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Are public–private partnerships still an answer for social infrastructure? A systematic literature review

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Abstract Social infrastructure has become an important element for measuring national economic development and social benefits that are usually financed in the form of government grants, private investment, and public–private partnerships (PPPs). However, social infrastructure PPPs have attracted considerable public debate due to their low profitability and complex operational demands. This study aims to answer the question, “are PPPs still an answer for social infrastructure?”, from the perspectives of the body of knowledge, application status, and prospects. Initially, an iterative search and review procedure and a scientometric analysis were performed to systematically screen the literature and to structure the body of knowledge of the social infrastructure PPPs literature. Furthermore, the application status and trends were analyzed to further explore the studied countries/regions, application sectors, and research topics. Results show that PPPs still have valuable application potential for delivering social infrastructure despite their mixed results across different topics. Six main research themes and the corresponding research trends were also identified, namely, financing and economics viability, risk management, performance management, contract and relationship management, governance and regulation, and facilitating and hindering factors. These findings offer practitioners and researchers a comprehensive overview and constructive guidance on social infrastructure PPPs.

Keywords public–private partnerships, social infrastructure, scientometric analysis, systematic review

1 Introduction

With the increasing demand for infrastructure and the limited national budget, the public sector is expected to cooperate with the private sector to finance and deliver infrastructure (Jefferies and McGeorge, 2009). Traditional public procurement is generally unsustainable because the implementation of projects requires extensive capital, and new approaches to address the increasing demand for social infrastructure are necessary to release the continual social pressure on the economy. Public–private partnerships (PPPs) are considered an appropriate procurement method to address the increasing demand for social infrastructure (Matraeva et al., 2016). PPPs have become increasingly popular over the last three decades and have been proven effective in most countries for delivering infrastructure projects (Roehrich et al., 2014). Babatunde et al. (2016) found that PPPs can improve the sustainability of public services and the efficiency and availability of resources for several social infrastructure projects.

The World Bank (1994) classified infrastructure into economic and social infrastructure. Economic infrastructure refers to the facilities and services that facilitate the achievement of economic development targets (Cui et al., 2018). Roads, bridges, railways, and water facilities are some examples of economic infrastructure projects. According to the Queensland Department of Infrastructure and Planning (2009) of Australia, social infrastructure refers to “the community facilities, services and networks that help individuals, families, groups and communities meet their social needs and maximize their potential for development, and enhance community wellbeing”. Table 1 presents some social infrastructure examples in detail.

In social infrastructure PPP projects, the private sector obtains and retains long-term control during the concession

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Table 1 Examples of social infrastructure

No.	Sector	Example	Literature source
1	Education	School	NZSIF (2009)
2	Healthcare	Student accommodation	
3	Housing	Hospital	Gilmour et al. (2010);
		Primary care center	Mercille (2019)
4	Sport	Public housing	Liu et al. (2017);
		Public rental housing	Yuan et al. (2017)
5	Military	Affordable housing	
6	Corrections and Justice	Stadium	Ke (2014)
7	Arts and Cultural Facilities	Defense force housing	NZSIF (2009)
		Prison	Yong (2010)
		Court	
		Library	Gilmour et al. (2010);
		Museum	Levey et al. (2020)
		Park	

period and takes responsibility for the design, construction, operation, management, maintenance, and financing until delivery. Compared with complete public ownership or privatization, the participation of social sectors can help address the needs of social infrastructure, transform government functions, reduce financial burden, promote the diversification of investment subjects, realize risk sharing, and improve operational efficiency (Chou and Pramudawardhani, 2015).

Market expansion and profit maximization are the main potential intentions and incentives for the private sector to invest in social infrastructure (Onyemaechi and Samy, 2016). The return on investment will be paid via government payments or subsidies and user charges (Alfen et al., 2009). Ye et al. (2018) used the logistic regression model and performed a questionnaire survey to find out the participation willingness of the private sector includes profitability, political connections, government intervention, and government support. They found that companies with higher profitability and more political relations are more likely to participate. Kavishe and Chileshe (2018) studied the motivational factors of the housing sector, including lack of capital, benefit of economies of scale, increasing revenue, and competition from other investors. In addition, reputation and social responsibility drive the private sector to participate and may have a positive social impact.

Whether PPPs can improve the performance of social infrastructure projects has been widely debated. Rodrigues and Zucco (2018) compared the performance of PPP schools and traditional procurement contracting in Belo Horizonte, Brazil and found that PPP schools outperform the other schools in most outcomes. Bastani et al. (2019) analyzed the main indicators of the Iranian Hasheminejad Hospital before and after implementing PPPs and argued that implementing PPPs can be considered a successful experience. Ferreira and Marques (2021) studied the quality and availability of Portuguese healthcare services and concluded that PPP hospitals can deliver medical service levels that are at least equivalent to those of public hospitals in terms of social performance. However,

social infrastructure PPP projects are not always desirable. Henjewe et al. (2014) compared the performance of healthcare and transport PPP projects from the strategic business case stage to the operational phase and found that PPP projects still have considerable cost and time overruns and demand changes in both sectors. The healthcare sector also outperforms the transport sector in terms of time performance but not in cost performance. Dharmapuri Tirumala et al. (2021) explored PPP and traditional schools in Melbourne and found no substantial difference in their performance. Similarly, the New Karolinska Solna PPPs hospital in Sweden faced a scandal due to massive operational problems and cost overruns (Waluszewski et al., 2019). Therefore, whether PPPs are the answer to social infrastructure is an important and necessary question worth studying.

Social infrastructure PPPs have low profitability and complex operational demands. Therefore, the private sector has no incentive to participate (Jefferies and McGeorge, 2009). The mixed performance of past social infrastructure PPP projects leads to the research question: Are PPPs still an answer for social infrastructure? To date, no study has addressed this question. To fill this gap, this study aims to fulfill two objectives. First, from literature research dimension, an overview of publication trends, co-occurrence of keywords, co-authorship analysis, and citation analysis of sources in the literature is characterized via scientometric analysis, which aims to analyze the general features of the social infrastructure PPP literature. Second, in terms of practical application, this study further investigates the application status and trends from the perspectives of the studied countries/regions, application sectors, and research topics. The comparison between developed and developing countries aims to explore the gaps and pave the way for the latter. The objectives of application sectors are to determine the status and challenges faced by major application departments, whereas the research topics are summarized to identify the research results and directions of different dimensions of social infrastructure PPPs. All the above aspects attempt to answer the core question.

