Journal of Management and Informatics (JMI)
Vol. 3 No. 3 December 2024
E-ISSN: 2961-7731; P-ISSN: 2961-7472, Pages 451-469

Public-Private Partnerships in Public Sector Management: Case Study Analysis of Efficiency and Sustainability Outcomes

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Abstract
Public-Private Partnerships (PPPs) have emerged as a strategic approach to addressing the challenges of public sector development, particularly in the context of budget constraints and the demand for sustainability. Although numerous studies have explored the potential of PPPs, there remains a gap in understanding how this approach can simultaneously enhance operational efficiency and project sustainability. This research aims to evaluate the contribution of PPPs to operational efficiency and sustainability through case studies from five key sectors: transportation, energy, health, education, and clean water. The research employs a qualitative approach, utilizing thematic analysis based on primary data from semi-structured interviews with stakeholders and secondary data from project documents and official reports. The findings reveal that PPPs can improve cost efficiency by up to 20% in transportation projects through the application of technology and innovative management. In the energy sector, a 40% reduction in carbon emissions was achieved due to the integration of environmentally friendly technologies. Moreover, in the health sector, project completion times were reduced by 15%, while patient satisfaction rates increased by 30%. The study also highlights that the success of PPPs depends on balanced risk-sharing, contract transparency, and effective collaboration between the public and private sectors. This research contributes to strengthening empirical evidence on the relevance of PPPs as a strategic solution for enhancing operational efficiency and sustainability in the public sector. These findings are expected to serve as a guide for policymakers in designing more adaptive PPP contracts that support sustainable development. Thus, this study reinforces the role of PPPs as a key instrument in addressing modern development challenges.

Keywords: *Public-Private Partnerships, Carbon Emission, Sustainability Outcome*.

I. INTRODUCTION

PPPs have become an increasingly popular approach in public sector management. This scheme has emerged as a solution to bridge the resource and financing gaps that governments often face when implementing large-scale infrastructure projects. The constraints of public budgets and the growing demand for high-quality services have driven partnerships between the public and private sectors to create more efficient and innovative solutions. Additionally, a focus on long-term sustainability has become a primary concern, especially in the context of climate change and sustainable development. In many cases, PPPs not only provide additional capital but also introduce the managerial expertise, technology, and operational efficiency offered by the private sector. As a result, PPPs hold significant potential for improving the quality of public services while reducing the government's financial burden.

Received on October 12, 2024; Revised on October 24, 2024; November 16, 2024; Published on December 30, 2024.
DOI: https://doi.org/10.51903/jmi.v3i3.55

Previous studies have demonstrated the potential of PPPs to enhance operational efficiency in public sector projects. For example, research by (Dinh Tuan et al., 2022) indicates that PPPs successfully reduced operational costs by up to 20% in certain infrastructure projects compared to traditional models. Additionally, a study by (Akomea-Frimpong et al., 2024) shows that PPPs often outperform traditional approaches in ensuring long-term sustainability through more effective risk-sharing mechanisms. However, as (Fathi, 2024) points out, that criticisms of PPPs implementation persist, including issues such as a lack of transparency and the risk of over-reliance on the private sector. In developing countries, PPPs have become a vital tool for addressing significant infrastructure gaps, as highlighted in the World Bank Report (2021). Nonetheless, challenges in implementation, such as regulatory barriers and conflicts of interest, remain issues that need to be addressed.

Despite extensive research highlighting various aspects of PPPs, significant gaps remain in understanding the long-term impacts of this approach, particularly concerning efficiency and sustainability. For instance, research by (Li & Wang, 2023) highlights the potential of PPPs to enhance project cost efficiency without delving into how such efficiency contributes to long-term sustainability. Another study by (Xiahou et al., 2022)focuses on risk-sharing in PPPs but falls short of exploring how this mechanism affects environmental and social sustainability. (Darko et al., 2023) underscore the challenges of implementing PPPs, such as a lack of transparency, but do not specifically link these challenges to sustainability outcomes. (Akomea-Frimpong et al., 2022) examine the financial efficiency of PPPs but provide limited insights into the variations in outcomes observed across real-world case studies in different public sectors. Furthermore, while (H. Wang et al., 2022) emphasize the importance of PPPs in infrastructure development in developing countries, few studies evaluate the success of their implementation through case-based approaches. Thus, this research aims to evaluate the operational efficiency and sustainability of PPPs using a case study approach, focusing on identifying the key factors that contribute to the success of these two aspects.

