

Exploring Factors that Impede Private Sector Investment in Rail Infrastructure in Ghana

^{1*}Collins Ameyaw., ²Sarfo Mensah, ³Richard Ohene Asiedu, ⁴Ibrahim Muhammed Kusi, ⁵Blondel Akun Abaitey, ⁶Anita Asamoah-Duodu, ⁷Gillian Mensah

^{1,2,4,5,6,7}Department of Construction Technology and Quantity Surveying, Faculty of Built and Natural Environment, Kumasi Technical University, Ghana.

³Department of Building Technology, Koforidua Technical University, Ghana.

*Corresponding author: collins.ameyaw@kstu.edu.gh

Abstract

Rail transportation is considered globally crucial to the growth and development of any economy. However, most developing countries are struggling to develop rail infrastructure despite its capacity to propel them to greater development. This study aims to identify the factors that impede private sector investment in rail infrastructure in Ghana. This study adopted a quantitative research method, utilizing surveys to collect data from stakeholders, asset owners, and private investors in the rail infrastructure sector. Data were analysed using principal component analysis (PCA). The results show that the major issues are limited access to funds, followed by regulatory uncertainty, insufficient government support, corruption, and the lack of a skilled workforce. Moreover, private investors complain of a poor and ambiguous Public-Private Partnership (PPP) policy and a lack of clear or transparent approaches to risk-sharing. In conclusion, eliminating investment barriers is necessary to address regulatory bottlenecks, enhance access to financing, and develop clear PPP guidelines. This study offers suggestions to policymakers and other stakeholders to create an enabling environment for private sector involvement in rail infrastructure development.

Keywords: Barriers, Ghana, Private Sector Investment, Public-Private Partnership, Rail Infrastructure.

1.0 INTRODUCTION

Rail infrastructure serves as a fundamental economic development instrument that allows trade, industrialization, and regional connectivity to flourish. Developing economies benefit from efficient rail networks, which reduce transportation costs and simultaneously boost logistics performance and competitiveness (African Development Bank, 2010; African Development Bank, 2015). Ghana faces substantial development challenges in its rail infrastructure because of year-long disregard, funding scarcity, and dependence on public money, which have stalled progress. Economic growth has suffered, and road network capacity has reached its limit because of poorly funded public infrastructure development (Arfin et al., 2021).

Public-private partnerships (PPPs) are a groundbreaking method for global infrastructure development. Modern rail infrastructure throughout China, India, and South Africa has emerged through private sector engagement, alongside technical expertise and modern innovation, resulting in significant economic and social improvements (Wentworth & Makokera, 2015; Wang et al., 2018). However, private sector investment success in Ghana remains minimal, primarily because

of regulatory challenges, elevated risk factors, and structural and institutional weaknesses (Opoku, 2010). Although the Ghana Railway Master Plan outlines ambitious development goals, private sector participation remains too low to deliver the required modern rail infrastructure (Foster & Pushak, 2011).

Road transport currently accounts for more than 90% of the total goods movement, demonstrating the urgent need for improvements in the rail sector. This imbalanced transport structure has contributed to declining logistics efficiency, road congestion, and deteriorating transportation conditions (Hagan, 2019). According to the Oduwaole (2024), a robust framework grounded in effective risk-sharing mechanisms, strong governance structures, and ease-of-business protocols is essential for the successful implementation of PPPs.

While researchers acknowledge an expanding body of literature on African Public–Private Partnerships, minimal focus has been placed on understanding Ghana’s rail sector challenges (Akweteh et al., 2021). Existing studies have largely concentrated on sectors such as energy, water, and roads, with limited empirical attention given to the rail sector and its distinctive institutional and contractual risk profiles. Moreover, prior scholarship often treats PPP-related risks in a generalized manner, overlooking how rail-specific characteristics, such as long gestation periods, high capital intensity, land acquisition complexities, and uncertain demand forecasts, interact with weak regulatory enforcement, policy reversals, and institutional fragmentation. Therefore, little is known about how these contextual conditions shape private investors’ risk perceptions, behavioural responses, and long-term commitment decisions in emerging economies such as Ghana. This study addresses this gap by systematically examining the institutional, regulatory, financial, and governance-related risks that impede private sector participation in Ghana’s rail infrastructure.

This study is conceptually anchored in Institutional Theory and Risk Allocation Theory. Institutional Theory explains how regulatory uncertainty, weak enforcement mechanisms, and political instability influence organisational behaviour and investor confidence in emerging markets (Berthod, 2018). Risk Allocation Theory further explains how misaligned risk-sharing arrangements between public and private actors can undermine project bankability and sustainability performance (Tallaki and Bracci, 2021). Together, these theoretical perspectives provide a robust analytical lens for understanding why private investors remains hesitant to engage in Ghana’s rail sector, despite its strategic economic importance.

The remainder of this paper is structured as follows. Section two reviews the relevant literature on PPPs, infrastructure investment risks, and private sector participation in developing economies. Section three presents the research methodology, including the data collection procedures and the principal component analysis (PCA) technique. Section four discusses the empirical findings and situates them within the broader theoretical and policy discourses. Finally, Section Five concludes the paper by outlining the key policy implications, recommendations, and directions for future research.

