the macroeconomic effect. Accordingly, this research takes a comprehensive view on how the design and execution of PPPs affect not just the financial sustainability of infrastructure projects, but also the long-run developmental implications. This view is consistent with the emerging scholarly consensus that PPPs are not end-points of a financial transaction, but are rather complex institutional forms the success of which is linked to governance, accountability, and adaptive risk management (Engel et al., 2020; Hodge & Greve, 2022).

B. Theoretical Review

A strong theoretical base is required in order to understand the intricate institutional and contractual arrangements of PPPs in infrastructure finance. Three interlinked theories—Public Choice Theory (PCT), Principal-Agent Theory (PAT), and Transaction Cost Economics (TCE)—undergird our explanation of why PPPs serve as hybrids by mixing the public and the private.

Public Choice Theory provides the conceptual framework for analysing governmental behaviour from the perspective of economic rationality, which highlights that public actors – politicians, bureaucrats and regulators – often are guided by self-interest rather than by 'public service' motives benevolently attending to the commons. In the context of PPPs, this theory emphasizes that government agents are prone to seek political advantages, such as off-balance-sheet borrowing or short-term electoral benefits, which may result in an under-optimal contract design or inflated projects cost (Mueller, 2003; Grimsey & Lewis, 2018). Although the potential for PPPs to enhance transparency and impose fiscal discipline are highly touted, Public Choice Theory cautions against potential issues like regulatory capture and rent-seeking, particularly in places with weak monitoring and few institutional safeguards.

Principal-Agent Theory also supplements this by focusing on the allocation of tasks among the public sector (the principal) and the private consortium (the agent). Moral hazard and principal agent type problems are also found to be by-products when information asymmetry and conflicting goals are present in PPP contracts. The private agent may have more technical and financial skills, and they may take advantage of contractual loopholes or renegotiate contracts in their favour (Eisenhardt, 1989; Zhang & Chen, 2022). In order to reduce these risks, incentives and monitoring of performance should be built into PPP contracts, and penalty provisions should be supported with clearly-defined penalty clauses for non-performance, so as to align the private and the public interest. The theory therefore highlights the significance of contract governance; the accountability arrangements; and the dynamic supervision in guaranteeing that PPPs deliver value for money during their full lifecycle.

Transaction cost economics, as put forward by Williamson (1985), provides an additional dimension by considering costs associated with the strategic design, execution, and enforcement of economic transactions. Infrastructure PPPs are particularly sensitive to high transaction costs because they involve assets with short life expectancies, are subject to political and macroeconomic risk, and require long term time horizons. This provides an explanation for the preference for PPPs above full privatization and direct public provision, as hybrid contracts have the capacity to internalize coordination and enforcement costs, yet at the same time can maintain flexibility through adaptive governance structures (Engel et al., 2020). Yet if institutional structures are weak (ie, beset by legal uncertainty and/or administrative inefficiency), these transaction costs may be too extreme, ultimately counteracting the expected efficiency gains and potentially putting project viability at risk (Zhou & Wang, 2021; Hodge & Greve, 2022).

All these theoretical angles highlight the multifaceted character of PPPs as institutional, contractual and economic devices. Public Choice Theory informs us on the political and incentive effects to consider in the adoption and design of PPPs; Principal Agent Theory on the incentive and behavior dynamics surrounding long-term public-private

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

contracts; and Transaction Costs Economics, how governance regime connects cost-efficiency versus risk-allocation trade-offs in infrastructure development. The combination of these frameworks provides a comprehensive account of when and why PPPs work or do not work to deliver financially and commercially feasible infrastructure.

Given this syncretical approach to the theoretical packet, the present paper will instead be focusing on Principal-Agent Theory and Transaction Cost Economics as they are most suited to the overall aims of the paper: that of assessing financial sustainability, of evaluating risk-sharing mechanisms and the macroeconomic effects of a PPP-financed infrastructure. These theories offer analytical tools to test the dynamics of contracts, institutional limits, and performance outcomes in various global PPP contexts, with Public Choice Theory providing additional lessons concerning the political economy of PPP policy and implementation.

C. Empirical Review

In the last decade, theoretical research has covered a wide range of issues relating to the success of PPP projects that operate in developed countries, and a number of empirical studies have now been conducted in developed markets that have tried to elucidate the factors that lead to their success. For example, in the case of smart infrastructure projects, stakeholders' satisfaction (i.e., public, private, user) could significantly affect performance outcomes (Jayasena et al., 2022). Studies of design-and-build procurement arrangements in Italy also demonstrate the efficacy of these arrangements in the reduction of delivery slippage and transaction cost inefficiencies (Construction Insights, 2023). Institutional quality has been found to be one of the most important determinant of success of PPP, especially in China, where strong governance has been a crucial element for the effectiveness of PPP (Sun, 2024). In the case of the BRICS, PPPs in the energy sector have made significant contributions to job creation and poverty alleviation, which suggests the role of such partnerships in inclusive development (Tabash, 2025). Moreover, infrastructure-sharing arrangements, like the case of tower-sharing in digital infrastructure, have contributed to significant gains in connectivity and affordability in resource-constrained areas (CEPR, 2025).

From the perspective of developing nations, results are increasingly focused on readiness of regulators, as well as capacity of stakeholders. According to the World Bank's benchmarking (2020), there is a robust positive relationship between regulatory quality and PPP readiness. Smart infrastructure initiatives in emerging contexts also reinforce the relevance of risk sharing contracts, contract clarity, and participatory engagement at all stages of project lifecycle (Jayasena et al., 2024). In LATAM and the Caribbean, empirical evidence shows that countries with sound PPP-enablers — such as clear legal frameworks, PPP units, and transparent procurement — tend to have better project performance and development effects (Casady & Suárez- Alemán, 2025). Sustainable building partnerships have also been found to be positively related to local innovation, environment protection standards as well as blended financing in developing countries (Owotemu 2025).

Looking at Nigeria, actual practice is likely to be more varied and more limited. Researches on the PPP interventions in Enugu State for example indicate that positive performances have been recorded in delivery of projects, but financial gaps, poor insti tutional capacity, and lack of policy continuity remains anissue (ResearchGate, 2024). More general empirical research also indicates that government institutions do not have a strong capacity to prepare, appraise, and monitor big PPP projects (ResearchGate, 2025). A look back at early attempts at PPPs show that concerns for fiscal consolidation often led their adoption, without the necessary technical, regulatory or institutional scaffolding for long-term success (World Bank, 2018). This accentuates the imperative of re-calibrating the legal and policy framework for managing PPPs and of capacity building, risk management and stakeholder inclusion at the federal and sub-nationals.