This study begins by presenting the objective background of previous social infrastructure PPPs and raising the research question. Afterward, the research methodology, which involves the iterative search and review procedure, scientometric analysis, and systematic review, is described. The research results, including the body of knowledge and application status and trends of social infrastructure PPPs, are then discussed. The paper concludes by presenting the main conclusions and suggestions for future research.

2 Literature review

The value of PPPs in social infrastructure projects

remains controversial. Solheim-Kile et al. (2019) identified three significant benefits of social infrastructure PPPs based on agency theory, namely, merging public- and private-sector interests to create synergies, gaining relational benefits, and partly transferring the operation and maintenance risk to the design phase. Oktavianus et al. (2018) argued that social infrastructure PPP projects have low risk and have direct revenue streams from the public sector. However, some scholars propose that the private sector increases the cost of capital in social infrastructure PPPs to avoid risks. Adamou et al. (2021) proposed three criticisms of the Private Finance Initiative (PFI), including excessive pursuit of off-balance-sheet, relatively few benefits for the private sector compared with borrowing costs, and potentially high professional fees. Barretta and Ruggiero (2008) argued that PPPs are not more advantageous than traditional public financing. Some scholars also claim that compared with non-PPP hospitals, the construction quality of PPP hospitals is not unambiguously better, and the value for money (VFM) of facilities management services is actually lower (Liebe and Pollock, 2009). Acerete et al. (2015) found no evidence to infer that PPPs provide the claimed low-cost benefits while maintaining a sustainable quality. Hurst and Reeves (2004) analyzed the contracts for five secondary schools in Ireland and claimed that the PPP mechanism does not bring significant innovations.

On the basis of these findings, many scholars have explored different strategies to improve social infrastructure PPP projects. Liu et al. (2017) adopted confirmatory factor analysis to develop a stakeholder-oriented performance measurement framework and demonstrated its potential to evaluate the performance of social infrastructure PPP projects. Simon et al. (2020) established a theoretical success framework from the perspective of “organization, process, and people” for the tendering phase to reduce complexity and achieve VFM. Matraeva et al. (2016) summarized eight models of social infrastructure PPPs, including concession agreements, life cycle costs (LCC), project financing, forfeiting models, attracting nonprofit organizations, service provision contracts (outsourcing), social service provision contracts, and property lease agreements and concluded that project financing, LCC, and the forfeiting model are the most promising models. O’Shea et al. (2020) retrospectively studied the buildings in Ireland’s school sector and highlighted accountability and transparency as two obstacles that influence the development of school PPPs. Sastoque et al. (2016) identified three constraints, namely, the lack of clear legislation, the uncertainty of risk allocation, and financial feasibility, that prevent some developing countries from implementing social infrastructure PPPs.

Previous reviews are limited to the entire construction industry or particular sectors and do not focus on social infrastructure. Tang et al. (2010) reviewed the literature on PPPs in construction from 1998 to 2007 and proposed

further research trends, including risks, financing, contractual agreements, development of PPP models, concession periods, and strategies in choosing the right type of PPP. Ke et al. (2009b) analyzed PPP articles from 1998 to 2008 and identified 7 research categories that involve many topics. Cui et al. (2018) performed a three-phase word frequency analysis and cluster analysis to analyze PPP studies from 1990 to 2016 and demonstrated that social infrastructure is more immature and far from extensive in PPP applications compared with economic infrastructure. Ma et al. (2019) adopted bibliometric analysis and systematic review to review the PPP literature published from 2008 to 2018. Torchia et al. (2015) identified six main research issues for healthcare PPPs, i.e., effectiveness, benefits, country overview, public interest, partners, and efficiency. However, no previous study has attempted to explore whether PPPs are the answer to social infrastructure projects despite their increasing importance, potential benefits, and growing interest.

After approximately three decades of PPP implementation, this is an opportune moment to review the procurement approach (Jefferies and McGeorge, 2009) and to conduct a systemic literature review to identify the contemporary research status and development prospects of PPPs.

3 Methodology

An iterative search and review procedure (Roehrich et al., 2014) was initially performed to obtain and filter the social infrastructure PPP literature published from 1990 to 2021. A scientometric analysis was then performed to visualize the co-occurrence keywords, scholars, and sources. A systematic review was further conducted to explore the studied countries/regions, application sectors, and research topics.

3.1 Iterative search and review procedure

The iterative search and review procedure involved identifying keywords, selecting databases, and screening articles. The comprehensive keywords search included PPPs- and social-infrastructure-related keywords as shown in Table 2. The PPP typologies used in this study were retrieved from Song et al. (2016), Cui et al. (2018), and Wang et al. (2018) and were used as the first part of the search string. Application examples of social infrastructure were then used as the second part of the search string to ensure the rationality of the selected keywords. The search string was then applied in Scopus, which covers a wider spectrum of journals and articles on infrastructure compared with Web of Science (Falagas et al., 2008). Scopus has also been used as the primary source of data in many mainstream journal articles centered on project management (Zhao et al., 2022).