2.0 LITERATURE REVIEW

Rail infrastructure development is a powerful economic development catalyst that supports trade flows by reducing transportation expenses while strengthening regional network linkages (Chen & Silva, 2013). Developing economies now use public-private partnerships (PPPs) to bridge infrastructure gaps through combined private funding and sector-based risk allocation (Kwak et

al., 2009). Institutional Theory and Risk Allocation Theory form the foundational theoretical bases for examining public-private partnership dynamics in this study. The Risk Allocation Theory demonstrates how public-private partnerships can create better resource utilization alongside efficiency enhancements. The theory elucidates on how political and economic as well as operational risks can impact private investment choices (Osei-Kyei & Chan, 2017).

Enhanced PPP frameworks have demonstrated their effectiveness through successful revitalization of rail systems across China, India, and South Africa. These countries implemented partnership risk-sharing strategies alongside strong government systems and investor rewards, which brought together public and private funding for operational optimization and economic development (Wang et al., 2018). For example, private investment in South Africa has supported freight rail, increased employment opportunities, and commercial transactions (Chisoro et al., 2024). However, Mawejje (2024) states that long-term private sector participation in infrastructure requires regulatory stability, appropriate financial rewards, and systems to limit investment exposure.

The Sub-Saharan African region, including Ghana, faces major hurdles in implementing Public-Private Partnerships for rail infrastructure development. Private sector partners tend to refrain from investing due to weak institutional and political structures and insufficient funding (Ng & Loosemore, 2007). Ghana's outdated rail infrastructure, alongside its few operational rail lines, leads to excessive road dependency, which generates excessive logistics costs and road congestion, as well as deteriorating transport standards (Awal et al., 2021). Despite the government's efforts, regulatory inconsistencies, financial instability, and governance issues act as barriers to the advancement of the Ghana Railway Master Plan (Foster & Pushak, 2011; Awal et al., 2021).

The success of Public-Private Partnerships (PPPs) heavily relies on integrating environmental and social aspects during project execution. Sustainable project construction combined with inclusive community interactions and strict adherence to environmental standards are important in today's world and for long-term success (Ametepey et al., 2015). Insights from water and energy sector management demonstrate how basic infrastructure issues can be solved; however, such methods need further investigation within Ghana's rail industry. Studies show that effective PPP results require strong legal structures paired with institutional arrangements and stakeholder partnerships and facilities training initiatives to facilitate private sector involvement (Grimsey & Lewis, 2017).

This study expands the existing knowledge on Ghana's rail sector challenges. This study aims to establish recommendations for sustainable PPP implementation in Ghana's rail infrastructure by identifying barriers such as regulatory uncertainty, financial limitations, and stakeholder disagreements.

2.1 Barriers to the Implementation of PPPs

The development of rail infrastructure is important for economic growth, but different kinds of barriers hinder private-sector investment, specifically in developing countries such as Ghana. This section discusses the barriers to private sector participation in rail infrastructure.

Private-sector investors, particularly in low-income economies, face significant financial challenges. Rail projects are capital-intensive and frequently require large sums of money for land acquisition, materials, and construction (Cheung et al., 2012). In developing economies, the cost burden is amplified by the reality that access to affordable financing is scarce, and the absence of robust financial mechanisms limits access to the funds needed to complete such projects (Osei-Kyei & Chan,

Implementing public–private partnership (PPP) policy for public construction projects in Ghana: critical success factors and policy implications., 2017). For example, the Atuabo Gas Processing Plant in Ghana, completed as a PPP project, required significant capital investment, which was challenging to secure owing to limited affordable financing options (Osei-Kyei & Chan, 2017). Such financial constraints mostly delay or compromise projects, which deters private investors from participating.

Corruption is another major deterrent to private investment in infrastructure projects, as seconded by Ameyaw & Alfen (2017). Issues such as bribery, lack of transparency, and misallocation of funds in procurement processes undermine trust and inflate costs (Locatelli et al., 2017). For instance, the Accra-Tema Motorway expansion project in Ghana had several allegations of procurement and awarding processes, pushing away potential and credible private-sector investors (GhanaWeb, 2021). Unclear financial models and repayment mechanisms discourage private sector engagement in rail infrastructure, as projects are considered to be high-risk ventures (Grimsey & Lewis, 2004).

Inadequate risk management practices further increase investors' concerns. This is a critical area in which several projects have fallen short. The inability to identify, allocate, and mitigate risks, such as cost overruns, technical obstacles, and foreign currency fluctuations, may cause investors to lose interest, making private participation unattractive (Wang et al., 2018). Additionally, integrating new railway infrastructure with existing transport systems presents technical and logistic challenges that reduce operational efficiency and economic viability (Rajabalinejad, 2018).

Inconsistent policies and bureaucratic inefficiencies regarding PPPs create an unstable investment environment, thereby reducing investor confidence (Ng & Loosemore, 2007). Related to this are delays and conflicts in rail infrastructure development, which are caused by poor contract management and insufficient enforcement mechanisms (Hodge & Greve, 2007). Lengthy approval processes, regulatory complexities, and land acquisition challenges further contribute to time and cost inefficiencies (Buckley, Kallergis, & Wainer, 2016).

