

Public-Private Partnerships (PPPs) in Infrastructure Development: A Bibliometric Review

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ABSTRACT

This study presents a comprehensive bibliometric analysis of scholarly literature on Public-Private Partnerships (PPPs) in infrastructure development, using data retrieved from the Scopus database and analyzed through VOSviewer. The objective is to map the intellectual structure, thematic evolution, and global collaboration patterns within the field. The results reveal three major research clusters: (1) infrastructure governance and economic development, (2) financial and managerial structuring, and (3) sustainability and risk assessment. Temporal overlay visualization indicates a shift from foundational themes toward applied concerns such as project finance, policy integration, and sector-specific applications including public health and agriculture. Density mapping shows high research concentration on infrastructure provision, sustainable development, and risk management. Co-authorship and country-level analyses highlight the dominance of scholars and institutions from the United States, United Kingdom, China, and other emerging economies, reflecting a globally interconnected research landscape. This review offers valuable insights into the progression and diversification of PPP research and suggests future directions focused on interdisciplinary integration, social impact, and inclusive infrastructure delivery.

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1. INTRODUCTION

Public-Private Partnerships (PPPs) have emerged as a pivotal mechanism in addressing infrastructure deficits worldwide. As global demands for improved transportation, energy, water supply, and digital connectivity continue to surge, traditional public financing mechanisms have proven insufficient, especially in developing

and emerging economies. PPPs offer an innovative financing and operational model, combining the strengths of both the public and private sectors to deliver infrastructure projects more efficiently and sustainably [1], [2]. By leveraging private sector investment, technological expertise, and management efficiency, PPPs aim to enhance the delivery of public infrastructure services while

mitigating fiscal constraints faced by governments [3].

The evolution of PPPs reflects broader trends in public administration and economic liberalization that have emphasized privatization, decentralization, and market-based governance. Since the 1990s, many countries have institutionalized PPP frameworks to mobilize private capital for public projects. The World Bank, International Monetary Fund (IMF), and other multilateral organizations have endorsed PPPs as a key strategy for infrastructure financing, particularly in sectors such as transport, healthcare, education, and energy [4]. Governments have adopted varied models of PPPs—ranging from build-operate-transfer (BOT) to design-build-finance-operate (DBFO)—depending on the nature of the project, risk allocation, and desired outcomes [5].

Despite their popularity, PPPs are complex arrangements requiring robust legal, financial, and institutional frameworks. Successful implementation hinges on clear risk-sharing agreements, transparency, stakeholder engagement, and effective regulatory oversight. The private sector's appetite for investment is influenced by factors such as political stability, return on investment, and regulatory predictability [6], [7]. Consequently, countries have developed specialized PPP units and legal reforms to facilitate project structuring, procurement, and dispute resolution. Moreover, public accountability and the equitable distribution of benefits remain key concerns, especially when projects involve essential services or affect vulnerable populations [8].

Academic interest in PPPs has grown substantially, leading to a diverse body of literature examining their models, performance, governance, and socio-economic implications. Research spans disciplines such as economics, political science, public administration, project management, and urban planning. Over the past two decades, bibliometric studies have emerged as a valuable method to synthesize this growing body of literature. By identifying

publication trends, influential authors, thematic clusters, and intellectual networks, bibliometric analysis helps map the knowledge structure of PPP-related research and guide future inquiries [9]. It also sheds light on the geographical distribution of research efforts, institutional collaborations, and methodological evolution.

In recent years, the strategic role of PPPs has been amplified by global challenges such as climate change, urbanization, and post-pandemic recovery. The demand for resilient, inclusive, and green infrastructure has underscored the need for innovative financing mechanisms like PPPs. Initiatives such as the United Nations Sustainable Development Goals (SDGs), the G20 Infrastructure Initiative, and the Belt and Road Initiative (BRI) have emphasized the mobilization of private capital in achieving long-term infrastructure goals (OECD, 2020). Within this context, PPPs are no longer viewed solely as financing tools but also as instruments for sustainable development, technological innovation, and cross-sector collaboration.

Despite the proliferation of scholarly work on PPPs, there is limited systematic understanding of the intellectual structure, thematic evolution, and collaborative patterns in the literature. Most reviews focus on qualitative syntheses or case-based analysis, lacking quantitative insight into publication trends, influential sources, or research frontiers. As the PPP literature becomes increasingly interdisciplinary and globalized, a bibliometric approach is essential to distill its key developments, knowledge gaps, and future directions. Without such synthesis, researchers and policymakers may struggle to navigate the complexity of PPP scholarship and capitalize on its policy relevance. This study aims to conduct a comprehensive bibliometric review of scholarly literature on Public-Private Partnerships (PPPs) in infrastructure development.

