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MAXIMIZING THE BENEFITS OF PUBLIC-PRIVATE PARTNERSHIP FOR INFRASTRUCTURE IN ENERGY SECTOR: A STUDY OF KEY CHALLENGES AND RECOMMENDATIONS

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Abstract:
This study aimed to analyze the main themes of research in Public-Private Partnership (PPP) in energy infrastructure development using a systematic literature review. The data was taken from highly selected international journals, and the study found that 48% of the publications were from Q1 Scopus Indexed journals. The most popular topics in the research were PPP challenges, project management and regulatory implications, risk management, and PPP financing. This study significantly contributes to the field by highlighting the main research themes in PPP in energy infrastructure development. It provides insights into the topics currently being researched and emphasizes the implementation of PPP in the energy sector. The study's findings can serve as a valuable reference for researchers, policymakers, and practitioners interested in PPP in energy infrastructure development and its relationship to accounting and finance. Additionally, the study provides a roadmap for future research in this area, highlighting areas that require further exploration and investigation.

Keywords: Public Private Partnership, Systematic Literature Review, Energy Sector, Infrastructure Development

INTRODUCTION

Background on Government Procurement and Public-Private Partnerships in the Energy Sector. Countries have recently shifted towards Public-Private Partnerships (PPPs) to fund and develop their infrastructure. The main reason is that it allows the government to take advantage of private sector financing and expertise, allowing for faster and more efficient development. PPPs benefit the government and private sector, making them widely used in various countries. According to Hodge & Greve (2007), PPPs allow the government to fund infrastructure projects through private financing.

The government's ability to fund infrastructure projects through private financing in the context of PPPs is commonly called "leveraging private financing" or "accessing private capital." The idea is that the government can use private investment to help finance infrastructure projects rather than rely solely on public funds. It allows the government to allocate resources more efficiently and complete projects faster. The use of private financing also brings in the expertise and resources of the private sector, which can help ensure the project's success.

In addition to reducing the government's financial burden, implementing Public-Private Partnerships (PPPs) has provided significant advantages. This is due to the private sector's better mobility and efficiency than the public sector. The private sector can avoid bureaucracy, reduce administrative burden, and save money on project costs in planning, design, construction, and operation. PPPs also promote a balanced risk-return structure between the public and private sectors, providing better service to the public. The private sector's ability to raise funds on a large scale for large-scale infrastructure projects also reduces the financial burden on the government. In other countries, such as Hong Kong, PPPs are chosen as a financing alternative for infrastructure

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projects due to incentives from the private sector, pressure for economic development and the demand for high-quality services (Cheung et al., 2009).

According to Broadbent and Laughlin (2004), there is a significant research gap in the implementation and knowledge of PPPs, and it is almost irresponsible not to analyze whether the predicted outcomes occur. By conducting this research, the researchers hope to fill this gap and provide helpful information for other researchers, identifying what topics still need to be discussed and providing insight into an under-researched area.

Purpose and Scope of the Study. This study aims to research Public-Private Partnerships (PPPs) in energy infrastructure. This is because, despite previous studies on PPPs, much research still needs to be done to evaluate the PPP scheme and its implementation. The main objective of this literature review study is to investigate the trend in research on Public-Private Partnership (PPP) projects in energy infrastructure between 2010 and 2020 in countries across Asia, America, Europe, and Australia. Additionally, the study aims to examine the connection of PPP research with accounting theory and finance. The increasing interest in using PPPs for energy infrastructure projects, coupled with the growth in research in the last decade, has prompted this study to provide a comprehensive understanding of the current state of research on PPP energy infrastructure. By understanding the trend in research and the connection with accounting and finance, the study aims to contribute to developing PPP policy and practices in the energy sector.