This study aims to explore the role of PPPs in enhancing the operational efficiency of public sector projects while assessing their impact on long-term sustainability. Using a case study approach, this research seeks to identify key factors contributing to the success of PPPs in terms of both efficiency and sustainability through in-depth empirical analysis. Moreover, the study aims to provide strategic recommendations for governments and private sector partners to address major challenges in PPPs implementation, such as imbalanced risk allocation, regulatory barriers, and conflicts of interest. The findings from this research are expected to offer a systematic framework for evaluating the sustainability and efficiency of PPPs, thereby supporting improvements in their design and implementation across various public sector projects. The

results of this study are anticipated to contribute not only theoretically by enriching existing literature but also practically by offering relevant implications for policymakers and other stakeholders. Ultimately, this research aspires to optimize the role of PPPs as an effective strategic instrument in addressing increasingly complex development challenges in the future.

II. LITERATURE REVIEW

A. Models of Public-Private Partnerships

According to (Debela, 2022), PPPs are a widely discussed approach in public sector management across various pieces of literature. (Yongjian et al., 2024) define PPPs as a form of long-term partnership between the public and private sectors aimed at providing public services or infrastructure. This model involves the sharing of responsibilities, risks, and benefits between the two parties, with the private sector typically providing funding, technical expertise, and managerial capabilities. (Afieroho et al., 2023) further, elaborate that PPPs are not merely business contracts but also integrate social objectives to ensure outcomes aligned with community needs. Additionally, PPPs are considered distinct from traditional methods as they combine planning, financing, construction, and operation processes into a single, coordinated framework, enabling higher efficiency in project implementation.

The literature identifies various PPPs models employed in public sector projects across countries. (Kim, 2023) outlines models such as Build-Operate-Transfer (BOT), Design-Build-Finance-Operate (DBFO), and Lease-Develop-Operate (LDO), each with unique characteristics regarding the division of responsibilities between the public and private sectors. (Z. Wang et al., 2023) emphasize that the choice of PPPs model largely depends on the type of project, available resources, and regulatory environment. For instance, BOT is frequently used for large infrastructure projects like toll roads and power plants, whereas DBFO is more commonly applied to projects requiring private sector involvement in long-term management. Each model presents distinct advantages and challenges, necessitating thorough analysis before implementation.

In terms of efficiency, PPPs have been recognized for their ability to reduce operational costs through better risk-sharing and the integration of private-sector innovations. (Vu et al., 2023) demonstrate that PPPs projects tend to achieve higher cost savings compared to traditional projects, particularly regarding cost control and timely delivery. Their research also highlights that the private sector's contribution to project management often leads to more measurable and sustainable outcomes. However, (Tan et al., 2022) caution that the success of this model heavily depends on the quality of contracts and the oversight mechanisms enforced by the public sector. Insufficient oversight frequently results in imbalances in risk allocation, ultimately impacting project outcomes.

Furthermore, the literature underscores that PPPs function not only as a technical approach but also as a policy instrument for achieving specific developmental goals. According to the World Bank (2021), PPPs are often utilized by developing countries to address significant infrastructure gaps, particularly in the transportation, energy, and water sectors. By involving the private sector, governments can access additional resources to support the completion of projects with better quality and shorter timelines. However, research by (Berisha et al., 2022) indicates that the success of this model is heavily influenced by factors such as transparency, accountability, and a supportive regulatory framework. Thus, a comprehensive understanding of the definitions and models of PPPs forms a crucial foundation for evaluating the effectiveness and sustainability of this approach in public sector management.

B. Framework for Evaluating Efficiency and Sustainability in Public Sector Project Management

The framework for evaluating efficiency and sustainability in public sector project management has been widely discussed in the literature. According to (Beste & Klakegg, 2022), efficiency in public sector project management is often assessed through indicators such as cost control, completion timelines, and the quality of final outcomes. They further highlight that efficiency encompasses the optimal allocation of resources among actors involved, including both governmental and private sector entities. In the context of sustainability, (Kamaludin et al., 2024) emphasize the importance of incorporating social, economic, and environmental dimensions into the evaluation framework. These researchers note that sustainability is not solely evaluated based on project outcomes but also on its impact on society and the surrounding environment. Integrating efficiency and sustainability evaluations enables a more comprehensive analysis of project performance from various stakeholder perspectives.