2. LITERATURE REVIEW

2.1 Definitions and Typologies of PPPs

At the foundational level, numerous studies attempt to define and categorize PPPs based on risk-sharing arrangements, duration, and ownership structure. [10] distinguish PPPs from outright privatization by emphasizing their contractual nature and the continuous involvement of the public sector. Common typologies in the literature include Build-Operate-Transfer (BOT), Build-Own-Operate (BOO), and Design-Build-Finance-Operate (DBFO) models, each delineating varying degrees of responsibility and risk allocation between the public and private actors [11]. These typologies provide a basis for comparative studies and have been widely used in policy-oriented frameworks by the World Bank and OECD.

The conceptual evolution of PPPs also reflects regional and sectoral nuances. For example, in the Global South, PPPs are often framed as mechanisms for infrastructure gap closure and economic development, while in developed economies, they are viewed more through the lens of efficiency gains and public sector reform [12]. This contextual variability has prompted scholars to caution against one-size-fits-all frameworks and advocate for adaptive governance approaches tailored to local institutional capacities.

2.2 Risk Allocation and Financial Structuring

A central theme in PPP research is the allocation and management of risk. Risk-sharing is considered the cornerstone of effective PPP

arrangements, with poorly designed contracts often resulting in cost overruns, disputes, or service failures [13]. Studies have developed models to identify, quantify, and allocate risks such as construction delays, demand shortfalls, political interference, and currency volatility. [14] argue that optimal risk allocation should assign risks to the party best able to manage them, a principle embedded in many PPP guidelines.

Financial structuring is another key component. PPPs often rely on blended finance mechanisms combining equity, debt, and public guarantees. Recent literature has examined the role of project finance structures, viability gap funding, and multilateral development bank participation in enhancing bankability [15], [16]. Moreover, the growing involvement of institutional investors, such as pension funds and sovereign wealth funds, has opened new avenues for long-term infrastructure finance, prompting inquiries into creditworthiness, securitization, and lifecycle costing.

2.3 Governance, Institutional Capacity, and Regulatory Frameworks

Effective governance is widely recognized as essential for successful PPP implementation. The presence of dedicated PPP units, transparent procurement processes, legal clarity, and dispute resolution mechanisms are frequently cited as enabling factors [17]. [18] highlight that PPP outcomes are shaped not only by contract design but also by the broader

institutional environment, including public sector capacity, political stability, and regulatory oversight.

Empirical studies across various jurisdictions have pointed to the importance of intergovernmental coordination, stakeholder engagement, and performance monitoring systems [19]. The emergence of hybrid governance models—where public agencies retain strategic control while outsourcing operational responsibilities—has further complicated traditional distinctions between public and private roles, leading to new forms of accountability and co-production [20].

2.4 Performance and Value for Money (VfM)

Assessing the performance of PPPs remains a contentious and complex issue. While proponents argue that PPPs enhance efficiency, innovation, and service quality, critics warn of inflated costs, inflexible contracts, and hidden fiscal liabilities [21]. Numerous performance frameworks have been developed, focusing on criteria such as cost-effectiveness, project delivery timelines, service quality, and user satisfaction.

Value for Money (VfM) assessments are central to justifying PPP decisions, yet methodological inconsistencies persist across contexts. For instance, the UK's Public Sector Comparator (PSC) has been both praised and criticized for its assumptions and opacity. More recent research incorporates lifecycle evaluation and public interest considerations, advocating for holistic approaches that include

environmental and social dimensions [22].

2.5 Sustainability and Resilience Dimensions

In light of global commitments such as the Sustainable Development Goals (SDGs), PPPs are increasingly evaluated not only on economic metrics but also on environmental sustainability and social equity. Scholars have explored how PPPs can contribute to green infrastructure, low-carbon transitions, and inclusive urban development [23]. Concepts such as sustainability-oriented innovation and resilience-building have gained traction, particularly in climate-sensitive sectors like water, transport, and energy.

Nevertheless, critics argue that many PPPs fail to adequately integrate sustainability principles, either due to weak regulatory mandates or private sector reluctance to internalize long-term externalities. The literature calls for a rebalancing of objectives to align PPPs with public value creation and long-term resilience, especially in the face of pandemics, climate disasters, and fiscal shocks [24].