Significance of the Study. In a report by Jarvis (2012) on the global Public-Private Partnership (PPP) market, the researchers use data to select priority countries for a systematic literature review. These countries include Asia (China, Malaysia, and Indonesia, Turkey, India), America (America, Brazil), Europe (UK, France) and Australia. This literature review aims to comprehensively understand the PPP market and the use of PPPs in these countries. The selection of these countries was based on the significance of their PPP market and their contribution to the global PPP market. The report aims to provide valuable insights into the PPP market and inform future research and policy decisions by focusing on these countries.

Research Questions. The study's objective is to analyze the trend in PPP research in the field of Energy Infrastructure across countries in Asia, America, Europe, and Australia between 2010 and 2021.

Literature Review. Overview of public-private partnerships in the energy sector. PPP is a cooperative agreement between the public and private sectors to provide public services or infrastructure. The concept of PPP is not new and has been around since ancient times, for example, the Dutch East Indies Company in World War 2. PPP can provide many benefits, including improved value for money, better budget management, improved infrastructure quality and efficiency, innovation, economic growth and job opportunities, and risk sharing. The implementation of PPP has increased significantly in recent years, with approximately 2% of GDP in developed countries and 7% in developing countries being invested in PPP infrastructure (IMF, 2017). It highlights the importance of PPP in addressing the need for infrastructure development and financing while balancing the cost and risk between the public and private sectors. Additionally, PPP enables the transfer of technology, expertise, and innovation from the private sector to the public sector, improving the quality and efficiency of infrastructure services.

Benefits and challenges of PPPs in energy infrastructure**.** However, despite the criticism, PPP has become an essential alternative procurement scheme for infrastructure development due to its potential benefits, such as improved value for money, reduced public sector budget shortages, improved infrastructure quality and efficiency, innovation in infrastructure development, and economic growth and job opportunities. Nevertheless, it is essential to consider the challenges that

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may arise from PPP projects, such as a lack of understanding of the process and implementation, difficulties in long-term collaboration between public and private sectors, high competition among private parties, potential political interference, and the possibility of monopolies leading to higher user costs. In conclusion, PPP is a financial model offering potential benefits for both the public and private sectors. However, weighing the benefits against the challenges and risks is essential to ensure successful implementation.

The World Bank guidebook (2014) highlights several public-private partnerships (PPP) benefits for both the private and government sectors. These benefits include the following: Large infrastructure projects will become more feasible due to access to better technology and incentives. Infrastructure development will be driven by innovation and better design rather than just construction. Service dynamics will improve coverage, quality, billing and collection, operational efficiency, and labor productivity. Project evaluation and due diligence will be improved, considering stakeholders' interests. Opportunities for local capital markets and institutional investors to participate in long-term revenue streams, better public procurement practices, Increased focus on Value for Money, Access to private capital for investment, Positive demonstration effect for local business, Transition to privatized services in critical sectors such as energy, health, and education

METHODS

This study uses a qualitative method by applying a Systematic Literature Review using secondary data based on the step-by-step SLR method (Ridley, D,2012). It can be explained in Figure 1 as follows:

Research Design

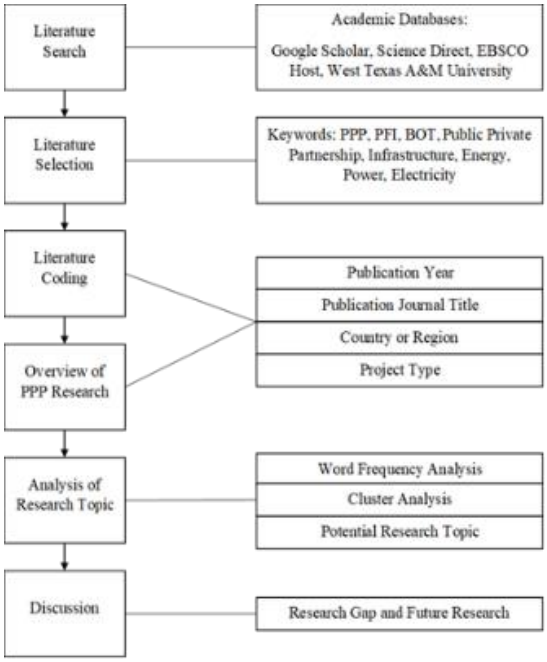

Figure 1. The overall flow of the research framework.