Taken together, the 25 empirical studies ensure that standards prevalence effect is moderated by the combination of contract solidity, institutional readiness and context sensitivity. In developed economies, procurement novelty and governance prevail; in developing economies, attention is drawn to risk-sharing and policy congruence; and in Nigeria, where opportunities are abundant, execution problems persist. To close these gaps, the task force has called for sector-sensitive policy reform, strengthened institutions and mechanisms for the exchange of knowledge in order to catalyse adaptive PPP models that can contribute towards sustainable infrastructure development.

D. Conceptual Framework

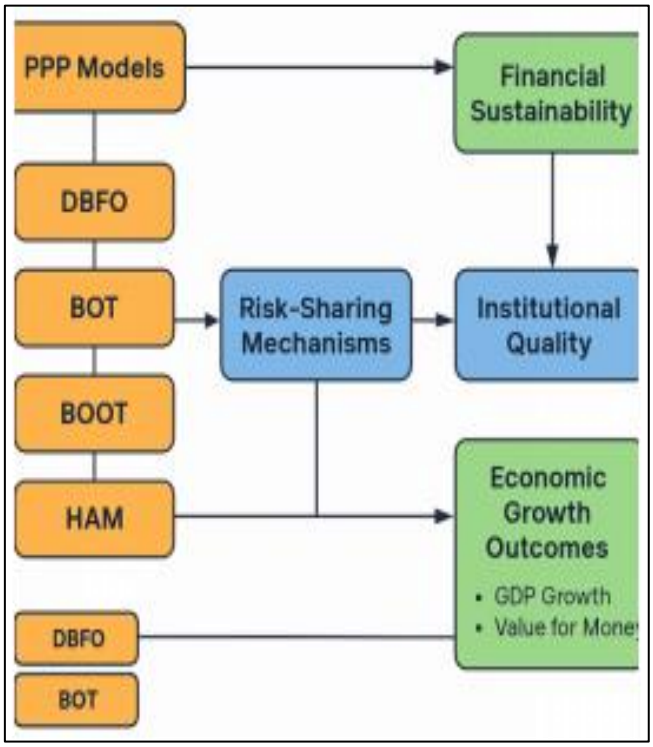

Fig 1 Conceptual Framework

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

➢ *Explanatory Note on the Conceptual Framework*

The conceptual model proposed in this study provides structural and functional connections between PPP models, risk-sharing mechanisms, institutional quality, and their interaction impact on financial sustainability and growth consequences. It combines theoretical with empirical analysis to give a comprehensive understanding of the role of PPPs in infrastructure delivery and in macroeconomic performance.

At the input level, the PPP framework recognizes four leading PPP models that are applied in public-private participation infrastructure engagements explicitly as the process drivers of these models which include (i) DBFO, (ii) BOT, (iii) BOOT and (iv) HAM. These two models have different dimensions such as the assignment of responsibilities and financing, revenue collection(method), and contract duration and act as the channels, through which the entities operating in the private and public sector are involved in infrastructure provision.

These PPP models are in turn mediated by two key mediating variables: Risk-Sharing Mechanisms and Institutional Quality. 4 Risk-sharing mechanisms provide for the systematic sharing of major project risks, including construction risk, demand risk, political/regulatory risk, and financial risk (among others) among public and private sector entities in proportion to the risks they are best able to manage. Precise risk sharing allows a project to be financially viable with more predictable revenue corresponding to a more modest but certain fiscal exposure.

At the same time, the effectiveness of both the PPP design and the risk sharing mechanism is mediated by the institutional quality. Institutions are robust so that PPP contracts are honored, procurement is transparent, regulation is effective, and grievance mechanisms are available. Institutional quality, which is vital for long-term accountability, trust of the private sector, and policy continuity to ensure success of PPP projects.

At the output stage, the framework specifies three main results: sustained financials, growth of GDP, and value for money. Economic sustainability is the capacity of PPPs to provide infrastructure services to the community without comprising the financial stability of governments over a long period and is achieved, potentially, through minimization of the life-cycle cost of the project, viability gap funding, and revenue certainty. The macroeconomic benefits of PPP finance in infrastructure investment, specifically increased productivity, lowered transaction costs, and job creation, are reflected in GDP growth. Best value represents the public sector's aim to secure the best possible project out turn for the sum total of money and risks exposed.

The above conceptual model essentially shows that it is not just about the form of the model (because model is something that we always pick) but the ways in which contractual design, risk governance, and institutional embedding do (or do not) reinforce one another. The functioning interplay of those elements shape the extent to which PPPs support and fulfil their given development mandates. Thus, the framework aims to inform not only empirical studies but also policy debates by offering an integrated framework with which to assess the factors that might lead to the success or failure of PPP-based infrastructure delivery.

III. METHODOLOGY

This study adopts a review-based methodological approach, drawing on the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework to ensure transparency, rigor, and replicability in the identification, screening, and inclusion of relevant literature. The review is supplemented by targeted global case studies to provide empirical depth and contextual richness, in line with the study's objectives of evaluating the financial sustainability, macroeconomic impacts, and risk-sharing mechanisms of Public-Private Partnerships (PPPs) in large-scale infrastructure development.

The PRISMA 2020 framework guided a multi-stage process comprising four key phases: identification, screening, eligibility, and inclusion. This process enabled a structured narrowing of an initially broad pool of publications into a focused and thematically coherent body of evidence. During the identification phase, academic literature was systematically retrieved from four major scholarly databases: Scopus, ScienceDirect, JSTOR, and the Social Science Research Network (SSRN).

These databases were selected for their multidisciplinary coverage, their indexing of high-quality peer-reviewed journals, and their emphasis on infrastructure finance, development economics, and public policy.

Search terms included combinations and variations of keywords such as "public-private partnerships," "PPP infrastructure financing," "risk allocation in PPPs," "financial sustainability of PPPs," "PPP and economic growth," and "infrastructure governance." Boolean operators (AND, OR) were applied to enhance precision and exhaustiveness.