Table 2 Retrieved keywords

	Keyword	Source
PPPs related	public private partnership; private finance initiative; build operate transfer; build own operate transfer; build transfer; build own operate; build lease transfer; transfer operate transfer; renovate operate transfer; design build finance operate; public private partnerships; design build finance maintain; design build finance operate maintain; private finance initiatives; transfer-operate-transfer; build transfer own; reconstruct operate transfer	Song et al. (2016); Cui et al. (2018); Wang et al. (2018)
Social infrastructure related	social infrastructure; hospital; healthcare; school; education; prison; social housing; public housing; public security; defense; elder care; elderly care; court; health; sports; aged care; museum	Gilmour et al. (2010); Liu et al. (2017); Ye et al. (2021)

An example search string is shown as follows:

TITLE-ABS-KEY (“public private partnership” OR “private finance initiative” OR “build operate transfer” OR “build own operate transfer” OR “build transfer” OR “build own operate” OR “build lease transfer” OR “transfer operate transfer” OR “renovate operate transfer” OR “design build finance operate” OR “public private partnerships” OR “design build finance maintain” OR “design build finance operate maintain” OR “transfer-operate-transfer” OR “private finance initiatives” OR “build transfer own” OR “reconstruct operate transfer”) AND TITLE-ABS-KEY (“social infrastructure” OR “hospital” OR “healthcare” OR “school” OR “education” OR “prison” OR “social housing” OR “public housing” OR “public security” OR “defense” OR “elder care” OR “elderly care” OR “court” OR “health” OR “sports” OR “aged care” OR “museum”).

An iterative selection procedure was then applied to determine a final sample of literature before filtering out irrelevant articles. First, this study used the abovementioned search string to retrieve articles from Scopus that were published from 1990 to 2021. The results were limited to journal articles published in English. Books, reviews, editorials, and conference papers were also excluded to obtain higher-quality information (Zhao, 2017). A total of 4279 documents were retrieved. At the second stage, those publications that did not focus on PPPs or PPPs-related issues were filtered out by reading their titles and abstracts. For example, some articles only mentioned rather than studied PPPs. At the third stage, those articles related to PPPs that did not fall within the scope of social infrastructure were filtered out by reading their full text. The literature was selected based on the synthesis of multiple opinions. Specifically, an article was excluded when all three authors agreed that it was not suitable for the research. In case of inconsistent opinions among these authors, another author would organize a cross-check discussion to decide whether the article in focus should be included or excluded from the study. A total of 234 bibliographic samples were eventually retained for subsequent scientometric analysis and systematic review.

3.2 Scientometric analysis

Scientometric analysis is conducive to building a body of

knowledge of the social infrastructure PPP literature. Scientometrics is defined as the “quantitative study of science, communication in science, and science policy” (Vezyridis and Timmons, 2016). This process involves measuring the impact, assessing journals and institutes, analyzing citations, and mapping scientific fields (Pereira et al., 2021b) to identify potential content and trends (Zhao, 2017). This study offers an objective and relatively accurate perspective by choosing quantitative scientometric analysis to review bibliographical elements.

VOSviewer was used in the scientometric analysis given its ability to map knowledge domains and its basic functions for producing, visualizing, and exploring the scientometric networks and densities of frequent terms and journals (Vezyridis and Timmons, 2016). The metric data exported from Scopus to VOSviewer were then analyzed and synthesized to visualize the author co-citation, keyword co-occurrence, and citation of documents and sources.

3.3 Systematic review

The scientometric analysis uses quantifiable bibliometric data for the quantitative analysis, whereas the systematic literature review follows a rigorous screening and analysis process for the qualitative content analysis. The systematic literature review was initially applied in the medical and healthcare fields before being applied in the organization and management fields over the past two decades (Aarseth et al., 2017). This process not only synthesizes the existing body of knowledge and identifies future research trends (Xia et al., 2018) but also reduces the likelihood of bias by using a predefined, transparent, and replicable methodology (Kitchenham and Charters, 2007) compared with other traditional and less systematic approaches. After reading the sample papers, the application countries/regions, sectors, and topics were summarized. Six main categories were then identified to present the information in a structured manner and to identify future research trends.

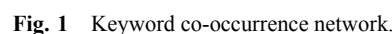
4 Results and discussion

4.1 Co-occurrence of keywords

After the iterative search and review procedure, the

Node size represents the frequency of keywords in the dataset, and the node color is determined by the year when a keyword occurs the most. The main keywords for each period are also presented. The 5 keywords with the highest occurrences include “PPPs” (occurrences = 128), “PFI” (occurrences = 35), “risk management” (occurrences = 16), “healthcare” (occurrences = 12) and “social infrastructure” (occurrences = 12). These results suggest that 1) the frequency of PFI is higher than other typologies of PPPs, that is, PFI is the dominant procurement method in UK, which has the most extensive PPP implementation experience in the world; 2) risk management is the highest topic keyword with a purple node color, which suggests that risk management has emerged earlier and received

Apart from analyzing the co-occurrence of keywords, scientometric analysis was applied to explore the publication trends, co-authorship, and citation of sources. Two periods can be summarized according to the annual publication frequency shown in Fig. 2. First, the publications from 1998 to 2006 present a fluctuating trend rather than a significant increase. Second, the publications reveal a rapid and sustained growth from 2007 to 2021, peaking in 2021 with 26 articles. The growth trend reflects that social infrastructure PPPs have attracted active scientific discourse and increasing scholarly attention and research value. This result is consistent with the findings of Cui et al. (2018) and Ma et al. (2019), who argued that social infrastructure PPPs have received less research attention and are more immature in PPP experience compared with economic infrastructure projects. Meanwhile, the co-authorship network is relatively scattered. The largest cluster included Mark Hellowell, Allyson M. Pollock, and Veronica Vecchi, who mainly focused on the hospital infrastructure of UK and Italy. In the citation analysis, the most published journal was *Public Money and Management* with 15 studies, followed by *Journal of Management in Engineering*, *Public Works Management and Policy*, *Built Environment Project and Asset Management*, and *International Journal of Project Management*. Such diversity of journals reflects the penetration, integration, and intersection of social infrastructure



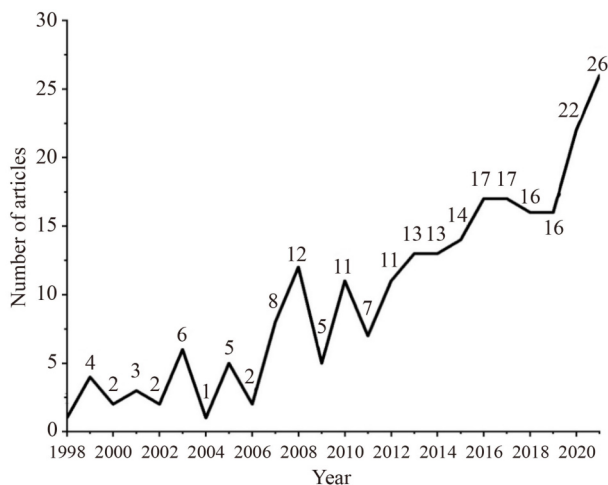


Fig. 2 Number of publications per year from 1998 to 2021.