Data Collection Methods and Sample Selectio. This research was based on a plot adaptation created by Cui et al. (2018) by collecting literature consisting of journals and conference papers from the academic databases of Google Scholar, Science Direct, EBSCOHost, and West Texas A&M

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University, which are described in Table 1. Then, based on the SLR Method (Siddaway,2014), the second process is to select and collect journals based on keywords mentioned in journals such as PPP, PFI, BOT, Public Private Partnership, Infrastructure, Energy, Power, and Electricity. Third and fourth, the researchers conducted coding and looked at the overall journals that the researchers collected to be categorized by year of publication, title, country, and type of topic discussed. After the journal was collected, researchers analyzed it with the help of Excel software and NVivo 12 by showing the results of Word Frequency, Cluster Analysis or research categorization, as well as research topics that still have the potential to be explored more deeply. The latter part is a researcher's analysis that concludes the gaps and provides input to researchers in the future.

Table 1. Keywords Validation

No.	Source	Keywords	Date	Time	Result	Relevant Papers
1	Google Scholar	"PPP" and "ENERGY" and "INFRASTRUCTURE" and "AUSTRALIA"	14-May-20	14:20	17800	1
		"PUBLIC" and "PRIVATE" and "PARTNERSHIP" and "INFRASTRUCTURE" and "ENERGY" and "AUSTRALIA"	11-May-20	18:00	17300	2
		(public-private partnership OR up OR pfi) AND energy AND china	19-May-20	14:48	59600	2
		"PUBLIC" and "PRIVATE" and "PARTNERSHIP" and "ENERGY" and "INFRASTRUCTURE" and "CHINA"	17-May-20	20:54	25200	4
		public-private partnership OR pfi AND energy OR power OR electricity AND Africa	02-Jun-20	12:23	17600	7
		("public-private partnership" OR pfi) AND (energy OR power OR electricity) AND Europe	03-Jun-20	18:24	17300	5
		("public-private partnership" OR pfi) AND (energy OR power OR electricity) AND Asia	05-Jun-20	16:16	17400	9
		("public-private partnership" OR pfi OR bot) AND (energy OR power OR electricity)	10-Jun-20	16:38	306000	11
		("public-private partnership" OR pfi OR bot) AND (energy OR power OR electricity) AND Germany	10-Jun-20	22:32	60100	2
		("public-private partnership" OR pfi OR bot) AND (energy OR power OR electricity) AND Japan	10-Jun-20	22:46	32400	1

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		("public-private partnership" OR pfi OR bot) AND (energy OR power OR electricity) AND Indonesia	11-Jun-20	10:00	17700	8
		"PPP" and "ENERGY" and "INFRASTRUCTURE"	11-Jun-20	12:35	24300	4
2	Science Direct	("public-private partnership" OR pfi) AND (energy OR power OR electricity)	07-Jun-20	21:56	6606	4
3	EBSCO	"public-private partnership" AND Energy AND China	24-May-20	21:49	21	2
		("public-private partnership" OR up OR pfi OR bot OR "private finance") AND (energy OR electric* OR power) AND (china OR Chinese OR "People's Republic of China")	27-May-20	21:03	231	2
		("public-private partnership" OR pfi) AND (energy OR power OR electricity) AND (America OR us OR USA)	06-Jun-20	21:09	46	1
4	West Texas A&M University Cornette Library	("public-private partnership" OR up OR pfi OR bot OR "private finance") AND (energy OR electric* OR power) AND (china OR Chinese OR "People's Republic of China")	28-May-20	20:51	148609	2
		Total				67

Researchers conducted a quality test of research journals. From the search engine journals used (Google et al. Texas A&M University Cornette Library), they obtained 67 journals to be used as research materials. SCImago Journal Rank (SJR) assesses journals in three categories: Q1, Q2, Q3, and Q4. Journals with Q1 quality represent 48% or 32 journals.