In addition, inadequate infrastructure, such as outdated rail networks, roads, power supplies, and connectivity, adds to the difficulty of attracting private-sector investments. Complementary systems rely on rail infrastructure to optimize their operations and achieve economic returns (Tucho, 2022). Moreover, the key to successful collaboration is trust between public and private partners. However, the effective implementation of PPPs is hindered by a lack of mutual trust, which is often related to imprecise objectives and poor communication (Kwak et al., 2009).

Another significant barrier is the lack of community engagement in the planning and implementation of rail projects, which tends to create resistance and delays. Successful community engagement is key to securing public support and successful project execution (Sambuo, 2024). Furthermore, policy reversal, project delays, and cancellations often stem from political instability and frequent changes in government policies, causing uncertainty among private investors (Bing et al., 2005).

Stakeholder disputes, mostly arising from misaligned priorities among the government, private investors, contractors, and other parties, delay project timelines and escalate costs due to conflicts among stakeholders. Effective dispute resolution mechanisms and clear definitions of roles and responsibilities are important for improving project efficiency (Osei-Kyei & Chan, 2015). Additionally, private sector involvement is further hindered by legal barriers, such as indistinct property rights, inadequate legislative support for PPPs, and delays and expensiveness of enforcing contracts. To protect investor interests, there is a need for an effective legal framework (Ameyaw & Alfen, 2017). Furthermore, project failures resulting from a lack of clear guidelines deter private-sector

participation. Private investors require transparent frameworks for risk assessment, roles, and financial returns (Cheung et al., 2012).

The lack of a skilled workforce to operate, maintain, and sustain rail infrastructure has had significant consequences for the performance and delivery of such projects in emerging economies (Steele & Roberts, 2022). Building Information Modelling (BIM) has been shown to enhance collaboration and lower risks while optimizing the costs of rail infrastructure projects worldwide (Bensalah et al., 2018). Better design integration, real-time project visualization, and conflict detection are all benefits of BIM and are essential for managing large-scale projects. Nevertheless, its adoption in Ghana remains nascent, owing to a lack of technical expertise and financial resources.

The water sector provides valuable insights into private sector involvement in infrastructure projects. The results of a study examining the viability of private sector involvement in Ghana's water supply projects highlighted policy inconsistency, a lack of enforceable contracts, and poor stakeholder engagement as key barriers to private sector involvement (Chan & Ameyaw, 2013). These factors are relevant to rail infrastructure because they suggest systemic governance problems that erode the confidence of investors.

Water experience from the global industry also indicates that such private sector engagement will only be successful if there are transparent governance structures, appropriate risk-sharing mechanisms, and a clearly defined legal framework (Agbemor & Smiley, 2021). Ghana's lack of these elements in the rail sector may have deterred private participation in past infrastructure projects.

The involvement of the private sector in infrastructure development is greatly constrained by economic barriers, such as currency fluctuations, inflation, and a lack of access to capital markets. Ameyaw & Chan (2016) used a fuzzy-set approach to prove that financial risks, such as delayed payment guarantees and inadequate tariff structures, discourage private sector investment in Ghana's power sector. Similarly, rail infrastructure projects suffer from the same economic challenges; they are heavily reliant on the predictability of revenue streams and rigorous financial planning.

3.0 Methodology

This study adopted a quantitative research method based on data obtained from structured surveys administered to key stakeholders, asset owners, and private investors involved in infrastructure and railway projects in Ghana. This study aimed to systematically examine the barriers to private sector investment in Ghana's rail infrastructure.

Principal Component Analysis (PCA) was selected as the primary analytical technique because the core objective of this study was data reduction and prioritisation of key barriers rather than theory testing or confirmation of latent constructs. Unlike Exploratory Factor Analysis (EFA), which assumes the existence of unobservable latent variables, PCA is appropriate for identifying dominant patterns within observed variables and ranking their relative importance. Structural Equation Modelling (SEM) was considered unsuitable because the study did not seek to model causal relationships, mediation effects, or complex structural paths, and the available sample size and theoretical maturity did not support a confirmatory modelling approach. Thus, PCA is the most appropriate multivariate method for generating policy-relevant insights from complex barrier data.

The variables included in the analysis were high initial costs, corruption, regulatory inefficiencies, political interference, financing constraints, and inadequate supporting infrastructure. These

variables were selected based on their prominence in previous empirical studies and in preliminary stakeholder consultations. All variables were operationalised using multi-item Likert-scale measures to capture their perceived severity and impact on private sector investment decisions.

The survey instrument was developed through a systematic review of the existing literature on infrastructure financing, public–private partnerships (PPPs), and rail project implementation barriers. Content validity was ensured through expert reviews by professionals in construction management, transport economics, and infrastructure planning. Internal consistency was assessed using Cronbach’s alpha, with all constructs exceeding the recommended threshold of 0.7, indicating an acceptable reliability.