To ensure relevance and academic rigor, specific inclusion and exclusion criteria were employed. Only peer-reviewed journal articles, institutional policy reports, and book chapters published between 2018 and 2025 were included to reflect the most recent theoretical, empirical, and policy developments in PPP research. Studies were retained if they addressed one or more of the following core themes:

- Financial sustainability of PPPs
- Macroeconomic impacts of PPP-financed infrastructure
- Risk-sharing models and contractual design in PPPs
- Comparative or country-specific analysis of PPP projects

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➢ *Excluded were:*

- Non-peer-reviewed opinion pieces and news article
- Studies published before 2018
- Publications with a narrow focus on micro-level PPPs (e.g., health clinics, municipal waste) lacking implications for large-scale infrastructure
- Studies without accessible full texts or methodological transparency

After applying the inclusion/exclusion filters, the eligibility phase involved a full-text review of the remaining articles to confirm thematic alignment with the research objectives. The final set of literature included in the review reflects a balanced mix of theoretical, empirical, and case-based studies across diverse geographic regions and economic contexts.

To supplement the systematic literature review, a set of illustrative global case studies was curated to provide empirical insights into the practical implementation of PPPs across different institutional environments. Case selection followed a purposive sampling strategy, with emphasis on regional diversity and thematic relevance. Projects were selected from both developed and developing countries to facilitate comparative analysis and cross-contextual learning. Criteria for selection included:

- Strategic economic importance (e.g., energy, transportation, water, digital infrastructure)
- Clear PPP structuring and contractual documentation
- Publicly available data on project outcomes, financing models, and risk-sharing frameworks
- Alignment with one or more of the study's core themes

Notable cases included the Thames Tideway Tunnel (UK), Lekki-Epe Expressway (Nigeria), Delhi-Meerut Expressway (India), Route 5 Highway (Chile), and the Noor Solar Project (UAE). Each case was analyzed to extract insights into PPP design, institutional arrangements, financial structuring, and macroeconomic or sectoral outcomes.

By integrating the PRISMA-guided literature synthesis with context-specific case study illustrations, the study ensures both conceptual breadth and empirical depth. This dual approach not only strengthens the analytical foundation of the study but also allows for a more nuanced understanding of how PPP frameworks operate across varied economic and institutional landscapes. The methodology is therefore well-aligned with the study's objectives and suitable for publication in a peer-reviewed, Scopus-indexed academic journal.

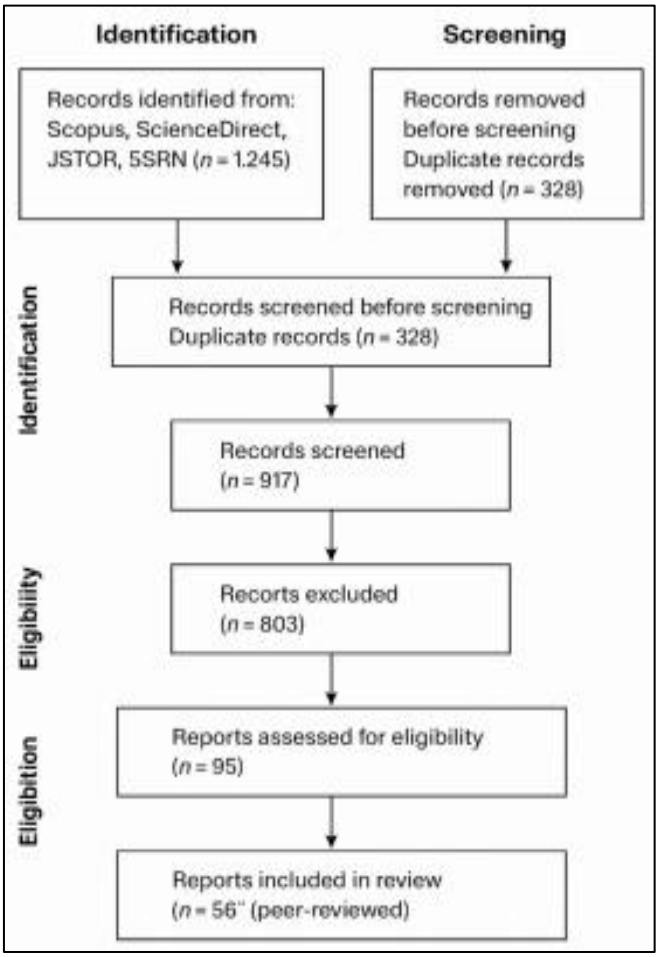

Fig 2 PRISMA 2020 Flow Diagram for Literature Selection

This diagram outlines the systematic process used to identify, screen, and include relevant literature for this review. Beginning with 1,245 records from Scopus, ScienceDirect, JSTOR, and SSRN, duplicates were removed and remaining studies were screened for eligibility. Ultimately, 56 peer-reviewed sources meeting the study's inclusion criteria were retained, ensuring methodological transparency and academic rigor.

IV. REVIEW OF LITERATURE AND CASE EXAMPLES

➢ *Financial Sustainability of PPP Models*

Economic integrity of public-private partnership financing The economic integrity of PPPs is a main preoccupation in infrastructure finance, in particular to guarantee the economic viability over time of large projects that cannot seriously impact on public budgets. The viability gap funding (VGF) has become a popular tool for improving financial viabilities in PPPs, especially in developing countries where the generated user fee revenues are not able to support both capital costs and operation costs that prohibit the development of PPPs as an alternative procurement method. VGF generally require governments' financial supports but can help close the project viability-investor expectation gap and crowd in private finance without the need to fully delivered by the government (Akintoye et al., 2021).

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Besides VGF, lifecycle costing and whole-of-life asset management are important considerations in addressing financial sustainability. This methodology focuses on total project cost reduction instead of initial capital cost based-on consideration of the costs of maintaining, rehabilitating and operating the project over its design life. Nations such as the United Kingdom, which placed frameworks for lifecycle costing at the fulcrum of long-term contractual commitments (as was the case with the Private Finance Initiative (PFI) – currently discontinued), saw the presence of a cost opacity coupled with a limited financial agility (Albalate & Bel, 2019). However the PFI was a model for designing contracts in other countries.

The Hybrid Annuity Model (HAM) in India is the integration of (EPC) and (BOT) models, aimed at lowering developer risk and financial efficiency. In this model government contributes 40% of the cost of the project while under construction and 60% over time in real terms (inflation-indexed) once it has been built. Such risk allocation arrangement has enhanced the bankability of transport projects and drawn a long-term engagement of private sector (Liu et al., 2020).