Sure! The revised text is "In the keyword table of the search engine used for collecting research journals." Keywords use the "Boolean Operators" method to get more specific and targeted journals. The primary source used is the Search engine Google Scholar. Journals are selected based on their title, abstract, and keywords to perform an initial journal screening. A total of 67 journals were the focus of the study.

Data Analysis Techniques. After diligently establishing a solid foundation of relevant research through literature gathering and curation, the study employed data analysis to extract valuable insights. This analysis employed a three-pronged approach, utilizing the strengths of both Excel and NVivo 12 software.

The first technique, Word Frequency Analysis, functioned like a spotlight, illuminating the most frequently occurring keywords across the collected journals. This analysis pinpointed the core areas that currently dominate research focus within the realm of PPP, PFI, BOT models, and energy infrastructure.

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Next came Cluster Analysis, a technique akin to grouping birds of a feather. Journals were clustered based on thematic similarities in their topics and the research methodologies employed. This clustering served a crucial purpose: it helped identify overarching trends within the research landscape and, more importantly, revealed potential gaps in current knowledge. These gaps represent fertile ground for future research endeavors.

Finally, the analysis embarked on a mission of discovery with Unearthing Research Potential. This technique served as a compass, guiding the researcher toward unexplored territories within the PPP, PFI, BOT, and energy infrastructure domains. By pinpointing topics that have yet to receive extensive research attention, this analysis identified exciting new avenues for future exploration. These areas hold immense promise for propelling the field forward by expanding the frontiers of knowledge.

The data analysis techniques employed in this study functioned like a multifaceted lens, providing a clear and multifaceted view of current research trends in energy infrastructure partnerships. They highlighted established focus areas and unveiled exciting new possibilities for future exploration, paving the way for advancements in this critical field.

RESULT AND DISCUSSION

The study found the distribution of research themes from the paper collection is explained in Table 2: (i) Risk (ii) PPP Challenges (iii) Financial (iv) PPP Sustainable Energy (v) PPP Importance (vi) Policy and Management Implications (vii) Legal (ix) Value for Money and the percentage of each research theme can be found in Figure 2.

Table 2. Topics Distribution

No	Theme	Total
1	PPP Challenges	31
2	PPP Importance	25
3	Policy and Management Implications	24
4	Financial	20

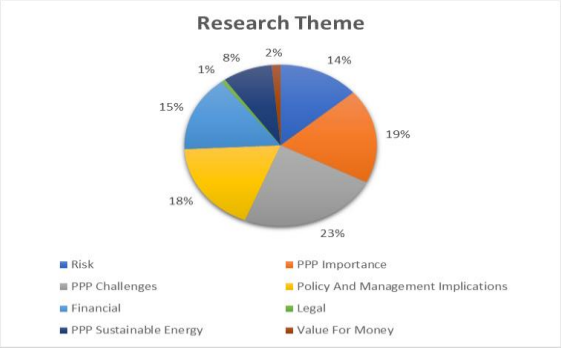

Figure 2. Research Theme Diagram

This graph shows the results of a study that analyzed the quality and testability of research journals related to Public-Private Partnerships (PPP). The study used references from the SCImago Journal and Country Rank to assess the quality of the journals. The SCImago Journal Rank (SJR) has

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four categories: Q1, Q2, Q3, and Q4. Researchers obtained 67 journals from search engines like Google Scholar, EBSCO Host, Science Direct, and West Texas A&M University Cornette Library. Of the 67 journals, 32 (48%) were rated as Q1, meaning they were high quality. 10 (15%) were rated as Q2, while 6 (9%) were rated as Q3. SCImago did not rate the remaining 19 journals (28%).