For the PCA, factor loadings exceeding 0.7 were considered statistically meaningful and were used to group related barriers into interpretable components. Sample size adequacy was evaluated using established PCA guidelines, which recommend a minimum of 5–10 respondents per variable. This threshold was met, ensuring the stability and robustness of the extracted components. The suitability of the dataset for PCA was further confirmed using the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett’s Test of Sphericity. Only datasets with KMO values above 0.6 and statistically significant Bartlett’s test results were retained, confirming factorability and compliance with PCA assumptions.

Data were collected using structured questionnaires distributed to stakeholders in the rail and infrastructure sectors, including engineers, quantity surveyors, architects, contractors, policymakers, and private investors. The survey focused on capturing the respondents’ perceptions of the key barriers to private sector participation in rail infrastructure development. Secondary data were obtained from published reports, government documents, and prior studies on PPPs in infrastructure sectors such as rail, energy, and water (Ameyaw and Chan, 2013; Wang et al., 2018).

A purposive snowball sampling technique was employed to ensure that the respondents possessed relevant expertise and practical experience in infrastructure investment and project delivery. While this approach facilitates access to knowledgeable professionals, its limitations are acknowledged. These include the potential for selection bias, network homogeneity, and reduced generalizability. Consequently, the findings are interpreted as representative of expert perspectives rather than those of the entire population of infrastructure stakeholders in Ghana.

The use of PCA enabled the transformation of complex and interrelated barrier variables into a smaller number of interpretable components, thereby producing actionable insights for policymakers and investors. For example, high initial capital costs emerged as the most critical barrier, consistent with earlier findings that rail projects in developing economies face amplified financial burdens owing to constrained access to affordable financing (Cheung et al., 2012).

Ethical approval was obtained from the relevant academic and institutional review boards prior to the data collection. Participants were fully informed of the study objectives, and informed consent was obtained. Anonymity, confidentiality, and voluntary participation were strictly maintained throughout the research process to ensure ethical compliance and the integrity of the data.

4.0 RESULTS AND DISCUSSION

To identify the barriers to implementing PPP railway projects, PCA is relevant because it helps uncover the underlying dimensions or factors that are believed to account for these barriers. PCA reduces complex data into a smaller set of factors by analysing the relationships between different variables,

thereby easily interpreting the key challenges. This also provides a deeper understanding of the various barriers, which are financial, regulatory, or operational, and would emerge systematically through the policy-making process and implementation strategies. In addition, PCA highlights the most significant barriers, empowering stakeholders to prioritize solutions that would improve the feasibility and success of PPP railway initiatives as a whole. These factors facilitate collaboration between governments and private parties to jointly achieve sustainable and effective transportation systems. Most importantly, the inferences drawn from the PCA will lead to better decision-making and eventually help the public and private sectors collaborate to ensure the successful execution of projects.

Table 1: Bartlett's Test of Sphericity

χ^2	df	p
644	190	<.001

Bartlett's test of sphericity tests the hypothesis that the correlation matrix of variables is significantly different from an identity matrix, meaning the variables are adequately correlated to proceed with factor analysis. In factor analysis, we want to ensure that the different variables are significantly correlated because factor analysis is based on the assumption that all variables share some common variances. This corresponds to a highly significant p-value ($p < .001$), which means that the correlation matrix is distinctly different from an identity matrix, indicating that the variables are adequately correlated to allow for factor analysis. In other words, factor analysis can be used to uncover an underlying factor because the data have sufficient shared variance among these variables. If the test ($p > .05$) was non-significant, it would have meant that the variables were not highly intercorrelated, and factor analysis would have been inappropriate for the data. Therefore, in this case, the significant result of Bartlett's test supports the appropriateness of factor analysis. Thus, this can be continued with the extraction of factors and further investigation of the underlying data structure.

Table 2: Initial Eigenvalues

Component	Eigenvalue	% of Variance	Cumulative %
1	9.66762	48.33811	48.3
2	2.11055	10.55276	58.9
3	1.75621	8.78105	67.7
4	1.32060	6.60302	74.3
5	1.11835	5.59173	79.9
6	0.97378	4.86892	84.7
7	0.79152	3.95759	88.7
8	0.49810	2.49052	91.2
9	0.40915	2.04575	93.2
10	0.36664	1.83321	95.1
11	0.30544	1.52721	96.6
12	0.25046	1.25232	97.8
13	0.13484	0.67418	98.5
14	0.10551	0.52757	99.0
15	0.06564	0.32819	99.4
16	0.05852	0.29259	99.7
17	0.04536	0.22679	99.9
18	0.01254	0.06268	100.0
19	0.00725	0.03627	100.0

Table 2: Initial Eigenvalues

Component	Eigenvalue	% of Variance	Cumulative %
20	0.00191	0.00954	100.0

The first five components explain a large portion of the variance in the data (79.9%); hence, they are the most important in helping us understand the nature of the barriers to the implementation of PPP railway projects. Components with eigenvalues less than 1 (Components 7 and above) explained very little additional variance and were likely to be discarded. Therefore, retaining the first five components would provide a more parsimonious and interpretable model that captures the most significant factors contributing to the barriers.