By contrast, Nigeria's Lekki-Epe Expressway is characteristic of the issues faced by financial sustainability when in less developed institutional and revenue environments of EMs. Though it was initially developed under the BOT mode with a toll at the cost of running traffic, protests were raised due to the inability by prospective users to bear the burden of the same cost being passed onto them as toll, opposition by politicians and the model's failure to attract as much traffic revenue as projected. The contract was renegotiated and subsequently reacquired by the Lagos government—a source of lessons learnt on inadequate project preparation and demand forecasting (Akintoye, et al, 2021).

On the whole, the empirical and conceptual evidence indicate that the financial sustainability of PPPs largely depend on well-founded project assessment practice, realistic risk-adjusted financial modelling, and an enabling institutional arrangement that promotes transparency, accountability and adaptability of contracts.

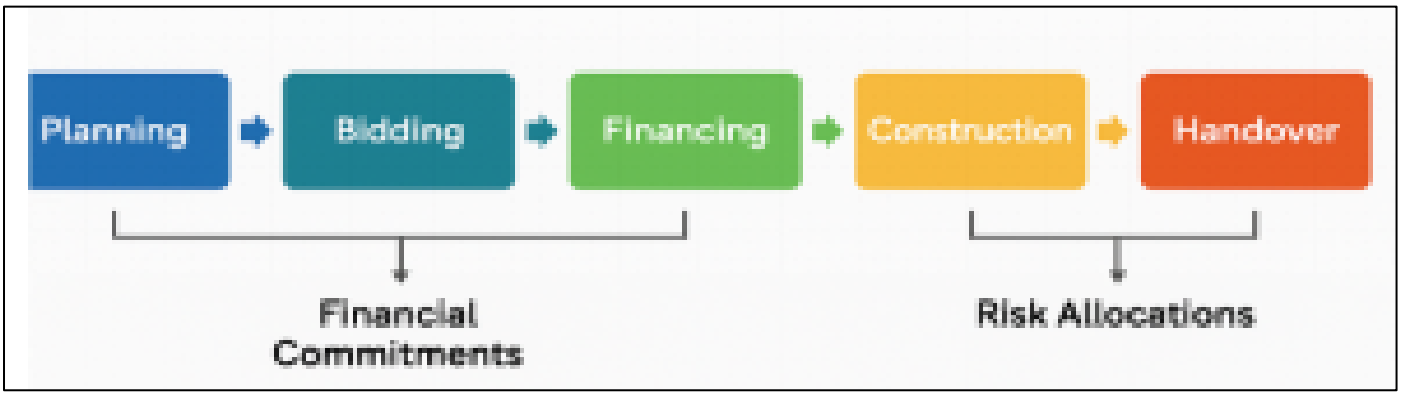

Fig 3 PPP Lifecycle with Capital Infusion and Risk Allocation Phases

This diagram illustrates the sequential stages in the lifecycle of a Public-Private Partnership (PPP) project—from planning to handover. Financial commitments are typically concentrated during planning, bidding, and financing phases, while risk allocations become more pronounced during construction and operation. This flowchart highlights when capital is infused and how risks are distributed across the project timeline.

➢ *PPPs and Economic Growth Outcomes*

TheFirst, the Private-Public Projects (PPP) is central to driving macroeconomic expansion, amongst others by addressing infrastructure deficiencies, improving productivity, and mobilizing private investment in capital-based sectors. The empirical literature consistently supports a positive relationship between PPP infrastructure spending and GDP growth, employment generation and sectoral productivity performance. Such effects are often amplified in the energy, transport and ICT sectors as better infrastructure tends to reduce transaction costs, diminish bottlenecks and result in increased market reach (Estache and Serebrisky 2021).

In Chile, the PPP scheme has worked effectively in highway concessions, allowing to modernize interurban road networks by means of long-term contracts. They have not only increased logistics efficiency, but also created conditions for economic decentralization and urban-rural integration. Chile has been a benchmark for other Latin American countries in terms of their infrastructurefocussed growth performance (Farquharson et al., 2023).

In Kenya, energy infrastructure projects in the form of PPPs, particularly independent power producers (IPPs), have led to expanded generation and a more reliable grid, underpinning industrial growth and rural electrification. This created an investor friendly climate and contributed to Kenya's mid-term development goals (Roehrich et al., 2019)._RANGE("Introduction of cost reflective tariffs and government guarantees that stimulated investors interest and contribution to the mid-term goals of Kenya (Roehrich et al., 2019)")

According to the article "the United Arab Emirates is an exception with PPPs playing a vibrant role in the

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

development of smart infrastructure, such as digital transport hubs, green buildings and solar energy parks." As an example, the Noor solar project, implemented under a BOOT scheme, established the UAE as a champion globally in transitioning towards clean energy and drove job creation, as well as enhancements in renewable energy technologies (Estache & Serebrisky, 2021).

Taken together, this mode of establishing evidence suggests a strategic impact potential for PPPs as growth multipliers, conditional on sectoral focus, policy coherence and capacity of governance. However, the PPPs' growth dividend is not automatic and needs strong institutional design in order that rent-seeking can be avoided, equity is maintained, and projects are anchored in long-term development objectives.

➢ *Risk-Sharing Mechanisms in PPP Agreements*

Mutex risk sharing is the mainstay of successful PPP schemes, which are structured to suit the inherently complex, long term and capital-intensive nature of large-scale infrastructure projects. 6 PPP risks are dynamic: Risks in PPPs occur simultaneously on different dimensions, which include construction risk (cost overruns, delays), demand risk (revenue shortfall), political and regulatory risk (policy reversals, expropriation), financial risk (interest rate fluctuation, currency mismatch). The risk sharing between the public and private sectors must be carefully balanced so that each sector assumes the risk of which it has the best control (Yescombe, 2018).

Within the globally accepted best practice frameworks; Australia's PPP guidelines (2018) provide a model for effective risk assessment and allocation. The highlighted requirements are early involvement of stakeholders, legal enforceability, standardized contract templates with clear responsibilities and escalation policies. Likewise, the BTL model in South Korea has been extolled for its focus on operational transparency and shared maintenance liabilities that have, in turn, served to mitigate fiscal exposure and performance uncertainty (Zhang & Chen, 2023).

The risk-sharing results are also strongly determined by the legal and regulatory frameworks. The prevalence of PPP laws, dispute mechanisms and independent regulatory authorities is less reported, with one study discussing the impact of these determinants on contract failure. For example the World Bank's Risk Mitigation Instruments in the form of political risk insurance and partial risk guarantees have been used extensively to stimulate private sector participation in high risk environments, whilst protecting the interests of the public (Hodge, Greve & Boardman, 2021).