3. METHODS

This study adopts a bibliometric approach to analyze scholarly publications on Public-Private Partnerships (PPPs) in infrastructure development, using VOSviewer as the primary analytical tool. The data were retrieved from the Scopus database, selected for its wide coverage of peer-reviewed literature across engineering, economics, social sciences, and public policy. The search strategy involved using keywords

such as "public-private partnership", "PPP", and "infrastructure development", targeting publications from the year 2000 to 2024, and filtering for articles, reviews, and conference proceedings written in English. The exported bibliographic data, including titles, abstracts,

keywords, authors, affiliations, and cited references, were processed in VOSviewer to generate co-authorship networks, keyword co-occurrence maps, citation analysis, and thematic clusters.

4. RESULTS AND DISCUSSION

4.1 Keyword Co-Occurrence Network

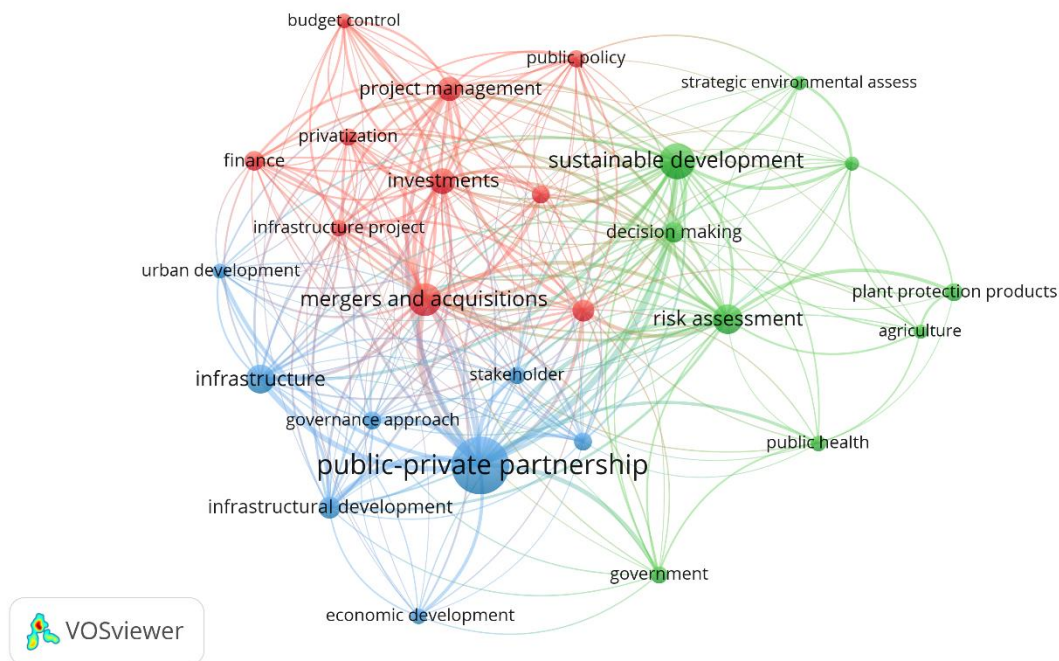


Figure 1. Network Visualization

Source: Data Analysis Result, 2025

The visualization provides a comprehensive overview of the thematic landscape in the literature on Public-Private Partnerships (PPPs) in infrastructure development. Each node represents a keyword, and the size of the node corresponds to its frequency of occurrence in the analyzed corpus. The proximity between nodes and the strength of connecting lines (edges) indicate the degree of co-occurrence—how often keywords appear together in the same documents. The map is divided into three major clusters, each colored differently, representing thematic groupings that reflect key research areas within PPP literature. The blue cluster centers around the core theme of public-private partnership, closely linked to terms such as infrastructure, infrastructural

development, economic development, urban development, and governance approach. This cluster represents the foundational discourse in PPP literature, focusing on the operational and policy-related aspects of infrastructure projects. It illustrates how PPPs are situated within broader development narratives, especially in urban and economic contexts. The strong linkages between "government," "infrastructure," and "public-private partnership" also reflect the central role of public institutions in initiating and regulating PPP projects.