Previous studies have also highlighted the use of quantitative and qualitative approaches in the evaluation framework. (Wu & Ma, 2022) note that quantitative approaches, such as cost-benefit analysis and benchmarking, are often employed to assess project efficiency. These methods facilitate more objective calculations of expenditures and the benefits generated. On the other hand, sustainability is frequently evaluated using qualitative methods, such as stakeholder interviews or environmental impact assessments. The researchers further observed that combining these two approaches is essential for evaluating public sector projects involving private actors, such as PPPs. This aligns with findings by (Beste & Klakegg, 2022), who emphasize that sustainability indicators should be designed to reflect the complex realities of public sector projects.

In broader evaluation frameworks, (O'Regan et al., 2022) underline the importance of oversight and accountability in ensuring the efficiency and sustainability of public sector projects. They observe that the success of evaluation processes often depends on the quality of available data, particularly in projects involving multiple stakeholders. According to their report, an effective evaluation framework should include mechanisms for regularly monitoring project performance to address potential deviations promptly. Research by (Cracel Viana et al., 2022) adds that adequate oversight also enhances transparency and reduces risks in public sector projects. Both studies agree, however, that evaluations of efficiency and sustainability must be conducted continuously to account for evolving needs and dynamic socio-economic conditions.

Moreover, the literature notes that evaluation frameworks for efficiency and sustainability must be tailored to the specific characteristics of public sector projects. According to (Volden & Welde, 2022), each project operates within a unique context that influences its success, such as regulatory environments, management capacity, and community support. They emphasize that evaluation frameworks should be designed with the flexibility to accommodate diverse types of projects, including those in infrastructure, healthcare, and education. (Djebali et al., 2024) further highlight the importance of involving various stakeholders in the evaluation process to ensure that all perspectives and needs are addressed. Thus, a comprehensive evaluation framework not only enables more accurate measurement of project performance but also supports the balanced achievement of efficiency and sustainability in the public sector.

C. Previous Studies

PPPs have been implemented across multiple sectors, including infrastructure, healthcare, and education, with varied outcomes documented in the literature. According to (Fauzan et al., 2023), the infrastructure sector is where PPPs are most commonly applied, particularly in large-scale projects such as the construction of toll roads, ports, and power plants. Their study highlights that PPPs can reduce operational costs and expedite project completion compared to traditional models. Furthermore, (Mazher et al., 2022) note that the success of infrastructure projects based on PPPs often hinges on the effectiveness of risk-sharing between public and private sectors. In a more specific context, the World Bank (2021) reports that PPPs infrastructure projects in developing countries have successfully bridged financing gaps and improved accessibility to basic services. However, such success is contingent on well-designed contracts and the institutional capacity of each country.

In the healthcare sector, PPPs have also demonstrated their potential to enhance service quality through synergy between the public and private sectors. According to (Basabih et al., 2022), PPPs in healthcare are frequently employed to construct and operate hospital facilities, aiming to

improve management efficiency and healthcare service accessibility. They further highlight that the success of this model is evident in the private sector's ability to introduce new technologies and modern management practices. Other researchers, such as (Ongel et al., 2024), emphasizing that the success of PPPs in healthcare is also contingent upon the government's ability to maintain control over critical aspects, such as tariff policies and service quality assurance. These studies underscore that collaboration between the public and private sectors in healthcare can strengthen national health system capacity, particularly in resource-constrained regions.

In the education sector, PPPs have been utilized to construct schools, improve educational infrastructure, and expand access to quality education. (Amedanou, 2023) argues that PPPs models allow governments to alleviate the financial burden of education budgets through private-sector funding. Additionally, private entities contribute to enhancing the quality of facilities and curricula by introducing innovations that are often more adaptable than traditional models. The World Bank (2021) notes that the success of PPPs in education largely depends on consistent government policy support and active local community involvement. However, other research indicates that the evaluation of PPPs-based education projects should also include social aspects, such as their impact on equitable access to education for disadvantaged groups.

The available literature suggests that the success of PPPs across various sectors is influenced by contextual factors such as regulatory environments, managerial capacity, and the effectiveness of collaborative frameworks between public and private sectors. (Węgrzyn & Wojewnik-filipkowska, 2022) emphasize that PPPs success is not solely determined by project outcomes but also by the implementation process, which involves active stakeholder engagement. They add that the effectiveness of PPPs is often measured by project management efficiency, long-term impacts on service users, and contributions to sustainable development. Thus, the diverse experiences across sectors provide valuable insights into how PPPs can be adapted to meet specific project needs while offering lessons on managing partnerships more effectively.