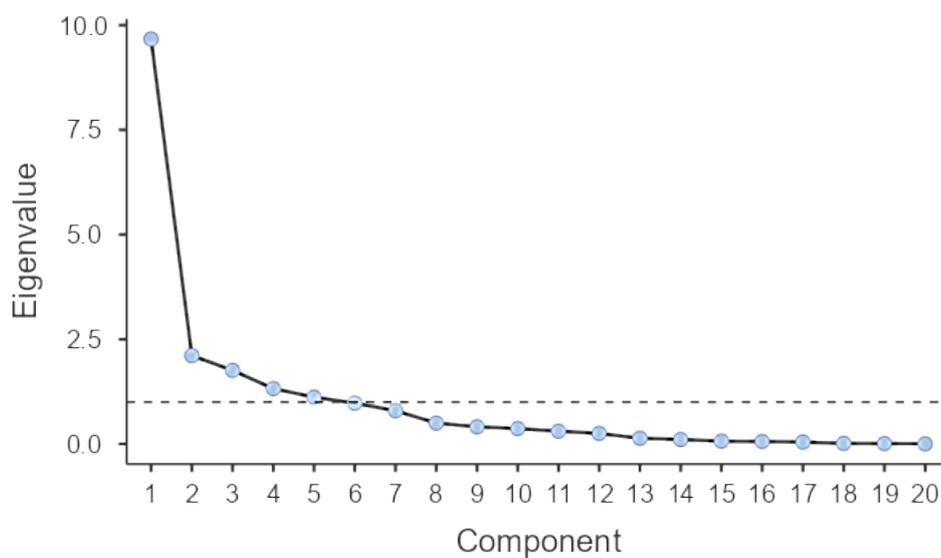


Figure 1: Scree Plot

Figure 1 presents a clear elbow after the 5th component, confirming that, as seen in Table 2, the first five components explain most of the variance, and the remaining components contribute very little to the data structure. More specifically, this visual confirmation lends additional support to retaining the first five components in the PCA, in concert with the eigenvalue criteria used in Table 2.

Table 3: Barriers to the Implementation of Public-Private Partnership Railways Projects

	Component					Uniqueness
	1	2	3	4	5	
Poor contract management	0.916					0.0769
Legal challenges	0.892					0.1112
Inconsistent government policies	0.736					0.2150
Stakeholder disputes	0.695	0.533				0.1498
Regulatory complexity	0.637	0.448			0.413	0.1995
Lack of skilled workforce		0.788				0.2249
Public opposition		0.764				0.2234
High initial cost		0.756	0.457			0.1294
Complex financing structures		0.609		0.362	0.488	0.2357

Table 3: Barriers to the Implementation of Public-Private Partnership Railway Projects

	Component					Uniqueness
	1	2	3	4	5	
Under roles and responsibilities			0.753			0.4010
Lack of community engagement			0.737	0.390	0.368	0.1500
Corruption	0.421		0.729	0.333		0.1557
Political instability	0.392		0.594		0.571	0.1046
Lack of trust between partners			0.544	0.461		0.4055
The challenge of integrating new railway infrastructure with existing systems		0.446	0.302	0.734		0.1537
Complex approval process				0.710	0.452	0.1474
Inadequate infrastructure	0.376			0.709		0.2994
Insufficient funding		0.395	0.307	0.481	0.337	0.4020
Lack of clear guidelines					0.803	0.1033
Inadequate risk management	0.470				0.745	0.1386

The factor loadings indicate that the inhibiting factors for PPP railway projects are organized into several key themes, including legal and contractual issues, financial and political challenges, technical and logistical barriers, bureaucratic and risk management issues, and the lack of clear guidelines. Poor contract management, legal obstacles, and disagreements among stakeholders are obstacles that are closely related to the foundational legal and contractual frameworks of PPP projects, the improvement of which can significantly enhance project efficiency and reduce delays. High initial costs, public opposition, corruption, and political instability suggest that securing funding, managing financial risks, and maintaining political stability are crucial to the success of PPP railway projects. In particular, corruption is prevalent to the extent that it emphasizes accountability and transparency in implementing such projects. Other challenges, such as integrative issues regarding new and old infrastructure, include myriad infrastructure. The challenge remains to ensure that new systems fit into existing ones and that infrastructure is laid down to support new initiatives. Complex approval processes and ineffective risk management provide evidence of bureaucratic inefficiency and a lack of proper planning and risk mitigation strategies. These barriers should be considered, as overcoming them can help smooth project implementation and minimizing unexpected costs. The final structural barrier is the lack of clear guidelines for the same. Standardized guidelines for PPP railway projects can minimize confusion in understanding and improve collaboration among partners.

The findings on the barriers to the successful implementation of PPP railway projects align with most empirical studies that highlight the same challenges in different regions and contexts. Legal and contractual issues have repeatedly been mentioned as the main barriers to PPP projects. For example, in a study on infrastructure projects, Sanni and Hashim (2013) discovered that poor contract management and legal uncertainties are important impediments to PPP project execution in developing countries. In addition, Chan et al. (2010) identified differences among stakeholders as major issues in infrastructure projects with high capital intensiveness, where misaligned interests between public and private partners are often reflected in delays and inefficiencies in the project. These aspects, which are better handled by contract management and clearer legal frameworks, could indeed make projects more effective. As Li et al. (2005) noted, "a clear legal structure is essential in minimizing disputes and thereby enhancing project performance."