The green cluster shifts toward broader societal and environmental considerations, anchored by keywords such as sustainable development, risk assessment, decision making, public health, agriculture,

and plant protection products. This thematic area explores the intersection of PPPs with sustainability and public welfare outcomes. The cluster suggests a growing research emphasis on integrating risk management frameworks, strategic environmental assessment, and social equity into PPP planning and evaluation. The strong interconnections with government and stakeholder reflect the push toward inclusive governance and public accountability in the pursuit of sustainable infrastructure solutions.

One of the notable insights from the visualization is the high level of interconnectivity between clusters, especially around central nodes such as sustainable development, risk assessment, and public-private partnership. This indicates that the literature is increasingly interdisciplinary, blending technical, economic, environmental, and governance perspectives. The integration of sustainability and risk management themes into traditional infrastructure and finance discussions marks a shift toward more holistic and long-term evaluation frameworks for PPPs

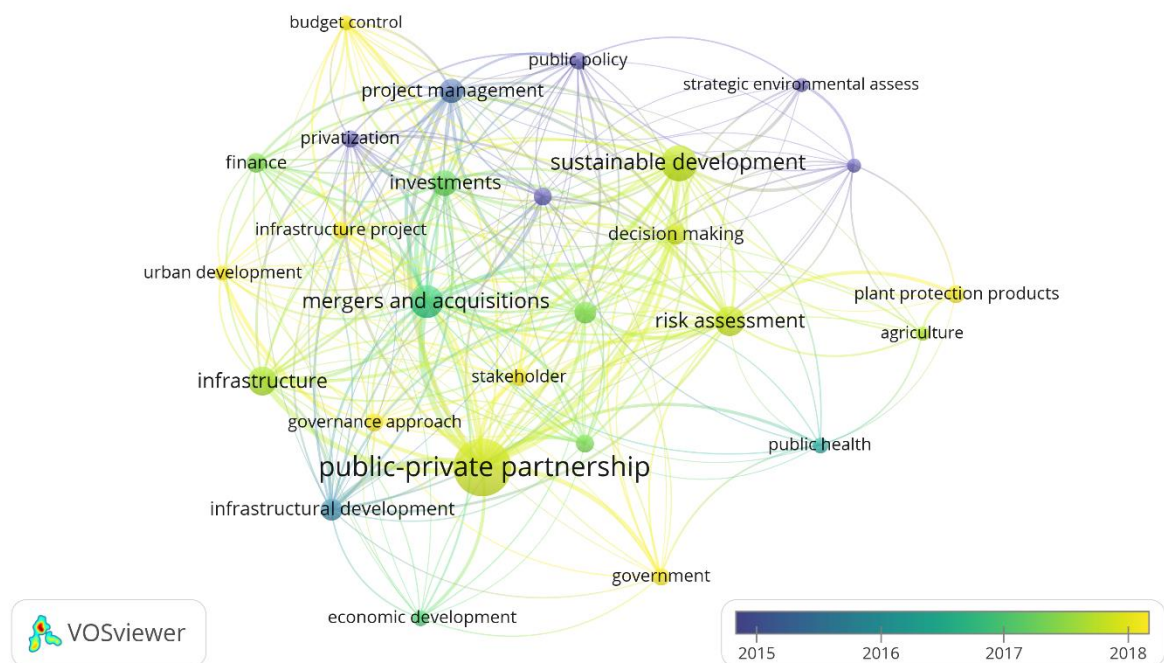


Figure 2. Overlay Visualization

Source: Data Analysis Result, 2025

This overlay visualization depicts the temporal evolution of research themes in Public-Private Partnerships (PPPs) in infrastructure development. Each node represents a keyword, while its color corresponds to the average publication year in which the term appears, based on the gradient scale at the bottom. Earlier topics are shaded in blue to purple (around 2015), while more recent ones transition to green and yellow (approaching 2018). This color progression

allows us to trace shifts in scholarly focus and identify emerging areas of research over time. The visualization reveals that core concepts such as public-private partnership, infrastructure, and economic development have sustained scholarly interest across multiple years, shown in green to yellow. These represent foundational themes that have remained consistently relevant. Meanwhile, newer attention has been directed toward project management, finance, and

budget control, which appear in lighter yellow tones, indicating a surge of interest closer to 2018. This suggests a growing focus on the operational and financial mechanisms behind PPP implementation, likely reflecting evolving governance models and increased private sector participation. Conversely, topics such as sustainable development, public policy, risk assessment, and strategic

environmental assessment remain in darker shades, indicating that they entered the literature slightly earlier and have since matured. This temporal distinction highlights how the research initially emphasized macro-level policy and sustainability concerns, then gradually evolved toward more technical and project-level issues like investment strategies and governance efficiency.