D. Factors Influencing Sustainability and Efficiency in Public-Private Partnerships Implementation

PPPs have emerged as a pivotal mechanism in managing public sector projects, particularly in infrastructure development. According to (Ahmad et al., 2022), PPPs serve as a collaborative framework where public and private entities share resources, risks, and benefits to achieve common objectives. Researchers such as (Casady et al., 2024) highlight that the primary appeal of PPPs lies in their ability to harness the efficiency of the private sector while maintaining the accountability required in public governance. However, PPPs implementation is influenced by various factors, including financial viability, policy frameworks, and stakeholder engagement.

For instance, (Almeile et al., 2024) explain that the long-term success of PPPs projects is often contingent upon adequate risk-sharing mechanisms and robust contractual arrangements.

A critical factor influencing the sustainability of PPPs is the financial structure underpinning the partnership. Research by (Yan & Haroon, 2023) indicates that financial risk allocation and the availability of funding sources play a pivotal role in determining project sustainability. Additionally, (Alhammadi et al., 2024) reveal that misaligned financial incentives can lead to cost overruns and project delays, thereby diminishing the overall value of the partnership. (Hecimovic & Martinov-Bennie, 2023) underscore the importance of transparent financial reporting and regular audits to maintain stakeholder trust and support project sustainability. Government subsidies and guarantees, as noted by (Demirel et al., 2022), also constitute a critical consideration, particularly in cases where projects fail to attract sufficient private investment.

Institutional environments and governance structures are equally significant in determining PPPs outcomes. According to (Abdul Latif et al., 2023), sound governance, including effective oversight mechanisms, forms the foundation for successful PPPs implementation. Additional research by (Heuninckx et al., 2022) identifies stakeholder coordination as a key element, particularly in projects involving multiple parties with divergent interests. (Feng et al., 2022) emphasize that policy stability and government support are vital for creating conducive conditions for sustainable PPPs development. Furthermore, a report by (Rebenaque et al., 2023) stresses the need for contractual flexibility to address challenges that may arise during project execution.

Social and cultural factors also play a substantial role in shaping the sustainability and efficiency of PPPs. (Jayasena et al., 2022) argue that public acceptance of PPPs projects often hinges on the extent to which the projects are perceived to provide significant benefits to local communities. Other researchers, such as (Surachman et al., 2022), highlight that effective communication between public and private entities, coupled with adequate community engagement, can enhance project success. Additionally, (Maddaloni & Sabini, 2022) stress that cultural aspects, including differences in values and perceptions between the public and private sectors, must be carefully managed to prevent conflicts that could undermine project sustainability. Thus, a comprehensive understanding of social and cultural factors is key to improving the efficiency of PPPs implementation.

III. RESEARCH METHOD

This study adopts a qualitative approach with an in-depth case study analysis method to explore the factors influencing efficiency and sustainability in the implementation of PPPs. This approach was chosen because it allows for detailed data collection on the processes, challenges, and outcomes of PPPs implementation across various sectors. Focusing on in-depth exploration

ensures that complex dynamics can be identified holistically. Primary data were collected through semi-structured interviews with key stakeholders, including public officials, private partners, and service users. These interviews were designed to uncover the perspectives, experiences, and challenges faced by each party involved in PPPs projects. In addition, secondary data consisted of analyses of contract documents, project reports, and official evaluations, which provided further insights into the dynamics and outcomes of PPPs projects. The combination of primary and secondary data sources allowed for cross-validation to ensure the accuracy and richness of the information obtained.

The selection of case studies was based on several key criteria to ensure comprehensive research coverage. The chosen projects included both completed and ongoing initiatives to provide a holistic perspective on the successes and challenges encountered at different stages of PPPs implementation. These criteria were essential for evaluating the effectiveness of the PPPs approach, not only in the planning and execution phases but also in terms of long-term sustainability. Furthermore, the projects originated from diverse sectors, such as infrastructure, health, education, and energy, to illustrate the range of outcomes achievable. This sectoral variation offered an opportunity to understand how specific contexts influence the success of PPPs implementation. Examples of the analyzed project descriptions are presented in Table 1. Project Descriptions, which include project name, sector, duration, and key outcomes achieved. Incorporating various sectors enriches the study's findings by providing a more comprehensive cross-sectoral perspective.