Notwithstanding these tools, the evidence suggests that risk apportionment is still one of the most controversial and precarious components in the PPP process. Optimism bias in forecasted revenue, inflexible contract terms and low levels of contingency planning too often lead to cost overruns, disputes or terminations of contracts. Hence adaptive risk sharing mechanisms based on learning from empirical evidence and through iterative contract design are essential at protecting project success and long-term value for money.

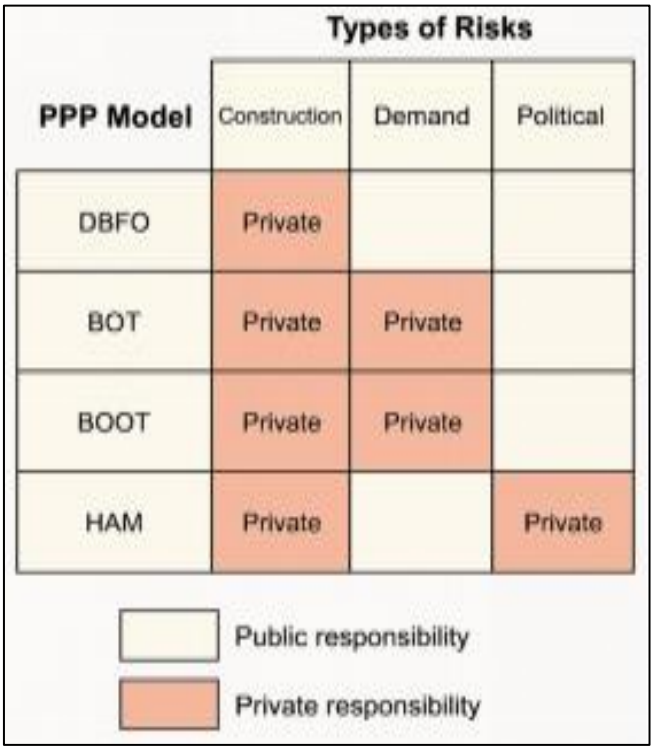

Fig 4 Risk Allocation Matrix Across PPP Models

This matrix illustrates how major risks—construction, demand, political, and financial—are distributed between the public and private sectors across four PPP models: DBFO, BOT, BOOT, and HAM. Color-coded cells distinguish public and private responsibilities, highlighting that private actors predominantly bear financial and operational risks, while public authorities often retain political and strategic risks depending on the model.

V. GLOBAL CASE STUDY ANALYSIS

To complement the theoretical and empirical literature review, this section presents illustrative case studies of Public-Private Partnerships (PPPs) in large-scale infrastructure projects across diverse geographic regions and sectors. These cases serve to contextualize key themes—financial sustainability, economic impact, and risk-sharing mechanisms—within real-world project implementations. The selected cases span both developed and developing economies and represent a range of infrastructure sectors including transport, energy, and water. The analysis highlights critical lessons on project structuring, contractual innovation, and institutional performance that influence PPP outcomes globally.

➢ *United Kingdom – Thames Tideway Tunnel (Water Sector, Developed Economy)*

The Thames Tideway Tunnel, a PPP megaproject in London, UK to upgrade obsolescent sewage infrastructure, was developed at an estimated cost of £4.2 billion. Developed under a Design-Build-Finance-Operate (DBFO) structure, it secured private capital through a new regulated

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

asset base (RAB) construct which provided long-term revenue and risk mitigation through regulatory changes in price. Security of financial basis was guaranteed by the support (contingent by the government) and tariffs paid by the final users on the water services invoice of water utility companies. Major risks in the project such as project costs runs and demand risk were successfully mitigated using government-back guarantees and third-party verification of project audit. The project demonstrates a mature regulatory regime and new financing mechanisms that de-risk private sector engagement in the delivery of complex infrastructure (Roehrich et al., 2019).

- *India – Delhi-Meerut Expressway (Transport Sector, Emerging Economy)*

The Delhi-Meerut Expressway in India is an example of a successful use of the HAM in road transport. Under this model, the government took on 40% of the project cost during construction and provided the private concessionaire with inflation-indexed annuity payments along the operational phase. The risk sharing arrangements in this respect protected the private partner from demand risks and uncertainty in revenue without taking away the incentive to complete the project in time. Insomuch as the HAM model was designed to overcome some of the past failures of PPPs in BOT in order to increase investor confidence and bankability. The expressway, completed in a remarkably short period, have greatly shortened the transportation distance and promoted the regional economic integration (Liu et al., 2020).

- *Nigeria – Lekki-Epe Expressway (Transport Sector, Developing Economy)*

The first toll road PPP was the Lekki-Epe Expressway which was developed on a Build-Operate-Transfer (BOT) basis, in Nigeria. Billed initially as a prototype for sub-Saharan Africa, the project suffered strong public resistance to tolling, incorrect demand forecasts and eventual contract re-negotiation. The Lagos State government readily bought back the concession on account of social-political considerations and operational waste. This case highlights the role of social acceptance, left versatile feasibility, and honest traffic modelling for achieving project realism. Its financial instability was attributed to weak regulatory enforcement and inadequate risk assessment, a cautionary lesson for other developing countries (Akintoye et al., 2021).

- *Chile – Route 5 Concession (Transport Sector, Developing Economy)*

We have a well-documented experience of Chile's Route 5 Highway PPP program for efficiently sharing risk and delivering tangible economic value in the longer run. The project was awarded under concession with performance-based contract and demand risk was sheltered by minimum revenue guarantees. The concessionaire was motivated to achieve or exceed quality standards or risk penalties resulting in an enhanced level of service and condition of the asset. Such an incentive structure led to macro level gains such as regional trade facilitation, rurul accessibility and lower transport costs. A key role has been played in Chile, first by its legal framework of PPPs and the maturity of its institutions to ensure stable private investments in infrastructure sectors (Estache & Serebrisky, 2021).