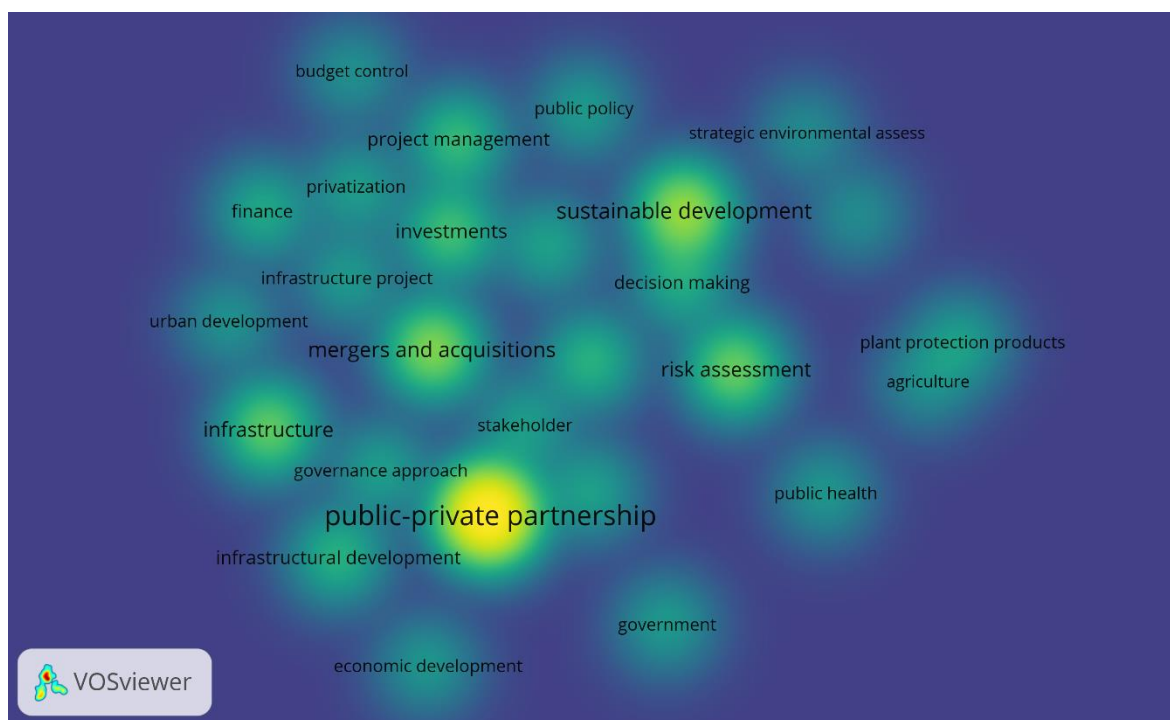


Figure 3. Density Visualization

Source: Data Analysis, 2025

This density visualization highlights the frequency and concentration of keyword occurrences in the literature on Public-Private Partnerships (PPPs) in infrastructure development. Brighter areas, shown in yellow, indicate keywords that appear most frequently and are central to the discourse, while darker blue or purple areas reflect less frequently used terms. The term public-private partnership is the most dominant and centrally positioned keyword, as expected, suggesting its foundational role in the academic conversation. Closely associated with it are infrastructure, infrastructural development, and economic development, which together represent the core concerns of the field.

Other areas of high density include sustainable development, risk assessment, and mergers and acquisitions, signaling their importance as secondary focal points in the literature. These keywords suggest an intersection between PPPs and broader societal, financial, and governance concerns. The clustering of keywords like project management, investments, finance, and policy around the center indicates an intense scholarly interest in the practical and regulatory aspects of implementing PPPs. Meanwhile, peripheral topics such as public health, plant protection products, and agriculture show emerging or niche intersections of PPPs with sector-specific applications.