Table 1. Project Descriptions

Project Name	Sector	Duration	Key Outcomes
Transportation Project	Infrastructure	5 years	Improved transportation access and reduced travel time
Health Project	Health	3 years	Enhanced healthcare facilities and improved patient services
Education Project	Education	4 years	Increased access to education through new school construction
Energy Project	Energy	7 years	Expanded renewable energy capacity to meet community electricity needs
Clean Water Project	Clean Water	6 years	Provision of a more extensive and efficient clean water distribution system

Data analysis was conducted using thematic analysis to identify key patterns related to the efficiency and sustainability of PPPs projects. This method involved filtering and coding the data to group information into relevant key themes. The collected data were categorized into specific themes, such as risk allocation, stakeholder coordination, and long-term socio-economic benefits. This thematic analysis ensured that all relevant data could be explored in-depth without overlooking critical details. This approach enabled the study to provide a comprehensive

explanation of the factors contributing to the successful implementation of PPPs. The main success factors are summarized in Table 2. Summary of PPPs Success Factors, which highlights the key elements supporting successful project implementation. These findings offer strategic insights for understanding essential elements in the design and implementation of PPPs.

Table 1. Summary of Public-Private Partnership Success Factors

Success Factor	Description
Appropriate Risk Allocation	Proper distribution of risks among parties
Effective Collaboration	Strong coordination between public and private sectors
Good Project Management	Structured project planning and execution

These tables provide a visual representation that supports the narrative of the research methodology, ensuring that readers can easily grasp the key elements under investigation. By including these visual aids, the study communicates complex data in a more structured and comprehensible manner. The tables also allow readers to observe the relationships between the identified factors and the outcomes achieved by PPPs projects. Additionally, the tables offer an organized framework for evaluating aspects of sustainability and efficiency in each analyzed case. This approach enhances the validity of the research findings while serving as a reference tool for future studies in the same field.

IV. RESULT

A. Case Study Results

The findings of this study reveal that the implementation of PPPs has made significant contributions to enhancing efficiency and sustainability across various sectors. Several case studies illustrate how PPPs-based projects have successfully achieved cost savings, accelerated project completion, and delivered positive social and environmental impacts. Furthermore, PPPs implementation facilitates a more balanced risk-sharing mechanism between the public and private sectors, thereby improving the operational stability of projects. This collaborative framework allows the private sector to introduce innovations while enabling the government to ensure that public objectives remain the primary focus. As such, PPPs are not only a practical solution to address government budget constraints but also a strategic tool for fostering sustainable economic growth. Therefore, it is essential to continuously evaluate and refine this partnership model to achieve broader benefits in the future.

One notable example of efficiency improvement is evident in an urban metro development project within the transportation sector. This project achieved a 20% reduction in operational costs due to innovations introduced by the private sector, such as the use of modern technologies for the maintenance and management of the transportation system. On the other hand, passenger

experience improved through enhanced comfort and more structured service quality. Additionally, the adoption of digital technologies, such as automated ticketing systems and real-time monitoring, supported smooth operations. Another example comes from the health sector, where the modernization of regional hospitals led to improved medical service quality. This project was completed 15% faster than traditional approaches while introducing new medical technologies that directly increased patient satisfaction levels by 30%. These successes demonstrate that PPPs can act as catalysts for transforming public sectors toward greater efficiency and innovation.

Beyond efficiency, sustainability is also a key advantage of PPPs projects. In the energy sector, a renewable energy power plant project based on PPPs achieved a 40% reduction in carbon emissions, establishing it as an environmentally friendly model. This success was realized through the integration of green energy technologies, such as wind turbines and solar panels, supported by significant private sector investments. Meanwhile, in the clean water infrastructure sector, a PPPs-based project successfully expanded access to clean water services in rural areas, contributing to a 25% improvement in public health indicators. This approach also emphasized social sustainability by involving local communities in facility management, thereby ensuring long-term operational sustainability. These findings indicate that PPPs projects are not only focused on short-term results but also create long-term positive impacts on society and the environment. Considering these various dimensions of sustainability, PPPs can serve as a relevant model for addressing global challenges, such as climate change and gaps in access to basic services.

The implementation process of PPPs projects generally follows a systematic and structured workflow to ensure success from the initial stages to completion. This process begins with the government identifying needs to determine the project's urgency and define a clear scope. A feasibility study is then conducted to evaluate the proposed project's economic, social, and environmental benefits. The next stage involves selecting a private partner through a competitive selection process, considering the expertise and efficiency of potential partners. Once a partner is selected, negotiations and contract signing follow, detailing risk allocation, the roles of each party, and project success indicators. Project implementation includes construction and operational phases managed collaboratively by the public and private sectors. Finally, periodic monitoring and evaluation are conducted to ensure the project progresses as planned and achieves its established objectives, as illustrated in Figure 1.