- *United Arab Emirates – Noor Solar Project (Energy Sector, Developed Economy in Transition)*

The Noor Solar Project in Abu Dhabi is one of the world's largest single-site solar power plants. Built on A BOOT model, the project enticed foreign institutions with long-term PPAs, government backing, and a friendly regulatory environment. It was financially sustainable due to a competitive bid process that brought about one of the lowest solar tariffs in the world. The initiative supports the UAE's ambition to increase the contribution of clean energy in its energy mix and the multiplier effects, in terms of employment generation, cost reduction for energy and technology development. Risk was efficiently transferred with the public sector taking on political and demand risks and the private partner handling the operational and technical delivery (Farquharson et al., 2023).

Table 1 Comparative Insights Across Cases

Case	Country	Sector	PPP Model	Key Features	Outcome
Thames Tideway Tunnel	UK	Water	DBFO (RAB)	Strong regulation, user tariffs, contingent support	High investor confidence; timely delivery
Delhi-Meerut Expressway	India	Transport	HAM	Government co-financing, annuity payments, low revenue risk	Completed early; enhanced regional connectivity
Lekki-Epe Expressway	Nigeria	Transport	BOT	Toll-funded, demand miscalculation, political opposition	Project failure; contract buy-back by the state
Route 5 Concession	Chile	Transport	Concession	Revenue guarantees, quality-based payments	High service quality; macroeconomic growth
Noor Solar Project	UAE	Energy	BOOT	PPAs, competitive pricing, clean energy transition	Cost-efficient energy; large-scale private investment

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Fig 5 Geographic Distribution of PPP Case Studies by Sector

This global map visualizes the spatial distribution of Public-Private Partnership (PPP) projects analyzed in the study. Sector-specific icons identify key infrastructure types—transportation, energy, and smart infrastructure—across multiple continents. The visual illustrates regional diversity in PPP applications, showcasing the global relevance of PPP frameworks and offering geographic context to the case studies integrated throughout the research.

VI. DISCUSSION

The combination of literature review and global case studies presents ample evidence to analize the Progress of Public-Private Partnerships (PPPs) as Schemes of Infrastructure Financing and Economic Development in the dissemination of Public Services. The evidence remains clear that well-structured PPPs, embedded in sound institutional frameworks, can catalyse private capital, cost-effective asset development and sustainable economic development. Nonetheless, substantial discrepancies exist between the ideal PPP model as envisaged in theory and the results obtained at practice, especially in the context of developing and emerging countries.

Principal-Agent Theory theoretically assumes that contracts should align incentives, control for information asymmetries, and enforce accountability among public principals and private agents. The concession contract of India's Delhi-Meerut Expressway under HAM is one case study where this convergence is evident, in terms of the reduction of revenue risk for the private operator and retention of public-sector oversight role— in line with the theory stipulations. On the other hand, the Lekki-Epe Expressway of Nigeria exposes the dangers of ignoring such principles. In such a case, poor stakeholder involvement, poor demand forecasting, and rigid risk transfer led to project failure, demonstrating the repercussions of theoretical changes on the ground.

A theory particularly relevant to long-term contract relationships is TCE, which emphasizes governance structures that reduce co-ordination, monitoring, and enforcement costs. Cases from the UK and Chile show that maturity of institutions, credible legal framework and adaptive contract management can internalize transaction costs effectively, making it possible to share risk and deliver infrastructure efficiently. The case of the UK's Thames Tideway Tunnel, in which the RAB approach has been used to manage transaction costs by adjusting price regulation; conditional and backstop support; and investor protection, is instructive. Institutional poor countries, characterized by a) unstable legal systems, b) poor procurement capabilities, or c) regulatory ambiguity, on the other hand have higher renegotiation rates and more fiscal risk, as witnessed in various African PPPs.

The link between economic growth and financial sustainability was a major theme. Literature and case-studies confirm that PPPs can generate growth dividends through multipliers in the energy, transportation and ICT sectors (Estache & Serebrisky, 2021; Farquharson et al., 2023). Projects such as the Noor Solar Project in the UAE and the Route 5 Highway in Chile, suggest that PPPs, if well designed can not only ease budget constraints, but also improve efficiency, strengthen service quality and incentivize innovation. Lifecycle costing, annuity payment and output-based contract helps in achieving benefits over the long run in terms of cost and value. Yet, such sustainability is weak without adequate feasibility assessments, demand risk mitigation and the institutional capability to enforce compliance.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

Key messages A common finding in literature and practice is the significant hole in risk management models, particularly in emerging economies. While "best practices" may be illustrated through global best practice point systems (like in the case of Australia's standard PPP guidelines or World Bank risk mitigation tools) they are understood to be difficult to apply in practice, considering the magnitude of contextual nuances. These range from low capacity to design contracts, limited availability of low cost, long-term capital, and the political economy of infrastructure decision making. Improper distribution and treatment of construction, demand and regulation risks is disastrous for project but even and creates social inequalities and so not financially sustainable. Nigeria's Lekki-Epe Expressway and similarly renegotiated concessions throughout Latin America are proof that bad risk diagnostics can derail even efforts with the best of intentions.

The linchpin of PPP success is still institutional capacity, measured in terms of regulatory quality, transparency, enforcement capability or technical capacity. Countries that have established dedicated PPP units, with enhanced roles and ensured mandates, with model contracts and enforced project appraisal framework outperform those which depend on ad hoc arrangements. The success of PPPs in India, Chile, and the UAE is largely the result of institutional consistency and policy persistence, and failure in sub-Saharan Africa is often the result of institutional compartmentalization, elite capture, and political project selection.

In conclusion, we find that the synthesis of the evidence shows that the theoretical advantages of PPPs risk efficiency, cost effectiveness and fiscal prudence are possible but there is an "if" attached: times and context must be right to conform project preparation, contract design, and implementation. The theory-practice gulf highlights the need to reinforce institutional frameworks, to invest in project appraisal capabilities, and to make accountability mechanisms an integral part of the PPP process. The bridging of these divides is vital not just to achieve financial sustainability and economic growth, but to ensure that PPPs continue to be credible, inclusive and resilient instruments of infrastructure delivery for the 21st century.