PPPs with other disciplines.

4.2 Application status and trend analysis

Adopting a visual software for scientific citation analysis is far from sufficient, and conducting in-depth studies and considering other perspectives are more important. Therefore, this study further explores the application status and trends by analyzing the countries/regions, sectors, and topics of social infrastructure PPPs to understand the gaps between developed and developing countries, the status and challenges faced by major application departments, and the research results and directions for different topics.

4.2.1 Studied countries/regions

Nineteen journal publications were excluded because they did not specify any country or region throughout the full text. The remaining 215 publications mainly come from 43 countries/regions, and the top 10 countries studied are shown in [Fig. 3](#). The top 5 countries are UK, Australia, China, Italy, and US, which have made substantial contributions to the development of social infrastructure PPPs. Numerous journal publications also suggest that these countries have made some progress in social infrastructure PPP research and are relatively active PPP markets.

Each country faces a unique situation in applying social infrastructure PPPs. First, these countries differ in their commonly applied models and contract duration due to their cultural, economic, and political backgrounds ([Grimsey and Lewis, 2002](#)). For example, PPP hospitals in UK often adopt the PFI model with a 40-year concession period involving non-core services. However, Spain often adopts the ALZIRA model with a 15- to 20-year concession period to provide both core and non-core services ([Sadeghi et al., 2016](#)). Second, developed countries, such

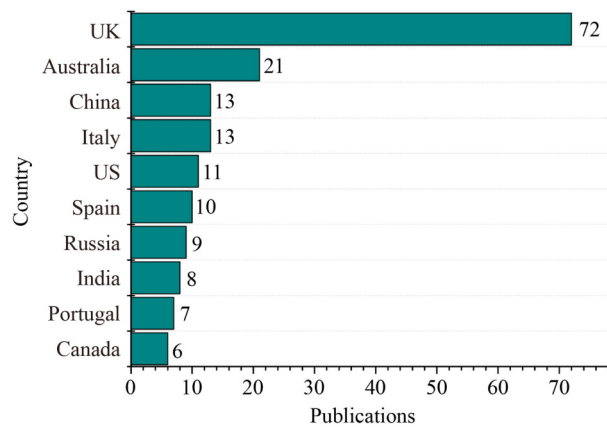


Fig. 3 Top 10 studied countries/regions.

as UK, may have developed relatively complete PPP project management processes and regulatory systems ([Oktavianus et al., 2018](#)), whereas developing countries are still lagging behind. Third, these countries have different financing sources and payment mechanisms. Most of them rely entirely on bank loans, whereas others also rely on pension funds. Their payment mechanisms also exhibit differences due to the different degrees of privatization of their public infrastructure. For instance, UK adopts a government payment model that is linked to the availability of assets, performance, and quality of services ([Boussabaine, 2006](#)), whereas China sometimes charges users for a small proportion of its projects. However, both developed and developing countries face some common problems. For example, off-balance sheet financing obscures the issue of government debt ([Adamou et al., 2021](#)), and long-term financing feasibility must be further studied. The financing mechanisms of their social infrastructure PPP projects also need to be innovated and should not only rely on bank loans. This study discusses the development of social infrastructure PPPs in UK, Australia, Canada, China, and India.

As one of the primary countries leading to the emergence of the PPP concept, UK introduced PFI in 1992 to attract more private sectors and help address infrastructure shortages. Due to excess returns, inflexible contracts, and non-transparent information of PFI, UK proposed the Private Finance 2 (PF2) model in 2012 to address these problems. However, the PF2 model was no longer used for infrastructure and public service procurement. UK was regarded as one of the most attractive markets in the world because of its friendly investment environment, open property rights, and effective judicial system ([Oktavianus et al., 2018](#)). PPPs are mainly concentrated in public services, with education and healthcare infrastructure accounting for 55.2% of all PPP projects ([Cheng et al., 2020](#)). However, for China and India, social infrastructure only accounts for a small proportion of all PPP projects.

Australia also has many years of experience in successfully applying PPP models and is widely recognized for its mature PPPs. Most infrastructure PPP projects in Australia are implemented by state governments instead of the federal government. The guidance document issued by Australia provides two sets of risk lists and offers suggestions for the construction of economic and social infrastructure. Social infrastructure PPPs accounted for the majority of the PPPs in the country from 2000 to 2013, with transportation PPPs recently becoming prominent (Gleeson et al., 2019). Almost all social infrastructure PPP projects in the country are fully funded by government grants that pay for service fees each quarter.

Canada is also among the most popular and mature countries in the PPP market. Canada carried out a significant expansion of its infrastructure and public buildings between the 1950s and 1970s to establish a lasting infrastructure network. However, with the aging of equipment and technological progress, the demand for social infrastructure in the country has changed. PPPs in Canada are mainly used to build and update social infrastructure. Canada also has a unique PPP model for pension fund investment. The participation of well-funded institutional investors has provided a large amount of low-cost funds for PPP projects and obtained long-term stable investment returns. As of June 2020, according to Canada Center of Public–Private Partnership, Canada has 290 PPP projects, with healthcare and education infrastructures accounting for 32.1% and 4.5%, respectively.