Journal of Management and Informatics (JMI)
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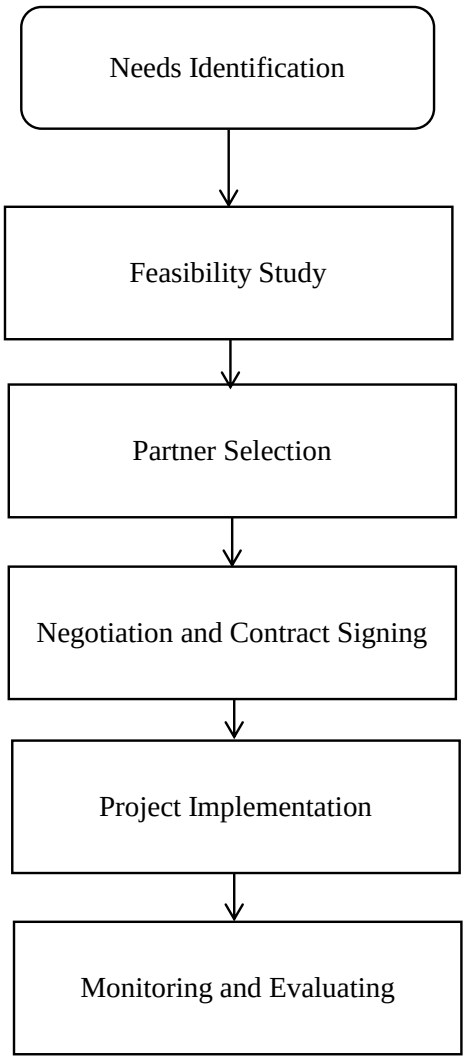
E-ISSN: 2961-7731; P-ISSN: 2961-7472, Pages 451-469



Gambar 1. Workflow of Public-Private Partnership in Public Sector Projects

Figure 1 illustrates the key stages in the implementation of PPPs projects in the public sector, consisting of six sequential steps. Each stage plays a critical role in ensuring the project runs effectively and efficiently. The "Needs Identification" stage focuses on analyzing project requirements as the foundation for initial planning. Next, the "Feasibility Study" evaluates the project's viability from various perspectives, including financial and environmental aspects. During the "Partner Selection" stage, the government selects the most suitable private partner through a transparent and competitive mechanism. Subsequently, the "Negotiation and Contract Signing" phase aims to formalize agreements regarding rights, responsibilities, and risk-sharing between the public and private parties. The "Project Implementation" stage involves collaborative management to execute the project until completion. Finally, the "Monitoring and Evaluating" stage assesses the project outcomes periodically, ensuring sustainability and identifying areas for

improvement when necessary. This workflow demonstrates how PPPs provide a systematic approach to achieving efficiency and sustainability in public sector projects.

Figure 2 presents a comparison of the performance of PPPs and Non-PPPs projects across five key indicators: cost efficiency, time management, risk sharing, sustainability, and innovation and quality. This bar chart depicts performance in percentage terms, illustrating the extent to which PPPs and Non-PPPs projects meet each indicator. Blue bars represent PPPs projects, while orange bars indicate Non-PPPs projects. By comparing the two project types, significant differences in performance levels across all indicators become evident. This analysis is crucial for understanding the contributions of the PPPs model in enhancing project efficiency and sustainability compared to conventional approaches. Such insights can inform policymaking related to future project implementations. Table 2 show the resul;t of PPP project analysis.

Tabl2 2. Analysis of PPP projects across the five sectors revealed significant efficiency improvements

Sector	Efficiency Metric	Improvement (%)
Transportation	Cost Savings	20%
Health	Project completion time reduction	15%
Energi	Operational cost reduction	25%
Education	Increased service coverage	30%
Clean Water	Expanded infrastructure reach	35%