The study also mentions other financial and political issues, such as high initial investment costs, public opposition, corruption, and political instability. These findings are consistent with the literature. For instance, Zhang (2005) points out that high upfront costs and public resistance are major barriers to PPP infrastructure projects, particularly in the transportation sector. The financial burden and the need for collaboration between public and private agencies to secure funding can delay the initiation and implementation of projects. Corruption is another major impediment, as discussed in several studies, including Bovis (2010), who pointed out how corruption in procurement processes compromises the integrity and efficiency of PPP projects. Additionally, some other factors that can delay these projects are attributed to political instability; for instance, Yescombe (2011) underpinned that political instability does not allow the successful implementation of PPP transportation infrastructure projects.

This is further supported by technical and logistical barriers, including issues of integration between new and existing infrastructure, which were also reported by Singh et al. (2024), who indicated that the integration of new infrastructure with existing systems often poses significant technical and logistical difficulties, particularly in railway projects. The complexity of railway systems, which rely on compatibility at many levels within the infrastructure, often requires careful planning and execution.

This study also identifies bureaucratic inefficiency and poor risk management as factors contributing to delays in project execution in alignment with Osei-Kyei and Chan (2017) and Lee et al. (2022). Osei-Kyei and Chan (2017) indicated that cumbersome approval processes and regulatory delays are major hindrances to the execution of PPP projects. Lee et al., (2022) similarly focused on an inappropriate risk management strategy, stressing that appropriate risk allocation and mitigation strategies are crucial because they reduce unexpected cost overruns and delays in project execution. Insufficient risk management is often associated with high levels of project timeline disruptions and budget overruns.

It also identified the absence of clear guidelines as a major structural barrier, and the absence of standardized methods and clearly elaborated operational guidelines with respect to carrying out PPP projects contributes to confusion and inefficiencies, as supported by Ameyaw and Chan (2016). Clearly, there is a need for structured guidelines to ensure that each party understands its roles and responsibilities toward enabling better collaboration and smoother project operations.

This study offers clear and actionable implications for practitioners and policymakers seeking to enhance PPP performance in Ghana's railway sector. First, contract reform should prioritise clarity, enforceability, and balanced risk allocation, with standardised PPP templates that explicitly define roles, dispute resolution mechanisms, termination clauses, and revenue-sharing arrangements. This would reduce opportunism, litigation, and project delays in the future. Second, strengthening regulations is essential. Independent oversight bodies should streamline approval processes and institutionalize transparent procurement systems to reduce uncertainty, curb corruption, and improve investor confidence. Third, risk management frameworks must be embedded in the project appraisal stage, including structured financial guarantees, demand-risk sharing, political risk insurance, and contingency planning. These measures would lower the perceived risk premiums and enhance bankability. Collectively, these reforms have strong policy relevance because they can reposition PPPs as credible instruments for long-term infrastructure delivery. By improving institutional predictability and governance quality, Ghana can unlock private capital, improve project sustainability, and significantly enhance rail sector performance

4.0 CONCLUSION

The main barriers to the successful implementation of PPP railway projects are legal challenges, financial obstacles, technical integration, and bureaucratic inefficiency. Some of the identified factors include poor contract management, lack of a skilled workforce, high initial costs, public opposition, and corruption as the most relevant serious impediments. These are some of the barriers that need to be considered for the effective improvement of the general effectiveness and success of PPP railway projects in the future. These findings create a strong case for policy-level intervention by establishing clear frameworks, enhancing transparency, and implementing robust risk management strategies that can significantly enhance the feasibility, efficiency, and long-term sustainability of railway infrastructure projects.

In conclusion, sustainable development and economic growth in Ghana depend on the substantial removal of obstacles to private-sector participation in the construction of Ghana's rail infrastructure. This study found that there are several major obstacles to making such a leap: limited funding, issues with governance and corruption, poor risk management procedures, and logistical and technical problems. We found that the most significant stumbling blocks were insufficient finance and high initial expenditures, which calls for innovative funding solutions and more public-private cooperation.

These results highlight the importance of institutional and legal frameworks, open governance systems, and the emergence of efficient regulatory procedures to address these issues in the future. The lessons learned from successful PPP's in other industries, such as energy and water, can be applied to the railway industry to create risk-sharing arrangements and build stakeholder confidence.

The integration of leading-edge technologies, such as building information Modelling (BIM) and stakeholder engagement, plays an important role in delivering sustainability and efficient projects. To create an environment conducive to investment, policymakers should reduce bureaucratic inefficiencies, combat corruption, and improve the capacity to build technical and managerial skills.

By tackling these challenges and capitalizing on the lessons learned, Ghana can harness PPPs' potential as a means to rejuvenate its rail infrastructure to facilitate interconnectivity, stimulate trade, and accelerate socioeconomic growth.