4.2 Co-Authorship Network

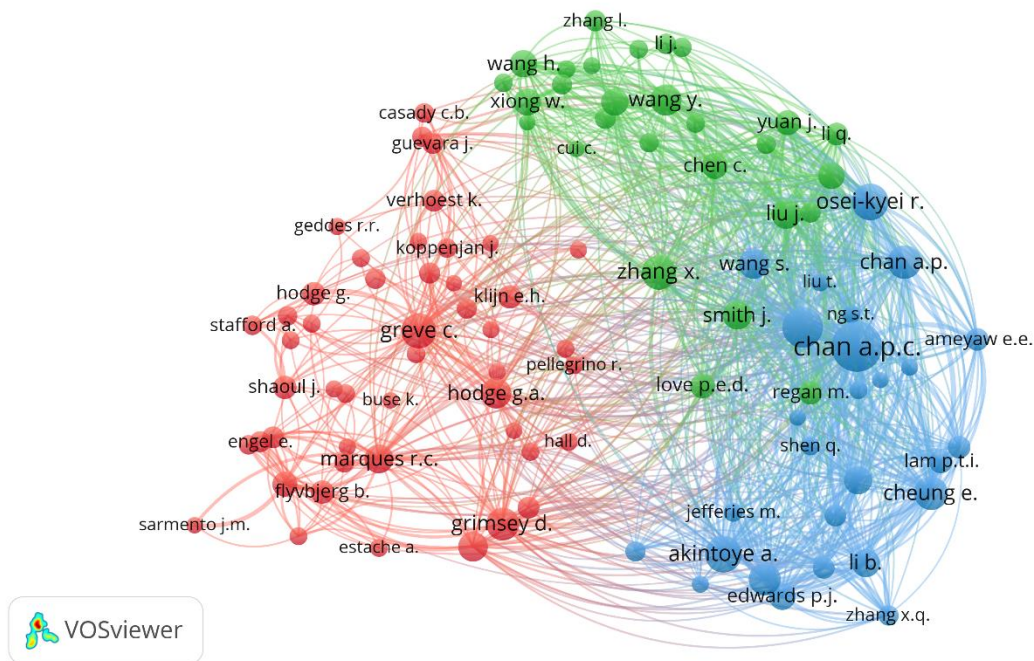


Figure 4. Author Collaboration Visualization

Source: Data Analysis, 2025

This co-authorship network visualization illustrates the collaborative structure among leading scholars in the field of Public-Private Partnerships (PPPs) in infrastructure development. Each node represents an author, with the size indicating the number of publications or citations, and the links showing co-authorship ties. The network is divided into three primary clusters: the red cluster represents Western-based scholars such as Grimsey D., Hodge G.,

and Greve C., who are known for governance and critical policy analyses of PPPs; the green cluster includes predominantly East Asian researchers like Zhang L., Wang H., and Li J., focusing on PPP implementation and performance in Chinese contexts; while the blue cluster features scholars such as Chan A.P.C., Cheung E., and Akintoye A., recognized for their contributions to PPP success factors, risk management, and construction project frameworks.

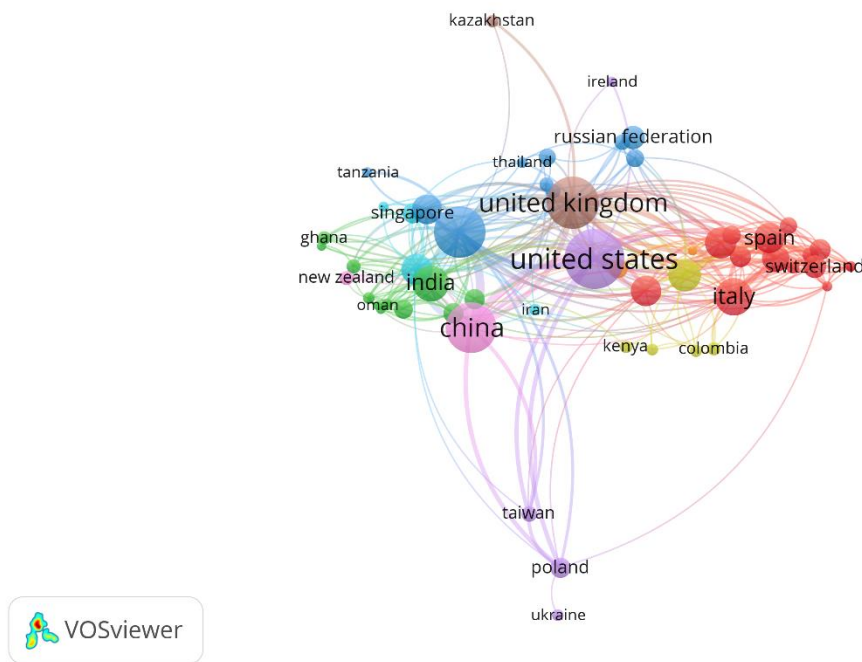


Figure 5. Country Collaboration Visualization

Source: Data Analysis, 2025

This country co-authorship visualization maps the geographical collaboration patterns in the global literature on Public-Private Partnerships (PPPs). Larger nodes such as United States, United Kingdom, and China signify their leading roles in publication output and international research influence. The thickness of the connecting lines illustrates the intensity of co-authorship between countries—most notably between the United States and the United Kingdom, reflecting a strong transatlantic research