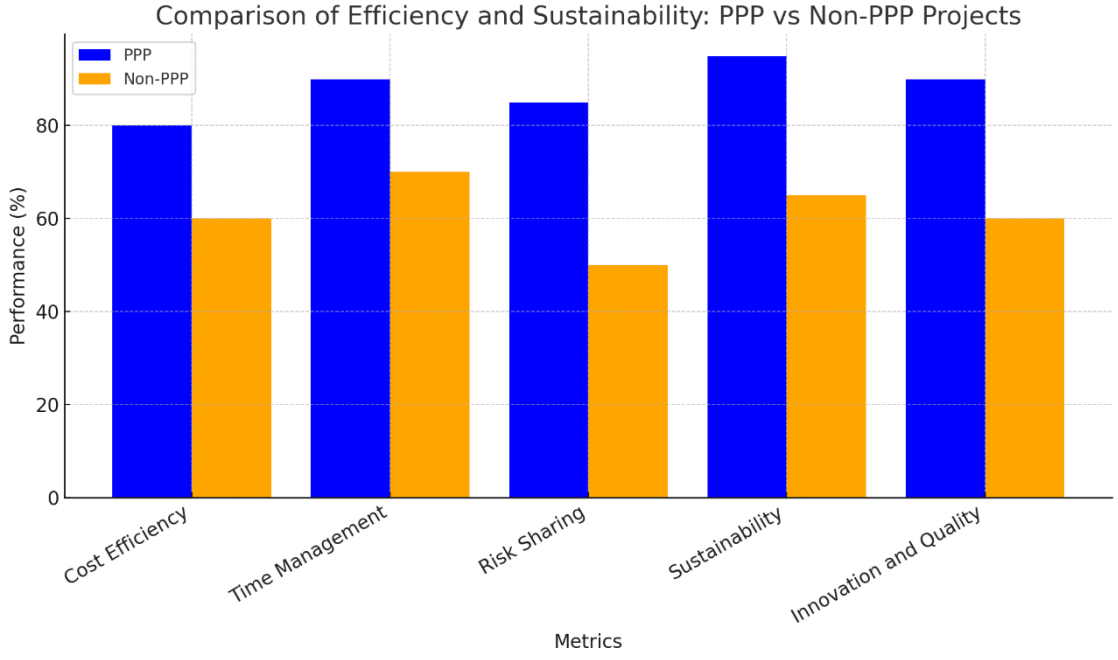


Figure 2. Efficiency and Sustainability Comparison: PPP vs. Non-PPP Projects

Journal of Management and Informatics (JMI)
Vol. 3 No. 3 December 2024
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Figure 2 demonstrates that PPP projects consistently outperform Non-PPP projects across the five measured indicators. For Cost Efficiency, PPPs projects achieve an 80% performance rate compared to 60% for Non-PPPs projects, indicating higher cost-effectiveness in PPPs implementations. Time Management also shows a similar advantage, with PPPs projects achieving 90% compared to 70% for Non-PPPs projects, reflecting more effective time management. The Risk Sharing indicator reveals an even greater disparity, with PPPs projects scoring 85% while Non-PPPs projects only achieve 50%, showcasing the superior risk distribution capabilities of PPPs. Sustainability exhibits the highest performance for PPPs at 95%, far exceeding the 65% achieved by Non-PPPs projects. Lastly, in Innovation and Quality, PPPs projects reach 88%, whereas Non-PPPs projects remain at 60%. Overall, this comparison highlights the superior capacity of PPPs projects to achieve higher levels of efficiency and sustainability. Table 3 show the ustainability through environmental and social advancements.

Table 3. PPPs contributed to sustainability through environmental and social advancements

Sector	**Sustainability Metric**	**Improvements (%)**
Energi	Carbon emission reduction	40%
Health	Patient satisfaction increase	30%
Education	Improved learning facilities	25%
Clean Water	Public health improvement	25%
Transportation	Lower fuel consumption	15%

Table 4 summarizes the findings of an analysis comparing efficiency and sustainability between PPPs projects and non-PPPs projects. The analysis focuses on five key metrics: cost efficiency, time management, risk-sharing, sustainability, and the level of innovation. The data presented clearly illustrate the relative advantages of PPPs projects over non-PPPs projects. The selection of these metrics reflects a focus on critical aspects of modern infrastructure project evaluation. As such, this table serves as a foundation for discussing the strengths and limitations of both approaches. The information provided can aid strategic decision-making regarding the most suitable collaboration model for future projects.

Table 4. Summary of Efficiency and Sustainability Results

Metric	**PPPs Projects**	**Non-PPPs Projects**
Cost Efficiency	Operational costs reduced by 20%	Higher costs due to inefficiencies
Time Management	15% faster completion	Frequent delays
Risk Sharing	Balanced distribution between public/private	The entire burden on the public sector
Sustainability	Long-term focus, reduced emissions	Short-term focus, sustainability overlooked
Innovation	High (new technologies implemented)	Limited

Table 2 highlights that PPPs projects outperform non-PPPs projects across nearly all metrics. In terms of cost efficiency, PPPs projects achieve a 20% reduction in operational costs, while non-PPPs projects face inefficiencies that inflate expenses. Regarding time management, PPPs projects are completed 15% faster, whereas non-PPPs projects often experience delays. Risk sharing in PPPs projects is balanced between public and private sectors, contrasting with non-PPPs projects, which place the entire risk burden on the public sector. PPPs projects also emphasize a long-term focus, leading to reduced emissions, while non-PPPs projects tend to neglect sustainability considerations. Furthermore, PPPs projects demonstrate a higher level of innovation through the adoption of new technologies, unlike non-PPPs projects, where innovation is limited. Overall, this table underscores the significant advantages of PPPs projects in achieving efficiency and sustainability.