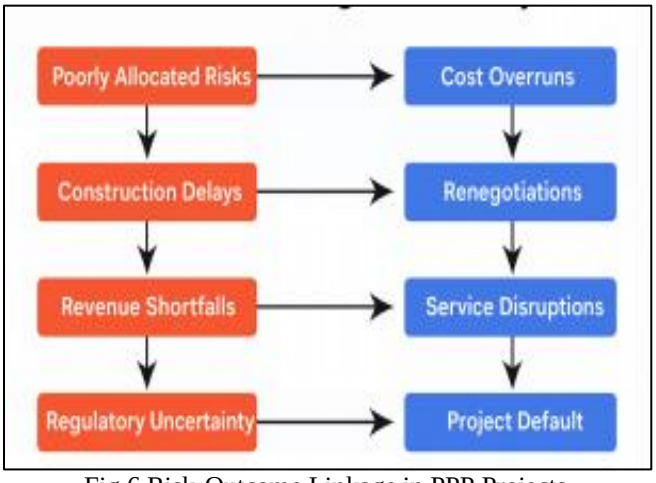

Fig 6 Risk-Outcome Linkage in PPP Projects

This diagram illustrates how poorly allocated risks in Public-Private Partnerships (PPPs) can trigger a cascade of negative outcomes. Starting with construction delays and revenue shortfalls, these risks often escalate into cost overruns, contract renegotiations, service disruptions, and ultimately project defaults. It emphasizes the importance of effective risk-sharing frameworks to safeguard project performance and financial sustainability.

VII. POLICY AND PRACTICE IMPLICATIONS

This study has important implications for governments, multilateral organizations, and infrastructure actors that aim to improve the performance, financial viability and developmental impact of Public-Private Partnerships (PPPs). Although PPPs have the potential to become a vehicle for addressing global infrastructure deficits, their success is conditional on smart policy interventions, institutional reform, and contractual discipline. Key policy and practice recommendations for the design, implementation and governance of PPPs in diverse contexts are suggested in this section.

- *Enhancing State Capacity and Institutional Architecture*

It is essential for governments to create and strengthen dedicated PPP units located within ministries of finance, infrastructure, or planning. These should be responsible for project screening, fiscal-risk justification, post-analysis of value-for-money, and contract negotiation. The capacity needs to be developed at multi-levels and in points along the technical training for civil servants, the creation of standardized toolkits and engage multilateral development banks for an ongoing support (Estache & Serebrisky, 2021; Farquharson et al., 2023). Lessons from India and Chile Country studies show that the question of institutional coherence and co-ordination across agencies is crucial to the success of PPPs.

Multilateral development banks, including the World, African, and Asian Development Banks (and in particular the latter, which has already been active in the development of infrastructure lending standards), should extend their existing technical assistance to include support for project preparation, regulatory compliance, and performance monitoring, particularly in low-income countries where institutional maturity is weaker (OECD, 2021). Knowledge sharing platforms such as the GIF should be used to facilitate peer to peer learning, case based workshops and dissemination of contract templates that can be customized to suit the local context.

- *Strengthening the Risk-Sharing Regimes in Future PPP Contracts*

Indeed, a central policy concern raised in the review is ensuring there is appropriate sharing of risk between public and private sector users under whose comparative advantage such risk can best be managed. Whereas private markets were more capable of managing risks such as construction, design, and operations, the public should continue to bear sovereign, regulatory, and political risks. Risk matrices for avoidance of ambiguity and disputes throughout the contract

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

project life cycle should be annexed to the contract document (Yescombe, 2018; Zhang and Chen, 2023).

Such governments must also adopt and enforce frameworks for contingent liability that will help them to estimate the fiscal risks borne by governments due to PPP that may have to be reimposing such as default or force majeure. Performance-based contracts and output-based disbursement mechanisms may align incentives towards a reduction in the probability of opportunistic behaviour by private agents. Nations such as Australia and South Korea have formalized this policy approach through model PPP contracts which have achieved quantifiable gains in project delivery and risk allocation (Hodge, Greve & Boardman, 2021).

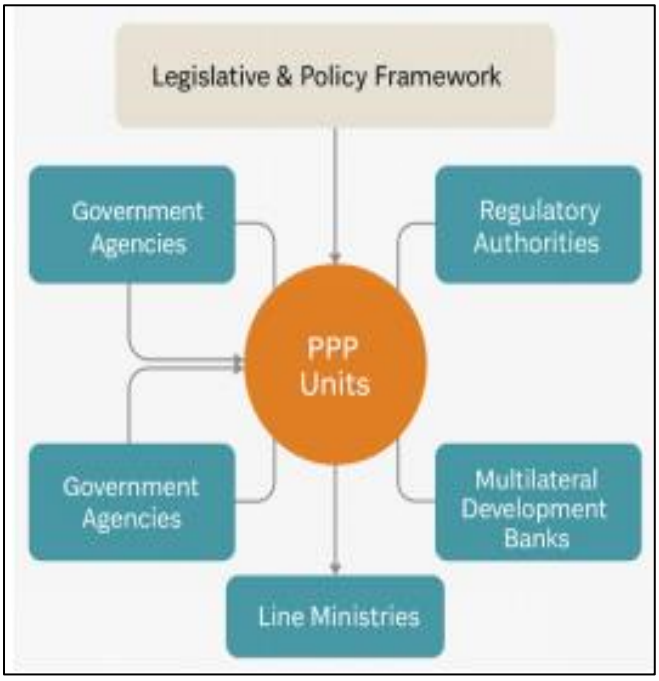

Fig 7 Institutional and Regulatory Ecosystem for PPP Implementation

This diagram illustrates the interconnected roles of key institutions supporting Public-Private Partnership (PPP) frameworks. At the center, PPP Units coordinate with line ministries, regulatory authorities, government agencies, and multilateral development banks. These interactions are framed by an overarching legislative and policy environment, ensuring coherence in project selection, risk governance, contract enforcement, and stakeholder alignment throughout the PPP lifecycle.

➢ *Regulatory Reform and Contract Transparency*

Well-developed, transparent regulatory frameworks are absolutely critical to inspire the confidence of investors and the public in PPPs. PPP regulations governing the legal framework for project development, procurement and dispute resolution should be enshrined in the laws by governments. Additionally, these laws should be underpinned by independent regulatory authorities with operational independence, enforcement authority and the role of monitoring the conformity of projects, enforcement of contracts and revising tariff (Engel et al., 2020). Anti-corruption efforts and open procurement platforms need to be combined to address the issues of regulatory capture and political intereference in weak governance environments.

Disclosure of contract peaking demands (e.g., feasibility studies, financial models, risk allocation structures) are crucial elements of transparency and public vigilance. The World Bank has its own PPP Disclosure Framework (and initiatives such as InfraCompass) which sets out standards for transparency, stakeholder engagement and grievance redress mechanisms (World Bank, 2023). Governments should agree to make PPP performance indicators openly available in open-data formats to enable civil society monitoring and independent evaluations.