AUTHORS' CONTRIBUTIONS:

Collins Ameyaw: Conceptualisation; Resources, Reviewing & Coordination of inputs

Sarfo Mensah: Writing – Review, Revision, & Editing

Richard Ohene Asiedu: Writing – Review & Editing,

Ibrahim Muhammed Kusi: Data Curation; Writing – Original Draft Preparation

Blondel Akun Abaitey: Writing, Formatting, Review & Editing

Anita Asamoah-Duodu: Writing – Review & Editing

Gillian Mensah: Writing – Review & Editing

FUNDING STATEMENT:

No external funding was received for this study.

CONFLICT OF INTEREST:

The authors declare no conflict of interest.

REFERENCES

- African Development Bank. (2010). Infrastructure Deficit and Opportunities in Africa. *Economic Brief*, 1.
- African Development Bank. (2015). *Rail Infrastructure in Africa: Financing Policy Options*.
- Agbemor, B. D., & Smiley, S. L. (2021). Risk factors and mitigation measures in public-private water sector partnerships: lessons from the Asutifi North District, Ghana. *H2Open Journal*, 4(1), 77-91.
- Akwetteh, L. N., Xu, C., Putri, M. D. P. W., & Okoe, L. N. (2021). The current railway development and its influencing factors in Ghana. *Open Journal of Social Sciences*, 9(3), 228-244.
- Ametepey, S. O., Gyadu-Asiedu, W., & Assah-Kissied, M. (2015). Sustainable construction implementation in Ghana: Focusing on awareness and challenges. *Civil and Environmental Research*, 7(2), 109-119.
- Ameyaw, E. E., & Chan, A. P. (2016). A fuzzy approach for the allocation of risks in public-private partnership water-infrastructure projects in developing countries. *Journal of Infrastructure Systems*, 22(3), p.0401601.
- Ameyaw, C., & Alfen, H. W. (2017). Identifying risks and mitigation strategies in private sector participation (PSP) in power generation projects in Ghana. *Journal of Facilities Management*, 15(2), 153-169.
- Ameyaw, E. E., & PC Chan, A. (2016). Critical success factors for public-private partnership in water supply projects. *Facilities*, 34, 124-160.
- Arfin, S., Chowdhury, F., & Rahman, M. M. (2021). COVID-19 pandemic: rethinking strategies for resilient urban design, perceptions, and planning. *Frontiers in Sustainable Cities*, 3, p.668263.
- Awal, I. M., Senadjki, A., & Nee, A. H. (2021). Prospects and Impediments of Railway Infrastructure Development in Ghana: Impact of Standard Gauge Railway (SGR) Technology. *Journal of Infrastructure Development*, 13(2), 87-106.
- Bensalah, M., Elouadi, A., & Mharzi, H. (2018). Integrating BIM in railway projects: Review & perspectives for Morocco & Mena. *Int. J. Recent Sci. Res*, 9(1), 23398-23403.
- Berthod O. (2018). "Institutional Theory of Organizations", *Institutional Theory of Organizations*,. 3306–3310. doi:10.1007/978-3-319-20928-9_63.
- Bing, L., Akintoye, A., Edwards, P. J., & Hardcastle, C. (2005). The allocation of risk in PPP/PFI construction projects in the UK. *International Journal of project management*, 23(1), 25-35.
- Bovis, C. (2010.). Public procurement, public-private partnerships and public services in the EU. *Eur. Private Partnership L*. 85-96.
- Buckley, R. M., Kallergis, A., & Wainer, L. (2016, May). The emergence of large-scale housing