China has a substantial PPP market, but its social infrastructure is generally lacking. In response to the 2008 Beijing Olympic Games, the Wenchuan earthquake, and the Spring Festival transportation crisis, the Chinese government started to vigorously promote infrastructure construction, earning the label “infrastructure maniac”. In response to the tremendous financial pressure brought about by extensive infrastructure investments to the government, China intensively introduced PPP policies to encourage private sector participation after 2014, which led to an increase in its PPP projects. A total of 7714 PPP projects were signed from 2014 to January 2022, with a total investment of 12.8 trillion yuan. These recent trends point toward PPPs being extensively used in China for delivering infrastructure. However, most of these infrastructures are for the transportation sector, and social infrastructure PPP projects in China started relatively late. In fact, only 515 (5.0%), 244 (2.4%), and 199 (1.2%) of all PPP projects in China are reserved for education, healthcare, and sports, respectively.

India introduced and developed PPPs earlier than other developing countries and is known for having the largest infrastructure PPP projects in South Asia (World Bank, 2021). Following its economic reforms in 1991, India continued to expand its economy rapidly. However, the country lagged behind its peers in terms of infrastructure construction. In its 11th Five-Year Plan, India focused

on a large number of PPP infrastructure projects that concentrated in the transportation and energy sectors (Gupta and Verma, 2020). One characteristic of the Indian PPP market is internationalization, and its proportion of foreign investments is higher than that of other countries. India has four PPP application fields, namely, transport, energy, water sanitation, and social and commercial infrastructure. Similar to China, the proportion of social and commercial infrastructure PPP projects in India is small at only 9.56% (Cheng et al., 2020).

The application of social infrastructure PPPs is an increasingly significant international phenomenon that remains nascent, especially in developing countries. The development of social infrastructure PPPs should be comprehensively considered to meet the increasing demand. Furthermore, the private sector must integrate the laws and practices of the country where the project is located in some transnational social infrastructure PPP projects and should not blindly follow routine construction to avoid project failures.

4.2.2 Application sectors

Consistent with the previous co-occurrence analysis of author keywords, hospitals are the most popular sector, followed by schools and housing. PPPs are also applied in sports, prisons, the military, and parks with comparatively small percentages. This study will focus on the hospital, school, and housing sectors. Their application range or models and challenges are summarized in Table 3.

• **Hospital PPPs.** Governments around the world are deeply concerned about booming healthcare expenses and decreasing governmental budgets due to aging populations, medical technological developments, and policy changes (Torchia et al., 2015). Public hospitals account for a large share of the market, but the lag in infrastructure, equipment, and facilities has always hindered the development of the healthcare industry. Privatization and PPPs are two typical routes for private sectors to invest in hospitals. Nevertheless, critics believe that privatization and welfare economic theory are contradictory (Yang et al., 2020). Therefore, implementing hospital PPPs seems imperative and inevitable because PPPs are conducive to allocating risk, improving efficiency, alleviating capital shortages in the public sector, and reducing fiscal and public pressures.

Among the three models of hospital PPPs classified by Wang et al. (2019), the most commonly applied is model 1, which has been implemented in UK, Italy, Canada, and other European countries. Spain and Portugal have adopted the other two models. Government payments, user fees, and government subsidies are three common payment mechanisms (Barrios-Ipenza et al., 2020).

The challenges affecting the development of hospital PPPs are as follows. First, hospitals have a high degree of

Table 3 Models of and challenges faced by different sectors

Sector	Range/Model	Challenge	Main reference
Hospital	1) Infrastructure and/or soft facilities; 2) Infrastructure, soft facilities, and clinical services; 3) Infrastructure, soft facilities, clinical services, and primary health care services	Architectural complexity; Whether the private sector participates in core clinical services	Froud and Shaoul (2001); Shaoul et al. (2008); Wang et al. (2019); Moro Visconti et al. (2019)
School	1) Asset creation and asset maintenance; 2) Asset creation, asset maintenance, and academic activities	Whether PPPs are beneficial to teaching quality; Content development of user charges	Reeves (2008); Khadaroo (2008); Wang et al. (2012); Sundaram and Mishra (2014)
Housing	1) Build-operate-transfer; 2) Build-operate-own	Proportion of government investment or subsidy and pricing strategy; Low occupancy rate; Political instability	Sengupta (2006); Abdul-Aziz and Jahn Kassim (2011); Wang et al. (2014); Kwofie et al. (2016)

architectural complexity. The future pattern of healthcare and its consequent demand on hospital buildings are unpredictable (Oktavianus et al., 2018). For example, New Karolinska Solna was built as general architecture with extensive reconstructions and adaptations that had seriously affected its cost and duration (Waluszewski et al., 2019). These problems pose a serious challenge, especially in the construction of smart hospitals. Second, the participation of the private sector in core clinical services remains a controversial topic (Monaghan et al., 2001). Many participants argue that PPPs are the most appropriate mechanism for the provision of clinical and non-clinical services according to Sadeghi et al. (2020), whereas others argue that only non-clinical and support services should be included in such partnerships. Pereira et al. (2021a) believed that allocating clinical services to the private sector is not advisable due to its high variability and complexity.

• **School PPPs.** School PPPs may involve asset creation, asset maintenance, and academic activities (Sundaram and Mishra, 2014). Asset creation aims to construct buildings, including classrooms and hostels. Asset maintenance maintains the created asset and delivers non-core services. Academic activities refer to core educational services involving teaching and conducting examinations, among others. The private sector often undertakes asset creation and asset maintenance because academic activities may threaten academic autonomy.

Many scholars have conducted comparative studies on school performance under PPPs and traditional procurement. Rodrigues and Zucco (2018) concluded that PPP schools outperform traditional schools in most categories. Meanwhile, Yaya (2017) revealed that PPP schools outperform conventionally financed schools in terms of construction conditions and maintenance standards, but the opposite is observed in terms of teacher access and improvement in staff morale. Carpintero and Siemiatycki (2015) found that PPP schools in Madrid provide not only infrastructure but also education services, both of which have been proven successful. Future studies can further explore the potential benefits of PPPs to teaching quality and the content of user charges that help achieve financing and economic viability.