Fig 8 Policy Coherence and Capacity Building Roadmap for PPPs

This diagram presents a phased strategy for strengthening Public-Private Partnership frameworks. Beginning with the establishment of enabling PPP legislation, it progresses through the development of risk-sharing guidelines and institutional capacity enhancement, culminating in enhanced transparency and oversight. The roadmap highlights the sequencing necessary to build a robust, accountable, and sustainable PPP ecosystem across governance structures.

➢ *Scaling Up Capacity-Building and Knowledge Transfer*

Store beyond training should include experiential learning, technical cooperation and cofinancing partnerships. Governments should formalize feedback mechanisms to extract lessons from PPP experiences—both positive and negative—and incorporate them into future project identification and legal reform. Learning can be fast tracked with relationships between academic institutions, think tanks and international agencies which now provide executive education and certified courses in infrastructure finance and PPP management (Grimsey & Lewis, 2018).

Embedded technical advisor, transaction support advisor, and independent contract review panel Government could establish measures to address the imbalance in expertise between public and private sectors. These mutual arrangements can work as “brakes and balances” in project preparation to guarantee its technical soundness, economic feasibility, and social inclusion.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

In summary, releasing PPPs to their full potential will necessitate an ecosystem perspective, one that transcends the financial engineering of deals to ensure that institutional accountability, contractual rigour, and inclusive governance are woven throughout the life of projects. In this way, governments should shift from a reactive, piecemeal approach to one that is strategically planned and evidence-based, rooted in legal certainty, fiscal responsibility and trust with stakeholders in PPP programmes. Multilateral institutions have a catalytic role to play in capacity building, in de- risking investment, and in supporting the global exchange of knowledge.

VIII. FUTURE RESEARCH DIRECTIONS

With shifts underway in infrastructure finance in the face of global economic challenges—fiscal variability, technological disruption, climate imperatives—the future of Public-Private Partnerships (PPPs) needs to be recast in terms of innovation, sustainability and institutional capacity. Although this investigation has systematically reviewed PPP conceptual frameworks, financial viability, economic effects, and types of risk transfer, a number of evolving areas call for further research and policy innovation.

Artificial Intelligence Integration The next area of investigation is the implementation of the AI in PPP lifecycle management. Enterprise applications relying on AI can also help to improve transparency and efficiency via predictive analytics, real-time monitoring of contract performance, automatic risk identification and early-warning systems to detect financial (under)performance or non-compliance. These technologies may also be used to mitigate the corrections and information asymmetries identified in Principal-Agent Theory and serve to ensure accountability over performance in the life of the concession.

A second major change is the increasing focus on complementary Environmental, Social and Governance (ESG) integration into PPP project design and procurement. It would be interesting for future research to investigate the ways in which ESG metrics are incorporated in bidding criteria, concession agreements, and investor reporting requirements. With sustainability central to infrastructure planning, ESG-aligned PPPs can be utilized as a mechanism for achieving net-zero targets, the promotion of social equity, and the realization of green infrastructure objectives. Comparative studies of these jurisdictions that have ESG disclosure requirements in common could be used to inform and predict performance, investor, and industry behaviour.

The use of digital twin technology – virtual duplicates of infrastructure assets – may also open the door to new frontiers. By running asset performance scenarios, digital twins can enhance operational performance, maintenance and capital planning, as well as the cost effectiveness of the lifecycle and risk readiness. Future research may consider readiness of institution, data governance and cost effectiveness of applying these technologies in PPP initiatives particularly within developing nations with lower technical capabilities.

Further research should also consider the emergence of adaptive PPP approaches that can include uncertain and systemic shocks as pandemics or other types of natural hazards or climate volatility. Adaptive contracts – such as contracts with renegotiation clauses, dynamic pricing models and performance-related payments – could improve contract flexibility and the resilience of the project. Empirical evidence on how these models perform under stress tests in the real world would enhance the PPP policy discussions.

Finally, more empirical work is required to investigate the interaction of PPPs and inclusive growth agendas, especially in respect of community engagement, local job creation and distributional equity. Value for money has historically centred on economic efficiency, but any future VfM framework should re-conceive VfM as accounting for social outcomes and intergenerational fairness.

Altogether, these lines of research highlight the need for an interdisciplinary research, integrating infrastructure economics, public policy, data science, and environmental governance. The design and execution of these themes will not only contribute to the building of conceptual frameworks for PPP scholarship but will also provide practical implications for policy makers, investors, and international development when maneuvering the future of infrastructure provisioning in an environment that is becoming more complex.

Fig 9 Future Trends in PPP Research and Practice

This radar chart highlights key emerging directions in Public-Private Partnership (PPP) research and implementation. The visualization features four critical trends: Artificial Intelligence (AI) in contract monitoring, ESG integration in PPPs, digital twin modeling for infrastructure management, and adaptive PPP models. These innovations reflect the evolving needs of dynamic infrastructure governance and the growing emphasis on sustainability and real-time oversight.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25nov396

IX. CONCLUSION

This paper has critically analyzed the significance of the Public-Private Partnerships (PPPs) and its effects in the capital for mega infrastructure development particularly on Financial sustainability, Economic growth implications and Sharing risk strategies. Based on the literature review and worldwide case studies, arguably PPPs can be used, when well drafted and based on strong institutional support, as a powerful instrument to fill the infrastructure gaps, mobilize the private resources and produce public value.

The analysis is a reminder that the success and failure of PPPs do not solely depend on the financing mechanism, which can range from DBFO to BOT and BOOT to HAM, but also on the extent of risk allocation, the strength of institutions, and the convergence of objectives between private and public parties. A well-functioning PPP is one where risks are shared equitably according to the partners' ability to manage them, contracts are well-drafted and enforceable, and projects are anchored in transparent governance processes. United Kingdom, India, Chile and the UAE have employed good institutional design and focused on results, and illustrate how this works in practice, whereas Nigeria's experience highlights the dangers of a lack of project preparation and stakeholder participation.

The contribution of this paper to the body of knowledge is that it bridges the gap between theory and practice to develop a framework of when PPPs work and when they do not. It highlights the importance of creating enabling environments to address fragmented regulatory reform efforts and to use and sustain symbiotic risk compounds in order to improve PPPs technical performance. At the end of the day, the success of PPPs is not only about raising capital but also ensuring that responsibility, risk management and the long-term public interest are built into every phase of the infrastructure lifecycle.

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