PPP Challenges in Several Countries. Privatization challenges in the energy sector interest researchers, as shown by its presence in 31 journals, making up 23% of the total research journals. The study by Victor et al. (2015) highlights the challenges faced by different countries in the process of privatization, including India (lack of transparency and corruption, equipment shortage), China (wasteful investment, complexity of evaluation), Malaysia (transparency required, tight supply of fuel), Nigeria (poor investment, unclear financing and supply), Cameroon (poor investment, corruption and weak regulatory agencies), and South Africa (government instability, significant increase in electricity consumption). PPP research has significantly increased over the past 20 years, with studies from 25 different countries. The research has evolved from initially focusing on risk, procurement, and finance to exploring seven categories: investment environment, procurement, economic viability, financial packaging, risk management, governance issues, and integration research. However, despite the active implementation of PPPs in Southeast Asian countries like Malaysia, Thailand, Indonesia, and the Philippines, there are limited journal articles or research studies on PPPs. (Ke, Wang, Chan, & Cheung, 2009).

PPP Importance. PPP Importance is the second most popular topic in the research community, with 25 journals discussing this issue, making up 19% of the total research journals. Benkovic et al. (2013) describe the advantages of a PPP project, including the transfer of significant financial assets from the private sector to the public sector to meet financial needs and the shift of financial risks and responsibilities from the public sector to the private sector, leading to enhanced overall quality of public sector services through professional management.

Policy and Management Implications. The third most popular topic in the research community is Policy and Management Implications, represented by 24 or 18% of the total research journals. This topic is widely discussed due to the numerous rules and regulations governing PPP projects, which are crucial for ensuring their success. Koliba et al. (2014) present research questions on the case study of eEnergy Vermont (eEVT) to explore how Vermont managed to implement intelligent grid infrastructure across the state, what factors led to the development of the eEVT collaboration, and what issues of significance and technical complexity arose during the scoping and implementation phases of the project. This research aims to reduce the occurrence of failures and disadvantages in PPP projects.

Financial. Financial issues are a critical aspect of Public-Private Partnership (PPP) projects and are discussed in 20 journals, accounting for 15% of the total journals. An example of such research is the study by Ofoegbu and Emengini (2013), which focuses on the cost of restoring electricity supply in Nigeria. The researchers found that the energy sector in Nigeria faces challenges such as instability, unreliability, and lack of profitability. The study recommends several measures to address these financial issues, including a balanced cost recovery plan, better efforts to ensure timely payment of bills, honesty of workers, enforcement of regulations against defaulters, and reducing electricity transmission and distribution losses.

Risks. In the context of PPP energy projects, various risks are usually encountered. According to research by Cheung and Chan (2011), the main risks are government intervention, financing risk, poor public decision-making process, and government corruption. Excessive government intervention can damage the relationship between the public and private sectors and lead to a failed PPP project, as in the case of Guangdong. Financing risk is another significant risk factor, as banks

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in China are often reluctant to provide long-term loans required for PPP projects. Poor public decision-making processes and government corruption are also significant risks, with corruption challenging to detect and enforce. Efficient allocation of risk through critical PPP project design and the creation of a power purchase agreement can result in more successful and profitable projects and benefit both parties involved. The power purchase agreement helps create a secure payment flow and forms the basis for project financing. To minimize risks in PPP energy projects, it is crucial to manage them through appropriate risk allocation and effective mitigation measures.

Risk allocation and mitigation are critical components of a successful power purchase agreement. Risk management should address project feasibility, resource availability, supply continuity, pricing and payment security, financing, and other conditions affecting the project. Contractual arrangements should also be designed to minimize the potential for disputes and provide precise dispute resolution mechanisms. Procurement should consider environmental and technical aspects, such as resource quality and reliability, safety, and environmental protection. Furthermore, financial institutions should consider the counterparty's creditworthiness, the debt service's structure, and the counterparty's capacity to meet its payment obligations. To protect their interests, all parties should strive to ensure the PPP is transparent, fair, and equitable.

PPP Sustainable Energy. The researchers are focusing on Sustainable Energy, specifically looking at energy from an environmentally sustainable perspective. They gather information from 11 journals, 8% of which discuss this topic. One example is a case study on the Maniwa Biomass project, which aligns with the UNFCCC climate change regulations. Another example is a study by Sheng et al. on a dynamic inductive power transfer roadway charging system in New Zealand, driven by the need for renewable energy and discussions around climate change.