• **Housing PPPs.** Housing is critical to sustainable development and is considered a social infrastructure component that serves an important material basis for people's life and development. Compared with other sectors such as hospitals and schools, housing investment value, transaction volume, and the application of housing PPPs are limited and context specific (Yuan et al., 2012). Build-operate-transfer and build-operate-own are the two most frequently used PPP models. In the former, the private sector is responsible for the construction and operation of projects. After the expiration of a contract, the government will recover the project assets and rights. Meanwhile, in the latter, the private sector takes ownership of the housing project and does not need to return the project after the expiration of the contract. Moskalyk (2011) argued that PPPs help provide affordable housing, whereas Batra (2021) identified five themes related to housing PPPs, namely, environmental, financial, structural, contextual, and execution.

Obstacles are present in the development of housing PPPs. First, the expected profit from these PPPs is generally unsatisfactory, thereby making this pursuit unattractive to the private sector (Shi et al., 2019). Government investments or subsidies and other pricing strategies are needed to achieve financial viability when the revenues charged from the end user are insufficient. Second, the low occupancy rates attributed to high rent, cumbersome audit procedures, and insufficient supporting facilities also present a major obstacle during the operation phase. Third, political instability, including the consequences and possibility of government change and withdrawal of support for housing PPP projects, can block the implementation of housing PPPs (Jamali, 2004).

4.2.3 Research topics

Several topics were identified from the literature and grouped into six major categories as shown in Table 4.

• **Financing and Economic Viability.** Financing and economic viability is the most frequently studied theme in the literature, and VFM and affordability are two basic financial criteria that must be satisfied in PPPs.

VFM is defined as “the optimum combination of whole

Table 4 Categories and subcategories identified from the literature

Category	Subcategory	Typical literature	Number
Financing and economics viability	VFM, affordability, economic evaluation, payment mechanism, cost-effective analysis, benefits and cost, cost simulation, refinancing, investment sustainability	Wang et al. (2012); de Marco and Mangano (2013); Cruz and Marques (2014); Solheim-Kile et al. (2019); Dai et al. (2021)	44
Risk management	Risk identification, risk allocation, risk factors, risk mitigation, risk assessment	Broadbent et al. (2008); de Marco and Mangano (2013); Ahmad et al. (2018); Meng et al. (2018)	22
Performance management	KPIs, performance evaluation frameworks, operation performance, performance comparison, stakeholder satisfaction	Yuan et al. (2018); Liu et al. (2018); Saeed et al. (2018); Rodrigues and Zucco (2018); Bastani et al. (2019); Geng et al. (2020)	23
Contract and relationship management	Procurement procedures, contract change, trust, flexible contract, concession period determination	Merrifield et al. (2002); Cruz and Marques (2013a); Abdullah and Khadaroo (2020); Simon et al. (2020)	23
Governance and regulation	Governance structures, regulation, government incentives, legislation, policy, transparency, accountability, bureaucracy and corruption	van Gestel et al. (2014); van den Hurk and Verhoest (2015); Levey et al. (2020); Liu et al. (2021); Stafford and Stapleton (2022)	25
Facilitating and hindering factors	Critical success factors, hindering factors, success or failure experience	Yuan et al. (2012); Ke (2014); Liu and Wilkinson (2015); Kwofie et al. (2016); Alteneiji et al. (2020)	16

life costs and quality” (HM Treasury, 2004) that is measured via quantitative and qualitative evaluations at the precontract stage (Ye et al., 2021). Quantitative analysis usually involves the public sector comparator (PSC) and cost–benefit analysis methods. Cruz and Marques (2014) shared that the calculation of the PSC is greatly affected by different discount rates. Vecchi et al. (2010) conducted a capital budget analysis of the return for Italian healthcare PPP projects using the net present value and internal rate of return. Shi et al. (2019) argued that the net present value and real option value constitute the investment value and built an investment valuation model of a public rental housing PPP project from the real option perspective. PPPs also have insufficient cost efficiency given that private financing is generally expensive (Hellowell and Pollock, 2009) and incurs extra costs that are lower than the benefits derived from PPPs (HM Treasury, 1997). The availability of financial data presents another challenge in the evaluation of PPP projects, and the financial information of many projects is not transparent. For qualitative evaluation, Ye et al. (2021) adopted an analytic hierarchy process to assign reasonable weights to VFM qualitative evaluation indicators of aged care PPP projects. Yaya (2017) argued that conventional schools are appreciably better than PPP schools in terms of overall VFM based on the non-financial information collected from headteachers via questionnaire surveys and interviews. Torchia et al. (2015) identified six determinants of VFM, including risk transfer, the long-term nature of contracts, competition, performance measurement and the use of an output specification, performance measurement and incentives, and private parties’ management skills.

Affordability is another important theme. After the private sector delivers the infrastructure, the public sector needs to pay for such infrastructure throughout the contract period, which is called “buying infrastructure on credit card” (Hodge, 2004). The cumulative annual payment of the government may exceed the cost of traditional procurement, which has attracted the attention of

scholars and practitioners. Inoue and Yoshitake (2016) conducted a cost simulation for a 30-year PFI public housing project in Japan and observed high interest payments. Hellowell (2016) thought that PPPs may incur additional costs, especially transaction and financing costs. With the increasing number of PPP projects, debt repayments will threaten the financial stability of local governments.

Whether social infrastructure PPP projects can achieve financing and economic viability cannot be easily ascertained due to the opacity of financial information. In the short term, PPPs may be a feasible option to deliver urgently needed infrastructure. However, PPPs do not appear to be a completely feasible answer in the long term as many of such projects face substantial cost overruns and higher interest expenses. Some research directions also warrant further exploration. First, a case study on the economic feasibility of social infrastructure PPP projects, including their construction and operation stages, should be conducted to compare their benefits and costs throughout their whole life cycle. However, such objective cannot be easily achieved due to the non-disclosure of financial information and long concession periods. Second, establishing and improving the scientific economic viability evaluation system is imperative to comprehensively evaluate the economic indicators of projects.