partnership. Regional clusters emerge, with India, Singapore, and China forming an active Asian network, while Spain, Italy, and Switzerland represent a prominent European collaboration hub. Notably, countries like Kenya, Ghana, and Tanzania also appear in the network, indicating increasing contributions from developing nations, often in collaboration with more research-intensive countries.

4.3 Citation Analysis

Table 2. Top Cited Research

Citations	Authors and year	Title
610	[25]	Critical success factors for PPP/PFI projects in the UK construction industry
586	[26]	Review of studies on the critical success factors for public-private partnership (PPP) projects from 1990 to 2013
554	[3]	Critical success factors for public-private partnerships in infrastructure development
391	[27]	Public-private partnerships: Perspectives on purposes, publicness, and good governance
386	[28]	Public-private partnerships: From contested concepts to prevalent practice
331	[29]	Critical success factors for PPPs in infrastructure developments: Chinese perspective

Citations	Authors and year	Title
288	[30]	A review of emerging trends in global PPP research: analysis and visualization
228	[31]	Role of public private partnerships to manage risks in public sector projects in Hong Kong
212	[32]	Governing public-private partnerships for sustainability: An analysis of procurement and governance practices of PPP infrastructure projects

Source: Scopus, 2025

Discussion

1. Thematic Clustering and Core Research Domains

The keyword co-occurrence map identifies three dominant thematic clusters. The first cluster, centered around the term public-private partnership, includes related keywords such as infrastructure, infrastructural development, urban development, and economic development. This cluster reflects the foundational focus of PPP research: the practical application of partnerships to address public infrastructure needs, especially in urbanizing contexts. The consistent co-appearance of governance approach and government within this cluster underscores the central role that institutional frameworks play in shaping PPP outcomes. These themes dominate early literature and remain relevant today, particularly in emerging economies seeking alternatives to sovereign debt for infrastructure financing.

The second cluster is financial and managerial in nature, comprising keywords such as finance, investments, budget control, project management, and mergers and acquisitions. This group reflects a maturing research interest in the financial architecture of PPPs and the risks and incentives that drive private sector participation. Over time, scholarly work has moved beyond generic support for PPPs and now probes their underlying financial viability and long-term sustainability. The inclusion of privatization also highlights ongoing debates over the ideological orientation of PPPs—whether they represent strategic partnerships or stealth mechanisms for privatizing public goods.

The third cluster, colored green in the co-occurrence map, encompasses themes related to sustainable development, risk assessment, decision making, and sector-specific applications such as agriculture and public health. This demonstrates a shift in research toward broader impact assessments, with growing concern for environmental and social dimensions. The presence of strategic environmental assessment and stakeholder reflects calls for more inclusive and accountable partnership processes. The cluster's diversity suggests that PPPs are increasingly understood not just as economic instruments, but as vehicles for achieving long-term policy goals such as the Sustainable Development Goals (SDGs).

2. Temporal Trends in Keyword Evolution

The overlay visualization of average publication years offers insight into how research focus has shifted over time. Core concepts such as public-private partnership, infrastructure, and infrastructural development appear in lighter green to yellow hues, indicating their continued centrality into the later years of the dataset (2017–2018). In contrast, keywords like sustainable development, public policy, and strategic environmental assessment show darker blue tones, indicating they emerged earlier and have since become integrated into the mainstream.

Interestingly, keywords such as project management, budget control, and investments appear in more recent years, suggesting an ongoing shift toward applied research focusing on PPP execution and governance performance. This trend may

reflect the growing professionalization and institutionalization of PPPs globally, as governments move from experimentation to optimization. Moreover, the appearance of keywords related to specific sectors (e.g., agriculture, public health, plant protection products) indicates expanding use cases for PPPs beyond conventional infrastructure, into domains concerned with social development and food security.