- programs: Beyond a public finance perspective. *Habitat International*, 54(3), 199-209.
- Chan, A. P., & Ameyaw, E. E. (2013). The private sector's involvement in the water industry of Ghana. *Journal of Engineering, Design and Technology*, 11(3), 251-275.
- Chan, A. P., Lam, P. T., Chan, D. W., Cheung, E., & Ke, Y. (2010). Critical success factors for PPPs in infrastructure developments: Chinese perspective. *Journal of construction engineering and management*, 136(5), 484-494.
- Chen, G., & Silva, J. A. (2013). Regional impacts of high-speed rail: A review of methods and models. *International Journal of Transportation Research*, 5(3), 131-143.
- Cheung, E., Chan, A. P., & Kajewski, S. (2012). Factors contributing to successful public private partnership projects: Comparing Hong Kong with Australia and the United Kingdom. *Journal of Facilities Management*, 10(1), 45-58.
- Chisoro, S., das Nair, R., Muzyamba, C., & Nontenja, N. (2024). *A review of economic regulation in the South African transport sector*.
- Foster, V., & Pushak, N. (2011). Ghana's infrastructure: A continental perspective. *World Bank Policy Research Working Paper*.
- GhanaWeb (2021). Accra-Tema Motorway expansion: NDC's assertions on status of contract inaccurate – Roads Minister. Available at :<https://www.ghanaweb.com/GhanaHomePage/NewsArchive/Accra-Tema-Motorway-expansion-NDC-s-assertions-on-status-of-contract-inaccurate-Roads-Minister-1156715>. (Accessed 20 January 2025).
- Grimsey, D., & Lewis, M. K. (2004). *Public private partnerships: The worldwide revolution in infrastructure provision and project finance*. In *Public Private Partnerships Public private partnerships: The worldwide revolution in infrastructure provision and project finance*. In *Public Private P*. Edward Elgar Publishing.
- Grimsey, D., & Lewis, M. k. (2017). Risk analysis in procurement: Evaluating Public–Private Partnerships and Other Procurement Options. In *In Global Developments in Public Infrastructure Procurement* (pp. 144-177). Edward Elgar Publishing.
- Hagan, S. E. (2019). Challenges with the Transit Trade Transport System Impeding Economic Growth–The Case of Ghana.
- Hodge, G. A., & Greve, C. (2007). Public–private partnerships: an international performance review. *Public administration review*, 67(3), pp.545-558.
- Kwak, Y. H., Chih, Y., & Ibbs, C. W. (2009). Towards a comprehensive understanding of public private partnerships for infrastructure development. *California management review*, 51(2), 51-78.
- Lee, J., Kim, K., & Oh, J. (2022). Build-Transfer-Operate with risk sharing approach for railway public-private-partnership project in Korea. *Asian Transport Studies*, 8, 100061.
- Locatelli, G., Mariani, G., Sainati, T., & Greco, M. (2017). Corruption in public projects and megaprojects: There is an elephant in the room. *International journal of project management*, 35(3), 252-268.
- Mawejje, J. (2024). Private sector participation in infrastructure in emerging market and developing economies: Evolution, constraints, and policies. *Global Policy*, 15(2), 465-474.
- MFR, J. O. (2024). Public private partnerships and international law: Building the blocks for sustainable infrastructure financing. *Journal of Sustainable Development Law and Policy (The)*, 15(1), 379-397.

- Ng, A., & Loosemore, M. (2007). Risk allocation in the private provision of public infrastructure. *International journal of project management*, 25(1), 66-76.
- Opoku, D. K. (2010). From a 'success' story to a highly indebted poor country: Ghana and neoliberal reforms. *Journal of Contemporary African Studies*, 28(2), 155-175.
- Osei-Kyei, R., & Chan, A. P. (2015). Review of studies on the Critical Success Factors for Public–Private Partnership (PPP) projects from 1990 to 2013. *International journal of project management*, 33(6), 1335-1346.
- Osei-Kyei, R., & Chan, A. P. (2017). Implementing public–private partnership (PPP) policy for public construction projects in Ghana: critical success factors and policy implications. *International journal of construction management*, 17(2), 113-123.
- Osei-Kyei, R., & Chan, A. P. (2017). Risk assessment in public-private partnership infrastructure projects: Empirical comparison between Ghana and Hong Kong. *Construction innovation*, 17(2), 204-223.
- Rajabalinejad, M. (2018). System integration: Challenges and opportunities for rail transport. In *13th Annual Conference on System of Systems Engineering (SoSE)* (pp. 471-476). Paris, France: IEEE.
- Sambuo, D. B. (2024). Community Engagement in the Planning Phase of Community Projects Sustainability in Kenya. *The Journal of Indonesia Sustainable Development Planning*, 5(3), .217-226.
- Sanni, A. O., & Hashim, M. (2013). Implementation of Public Private Partnership projects in developing countries: Lessons from Malaysia. In *In Recent Trends in Social and Behaviour Sciences: Proceedings of the International Congress on Interdisciplinary Behaviour and Social Sciences* (1st Edition ed., p. 223).
- Singh, S., Qadri, M., & Singh, S. (2024). Challenges in Implementing Emerging Technologies to Existing Rail Transit Infrastructure. *International Conference on Transportation and Development 2024*, 637-346.
- Steele, H., & Roberts, C. (2022). *Towards a sustainable digital railway*. In *Sustainable Railway Engineering and Operations*. Emerald Publishing Limited.
- Tallaki, M., & Bracci, E. (2021). Risk allocation, transfer and management in public–private partnership and private finance initiatives: a systematic literature review. *International Journal of Public Sector Management*, 34(7), 709–731. doi:10.1108/ijpsm-06-2020-0161
- Tucho, G. T. (2022). A review on the socio-economic impacts of informal transportation and its complementarity to address equity and achieve sustainable development goals. *Journal of Engineering and Applied Science*, 69(1), 28.
- Turner, S., & Welford, J. (2023). System Integration in a fragmented rail industry. Available At: <http://network.wsp-pb.com/article/system-integration-in-a-fragmentedrail-industry>.
- Wang, H., Xiong, W., Wu, G., & Zhu, D. (2018). Public–private partnership in Public Administration discipline: a literature review. *Public management review*, 20(2).
- Wentworth, L., & Makokera, C. G. (2015). Private sector participation in infrastructure for development. *South African Journal of International Affairs*, 22(3), 325-341.
- Yescombe, E. R. (2011). *Public-private partnerships: principles of policy and finance*. Elsevier.
- Zhang, X. (2005). Paving the way for public–private partnerships in infrastructure development. *Journal of construction Engineering and Management*, 131(1), .71-80.