• **Risk Management.** The risk management process usually involves risk identification, risk allocation, and risk mitigation. This process aims to “minimize total project risk by placing particular risks with the party best able to manage them” (National Health Service of UK, 2007) rather than transferring the maximum total risk to the private sector. This optimum risk transfer can lead to “dramatic improvements in VFM” (HM Treasury, 1999).

Risk is present throughout the whole social infrastructure construction process. Grimsey and Lewis (2002) identified nine types of infrastructure risk, including political, environmental, financial hedging, construction, technical, operating, revenue, force majeure, and default risks. Bing

et al. (2005) proposed “social risks” that significantly influence social infrastructure. Following risk identification, a risk allocation matrix should be established to clarify the responsibilities of both parties. Meng et al. (2018) used the analytic hierarchy process to establish macro, meso, and micro risk indicators, analyzed the weight of each influencing factor, and proposed a scheme to strengthen risk management and control. Vrangbæk (2008) listed potential risk factors for healthcare PPP projects and allocated them into private partner risks, public partner risks, and shared risks. Owolabi et al. (2019) proposed the “bankability and risk qualitative framework”, which provides information on the bankability of key risks and presents the key parameters for winning financing approval for PPP projects by assessing the feasibility of construction and completion, operation, supply, and demand risks. Opawole et al. (2019) identified risk factors for a university hostel PPP project and proposed the corresponding risk mitigation strategies. Maslova and Sokolov (2017) described the general and specific risks inherent in healthcare PPP projects as well as the measures to mitigate these risks.

Compared with traditional procurement methods, PPPs contribute to the risk management of social infrastructure projects. Some risks can be dealt with more effectively when transferred to the private sector. However, the boundary of risk allocation remains ambiguous and should be further defined in future research. Furthermore, future risks, especially social risks, should be predicted and written into contracts to avoid contract disputes.

• **Performance Management.** Performance management mainly focuses on key performance indicators (KPIs) and performance evaluation frameworks. Detailed lists of KPIs are usually developed by the public sector and related to payment mechanisms. Financial penalties should be paid if service providers fail to meet standards established in the contract (Javed et al., 2013). KPIs are primarily used to evaluate the performance of social infrastructure PPPs. These indicators initially include time, quality, and cost during construction (Geng et al., 2020) and are later developed into multidimensional indicators. Bastani et al. (2019) adopted the statistical analysis method to compare the main performance indicators of the Hasheminejad Hospital before and after the implementation of the PPP model. Geng et al. (2020) developed a reliability-based decision support framework that combines the end users’ perceived service quality with the service quality specified in PPP contracts. When the delivered service is lower than that specified in contracts, the government should establish an abatement system related to KPIs.

The performance evaluation framework is another research topic. Previous studies have mainly concentrated on the construction period rather than the operation phase. However, later studies expanded their research scope to the operation phase and the entire project lifecycle. Saeed

et al. (2018) established a performance evaluation framework focusing on the operation phase for PPP schools in Australia. Liu et al. (2018) argued that the performance evaluation of hospitals and prisons is mainly limited to the construction and operation phases and consequently proposed a process-based and stakeholder-oriented performance prism to facilitate the evaluation of PPPs throughout their lifecycle. Liu et al. (2017) proposed a lifecycle performance measurement framework for social infrastructure PPPs that includes five measurement perspectives and core performance indicators to measure and control the performance of future projects. The National Audit Office of UK (2006) developed a matrix evaluation framework that evaluates the quality of service, operational efficiency, and financial management for different lifecycle periods. Establishing a robust and comprehensive performance evaluation mechanism is necessary by assessing the quality, quantity, and cost of deliverables instead of merely focusing on the cost (Rajasulochana and Maurya, 2020).

Scholars have also compared the performance of the PPP model with that of the traditional procurement method. Some researchers believe that PPPs have more advantages, whereas others believe that PPPs have not achieved the ideal results. However, some scholars believe that both models have advantages in different aspects. Future research should explore the pay for performance mechanism and performance pricing model to determine whether revenues should be deducted or compensated. Moreover, specific performance evaluation frameworks that include both qualitative and quantitative indicators must be established for specific sectors given that social infrastructure covers a wide range of sectors with distinctive industry characteristics.

• **Contract and Relationship Management.** Identifying and ensuring strong contracts and relationship governance mechanisms are among the most significant issues that determine the successful implementation of social infrastructure PPP projects (Zheng et al., 2008).

Contract management involves procurement procedures and flexible contracts. A reasonable and perfect procurement procedure is a prerequisite for the success of social infrastructure PPPs. According to Łakomy-Zinowik and Horváthová (2016), choosing a private partner for a healthcare infrastructure PPP project in UK approximately takes two years. As many public tenders failed to attract qualified private sectors, PPPs were abandoned in favor of the traditional procurement approach (Moro Visconti et al., 2019). For example, New Karolinska Solna was a failed hospital PPP project that started in late 2016 and closed down in 2018. However, the procurement for this project continued when one bid was received, which foreshadowed the failure of this project (Waluszewski et al., 2019). Chiara and Kokkaew (2009) proposed the concept of “contract flexibility analysis”. Cruz and Marques (2013b) developed a double-entry matrix as a new model

for contract flexibility based on real options theory. Some PPP contracts encompass the construction and operational phases, whereas some contracts are signed in phases, which also influence contract flexibility.

In informal relationship management, the public and private sectors have different strategic and operational objectives that may lead to a conflict of interests (Zhang et al., 2009). Relationship governance mechanisms are conducive to building trust and enhancing informal control to reduce the opportunistic behavior of the private sector (Caldwell et al., 2009). In terms of trust and control, the conflicts between these two parties can be resolved easily and efficiently through higher levels of goodwill and trust to avoid schedule delays and cost overruns (Barretta and Ruggiero, 2018). Abdullah and Khadaroo (2020) examined the complex trade-offs between the trust and control of school PPP contracts. English and Baxter (2010) explored the shifting constructions of contracting and trust of prison PPPs between pre-2000 and post-2000 in Victoria, Australia and found that trusting behaviors can mediate the accomplishment of PPP agreements.