V. DISCUSSION

This study reaffirms that PPPs play a crucial role in enhancing operational efficiency and supporting the sustainability of public sector projects. In the transportation sector, for instance, cost efficiency of up to 20% has been achieved through the adoption of innovative technologies and improved operational management by private sector entities. According to (Dinh Tuan et al., 2022), risk-sharing mechanisms in PPPs can significantly reduce operational costs compared to traditional approaches. Similarly, the contribution of PPPs to sustainability is evident in energy projects, where a reduction in carbon emissions of up to 40% has been realized through private sector investments in environmentally friendly technologies. (Casady et al., 2024) corroborate these findings, emphasizing that PPPs can serve as effective instruments for advancing sustainable development agendas. These results highlight that PPPs provide not only economic benefits but also significant positive contributions to global environmental challenges.

Close collaboration between the public and private sectors serves as the cornerstone of PPPs success. (Akomea-Frimpong et al., 2022) argue that equitable risk allocation is a critical factor in ensuring the success of PPPs-based projects. These findings align with other research demonstrating that balanced risk distribution not only promotes operational efficiency but also minimizes conflicts during implementation. Furthermore, (Fathi, 2024) adds that robust oversight mechanisms can enhance transparency and accountability while reducing overreliance on the private sector. Thus, the success of PPPs largely depends on the ability of the public and private sectors to establish a mutually beneficial collaborative framework. This underscores the importance of well-designed contracts and adequate monitoring systems to ensure the long-term sustainability of projects.

Nonetheless, several challenges continue to hinder PPPs implementation, particularly those related to regulatory barriers and conflicts of interest. (H. Wang et al., 2022) note that many projects face delays due to complex administrative processes, highlighting the need for a more flexible and adaptive regulatory framework. Additionally, as suggested by (Cracel Viana et al., 2022), transparency in contract management is a critical issue to mitigate conflicts and build trust between stakeholders. These challenges underscore the necessity of strengthening regulatory frameworks, improving administrative efficiency, and ensuring the active engagement of all stakeholders to secure the success of PPPs. Consequently, regulatory reforms that promote transparency and efficiency represent a strategic and urgent step for supporting future PPPs implementations.

This study also makes a significant theoretical contribution by emphasizing the relevance of PPPs in supporting sustainable development, particularly in developing countries. (Kamaludin et al., 2024) assert that PPPs can serve as strategic instruments for achieving sustainable development goals by combining operational efficiency with positive environmental impacts. These findings offer practical implications for governments in designing adaptive contract models that address specific project needs and socio-economic contexts. Moreover, the study suggests that governments enhance managerial capacity in the public sector to optimize collaboration with private partners. Further research is needed to explore variations in PPPs implementation across sectors and contexts, enabling this model to evolve as an innovative and inclusive solution. With a more integrated approach, PPPs can serve as key drivers of sustainable development in the future.

VI. CONCLUSION AND RECOMMENDATION

The findings of this study demonstrate that the implementation of PPPs contributes significantly to enhancing operational efficiency and sustainability across various public sectors. PPPs have been shown to reduce operational costs, accelerate project completion, and generate positive social and environmental impacts. The success of PPPs implementation heavily relies on clear contract design, which includes balanced risk allocation and measurable success indicators. Furthermore, the active involvement of all stakeholders, including both public and private sectors, is a key element in ensuring smooth project implementation. Robust collaborative mechanisms foster innovation that supports long-term efficiency and sustainability. Thus, PPPs can be regarded as an effective strategy to address the increasingly complex challenges of modern development.

To ensure the success of future PPPs implementations, it is essential to optimize regulatory frameworks that support such partnerships, including clearer rules on risk allocation and project

evaluation mechanisms. Additionally, capacity building within the public sector is crucial to effectively manage and oversee PPPs projects. Further research is also necessary to analyze the quantitative outcomes of various PPPs projects, including measuring their social and environmental sustainability impacts. A focus on cross-sectoral comparative studies will provide more comprehensive insights into the unique success factors and challenges faced. With a more integrated approach, future research can offer more targeted recommendations for policymakers and private partners. These efforts are expected to strengthen the potential of PPPs in creating innovative and sustainable development solutions.

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