Value for Money. Value for money is another topic of interest for the researchers. They found 2 journals, or 2% of the total collected, that discuss this topic. One example of research by Atmo & Duffield in 2014 focuses on the value for money of a PPP project. The research highlights five drivers that can increase the value for money in a PPP project: a supportive environment, risk allocation, competence, innovation, project lifecycle considerations, and utilization of available private sector skills. These drivers include improving the procurement process for increased transparency, risk allocation through financial incentives, using environmentally friendly technology to attract support, using energy-efficient technology for more extended cost savings, and selecting a project consortium with international experience to increase bankability and risk management.

Legal and Regulatory Framework. The final topic of interest for the researchers is Legal. One example of research in this area is by Chowdhury et al. in 2012, which looks at a PPP project's regulatory and legal factors. The study found that "comprehensive and transparent law" and "strong political commitment" were the most critical factors, as indicated by the highest mean count (4.25). Other important factors included a well-developed legal system and a long track record of a country's legal stability. The "trade liberalization, privatization, or deregulation of key sectors" factor was deemed less critical. The results suggest that most respondents recognize the importance of the legal framework and institutions in using Special Purpose Vehicles in PPP projects in Asian countries.

Key Findings and Implications for Future Procurement Processes in the Energy Sector. Interpret results of the literature review and years of studies conducted in 25 countries. The most popular research topics are privatization challenges, PPP importance, policy and management implications, financial issues, risks, sustainable energy, and value for money. The privatization challenges include more transparency, corruption, and poor investment in countries like India, China, Nigeria, and South Africa. PPP's importance is the transfer of financial assets from the private

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to the public sector and the transfer of financial risks and responsibilities to the private sector for enhanced public services. Policy and management implications are the numerous rules and regulations crucial for the success of PPP projects. Financial issues are a critical aspect of PPP projects and are discussed in 20 journals. The main risks in PPP energy projects include government intervention, financing risk, poor public decision-making process, and government corruption. The need for renewable energy and discussions around climate change drive the focus on sustainable energy. The topic of value for money is discussed in 2 journals, highlighting the importance of a PPP project to provide value for the money invested.

Recommendations for Improving PPPs in Energy Infrastructure Procurement. Implications of the study for government procurement processes and PPPs in the energy sector could potentially lead to Improved transparency and accountability in procurement processes, ensuring that contracts are awarded based on merit and in line with established regulations. A more significant understanding of the advantages and disadvantages of PPPs in the energy sector is needed to help policymakers make informed decisions about their use in future projects. Increased stakeholder engagement in procurement processes and PPP projects, leading to more effective and efficient project delivery. Better alignment between the goals of governments and private sector partners, resulting in the long-term success of PPP projects in the energy sector.

Recommendations for Future Research in this Area. Regarding recommendations for future research in this area, the following could be considered: further studies could be conducted to understand the specific challenges and opportunities of PPPs in different energy sub-sectors, such as renewables, oil and gas, and conventional power generation. Research could also be conducted on the impact of PPPs on energy sector development and its role in reducing energy poverty. An analysis of the role of PPPs in the transition towards a low-carbon energy sector could be helpful for policymakers and stakeholders. Evaluating the long-term performance of PPPs in the energy sector, including their economic, social, and environmental outcomes, could provide valuable insights for future projects.

CONCLUSION

The study's conclusion on government procurement processes and PPPs in the energy sector highlights the importance of transparency and accountability in procurement processes and the potential benefits and challenges of using PPPs in the energy sector. It also suggests areas for future research, such as understanding the specific challenges and opportunities of PPPs in different energy sub-sectors, the impact of PPPs on energy sector development, the role of PPPs in the transition towards a low-carbon energy sector, and evaluating the long-term performance of PPPs in the energy sector.

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