3. Density and Centrality of Research Themes

The density visualization reinforces the thematic analysis by illustrating where research activity is most concentrated. Unsurprisingly, public-private partnership appears as the densest and most frequently occurring term, positioned centrally in the map. Surrounding this are high-density terms like infrastructure, economic development, sustainable development, and risk assessment. This suggests that these topics are not only frequently discussed but also interlinked, forming the conceptual backbone of PPP scholarship. Terms like mergers and acquisitions, project management, and finance also appear in moderate-to-high density areas, reflecting their importance in operationalizing PPPs. The relatively lower density of keywords such as plant protection products, agriculture, and public health indicates that while these represent growing areas of interest, they remain peripheral in terms of publication volume. Nonetheless, their presence in the network signals an important evolution toward more diversified and context-specific PPP applications, particularly in response to global challenges such as climate change and pandemics.

4. Author Networks and Knowledge Communities

The co-authorship map reveals a vibrant and globally distributed network of scholars engaged in PPP research. Three main clusters are identifiable: one led by Western scholars such as Grimsey, Greve, and Hodge who have contributed extensively to governance and policy analysis; another

formed by Asian scholars including Li, Wang, Zhang, and Liu, whose work emphasizes PPP implementation and infrastructure performance; and a third cluster represented by figures like Chan A.P.C., Cheung E., and Akintoye A., who have developed empirical models on risk sharing, success factors, and stakeholder engagement. Notably, Chan A.P.C. functions as a bridge between multiple clusters, suggesting his role in fostering interdisciplinary and cross-regional collaboration. This reflects the increasing globalization of PPP research, where theoretical and empirical insights from one region inform practices in another. The collaborative structure also implies the formation of “knowledge communities” with shared methodologies, assumptions, and policy concerns. These communities contribute to a richer and more pluralistic understanding of PPPs across different institutional contexts.

5. Global Research Collaboration and Regional Representation

The country co-authorship map sheds light on the geopolitical dynamics of PPP research. The United States and United Kingdom emerge as central actors, both in terms of volume and interconnectivity, often serving as research hubs that collaborate with a wide range of countries including China, India, and various European and African nations. The prominence of China and India as individual contributors also reflects their growing influence in shaping global infrastructure discourse, particularly through large-scale initiatives like the Belt and Road Initiative (BRI) and public service reforms in South Asia. Interestingly, countries such as Spain, Switzerland, and Italy form a distinct European cluster, whereas Singapore, Oman, New Zealand, and Tanzania show active participation from smaller or emerging economies. This suggests a diffusion of PPP scholarship beyond traditional academic powerhouses and into regions where PPPs are being actively implemented. It also highlights a strong international appetite for comparative PPP research and knowledge

exchange across diverse political and institutional settings.

6. Implications and Future Research Directions

The bibliometric findings offer several implications for future PPP research. First, there is a need for deeper integration between financial and social perspectives. While risk management and value-for-money assessments are well studied, there is less emphasis on long-term public value and equity outcomes. Second, interdisciplinary research that bridges engineering, economics, policy, and environmental sciences is essential to tackle the growing complexity of PPPs. Third, regional case studies, particularly from underrepresented areas such as Africa and Southeast Asia, could help diversify the empirical base and reveal new forms of innovation. Moreover, the growing appearance of keywords related to agriculture, health, and environmental sustainability suggests that future PPP research should broaden its scope to include social infrastructure and sustainable service delivery. Finally, enhanced methodological rigor, through mixed-methods approaches, longitudinal analysis, and participatory research designs can improve the relevance and applicability of scholarly insights to real-world policy and practice.

5. CONCLUSION

This bibliometric review has provided a comprehensive mapping of the intellectual landscape of Public-Private Partnership (PPP) research in infrastructure development, revealing key thematic clusters, temporal trends, influential authors, and global collaboration networks. The analysis highlights how PPP studies have evolved from foundational concerns with infrastructure delivery and governance toward more nuanced explorations of financial structuring, risk assessment, and sustainability. The integration of environmental and social considerations, alongside traditional economic perspectives, reflects the growing complexity and policy relevance of PPPs in addressing global infrastructure challenges. Prominent scholars and countries have shaped the discourse through robust international collaboration, yet emerging economies are increasingly contributing to and diversifying the research agenda. Moving forward, scholars should prioritize interdisciplinary approaches, equity-focused evaluations, and comparative insights to support the design of PPPs that are not only efficient but also inclusive and resilient.

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