The contracts of social infrastructure PPP projects are generally complex due to a large number of stakeholders involved. These contracts can be effectively executed but are also vulnerable to changes or early termination. Future research may focus on concession periods, contract changes, renegotiations, step-in rights, enter and exit mechanisms, defaults, and termination to perfect the contract system and establish flexible contracts.

• **Governance and Regulation.** Governance and regulation encompasses various aspects, including governance structure, government incentives, policy, transparency, accountability, corruption, and legislation. The implementation and governance of social infrastructure PPP projects are usually undertaken by the Special Purpose Vehicle (SPV), which is funded and established by the private sector consisting of one enterprise or a consortium of multiple enterprises. SPV usually serves as the implementer and operator that is responsible for the design, financing, construction, operation, maintenance, and handover of projects. The government has realized a functional transformation from a provider to a regulator. However, this transformation only represents corporate-level governance, and governance and regulation at the national and social levels remain imperfect. Establishing governance and a regulatory structure is a gradual and continuous process that does not always synchronize with the rate of PPP implementation. van den Hurk and Verhoest (2015) thought that a relatively complex governance structure does not match simple infrastructure, whereas a simple governance structure has better manageability. Torchia and Calabrò (2018) identified the most significant governance problems of healthcare PPPs and the six principles of good governance. O'Shea et al. (2020) proposed some measures for improving governance

based on 20 years of experience in Irish social infrastructure PPP projects. Reich (2018) developed a governance matrix for PPPs to assess transparency and accountability. In terms of legislation, developing countries generally lack laws on PPPs (Nishtar, 2004). Levey et al. (2020) studied the relationship between general or specific state social infrastructure PPPs enabling legislation and PPP student housing.

The government has also adopted incentive instruments, including government sponsorship, financing assistance, government guarantees, tax exemptions or reductions, and new market opportunities (Ke et al., 2009a), to promote the investment enthusiasm of the private sector (Li et al., 2022). Government incentives can also be divided into ex-ante and ex-post incentives. On the one hand, the government should give appropriate incentives to the social sector before a behavior is observed, thereby encouraging the social sector to make efforts. On the other hand, the government should supervise the social sector according to its level of effort and work performance by utilizing incentives after the event. The dynamic incentive mechanism can help implement flexible PPP contracts to address the uncertainties that emerge during operation (Zhang et al., 2020). Appropriate government incentive mechanisms can effectively restrain the opportunistic behavior of the private sector, stimulate synergy, promote the smooth implementation of projects, and improve project performance to achieve a win-win situation for PPP projects (Liu et al., 2016).

Some progress has been made in the governance of social infrastructure PPP projects, but some deficiencies remain in developing countries. First, in terms of transparency, a data platform should be established to disclose major financial information that can support the economic feasibility and performance evaluation of social infrastructure PPP projects. Second, relevant laws should be gradually established, and governance and regulatory mechanisms must be improved to create a conducive local institutional environment. Third, future research should explore the proportion of equity or creditor rights of PPP project stakeholders to achieve better governance and avoid excessive debt.

• **Facilitating and Hindering Factors.** This topic centers on critical success factors (CSFs), hindering factors, and success or failure experiences. CSFs have been explored in 10 articles through case studies, questionnaire surveys, or interviews. Yuan et al. (2017) established a conceptual model of public rental housing PPPs and identified six CSFs, including household income, market rents in the same district, floor area and structure, construction costs, transportation, and public facilities. Osei-Kyei et al. (2021) investigated the CSFs of global retirement village PPPs and identified 7 major factor groupings involving 27 CSFs. Yang et al. (2020) adopted structural equation modeling to study the Chinese health-care market and identified the CSFs that affect private

sector participation. For the hindering factors and barriers, Batra (2021) summarized the constraints, gaps, and challenges that influence housing PPPs. Ke (2014) studied the failure experiences of Beijing National Stadiums and discovered that PPPs are not a panacea for infrastructure development. Vecchi et al. (2020) analyzed the main drawbacks of the Design-Build-Finance-Maintain-Operate contract applied in the Italian healthcare sector and concluded that many non-core services may generate considerable rigidity. Chojnacka (2021) reviewed the sports and recreation infrastructure PPP projects in Poland and found that higher financing costs, competitiveness, changes in laws during the term of the contract, and lack of a clear division of tasks and risks between parties may hinder the use of PPP contracts.

Social infrastructure PPP projects have witnessed both success and failure, but the successful projects usually outnumber those projects that have been terminated early. Future research can continue exploring the failure experiences of specific projects and the successful experience of developed countries to identify the facilitating and hindering factors and pave the way for developing countries.

5 Conclusions

Social infrastructure is hindered by the insufficient supply of infrastructure, facilities, and large-scale capital. The PPP model combines the advantages of the public and private sectors to solve these challenges. However, social infrastructure PPPs are also confronted with low probability, complex operational demands, and additional risks brought by long concession periods. This study explored whether PPPs are the answer for social infrastructure by constructing the body of knowledge and exploring the application status and trends in the social infrastructure PPP literature. The body of knowledge aims to present an overview of the publication trends, keyword co-occurrences, co-authorships, and citations. Application status and trend analysis were also conducted to further understand the studied countries/regions, application sectors, and research topics. A development overview of the social infrastructure PPP literature was eventually constructed based on the reviewed literature.

This study attempts to answer core research questions from the literature review and practical applications. Generally, PPPs still have valuable application potential for social infrastructure. Several conclusions can be drawn from the derived body of knowledge. First, the social infrastructure PPP literature shows an upward trend, indicating the increasing scholarly attention and research value, but this topic remains immature compared with economic infrastructure PPPs. Second, the keyword co-occurrence analysis reveals past research concerns and

current research highlights. PPPs, PFI, risk management, healthcare, and social infrastructure are identified as the top five keywords with the highest co-occurrences. Third, the co-authorship analysis reveals a relatively scattered network and identifies the main research groups and their corresponding directions. Fourth, the source citation analysis summarizes the most published journals and highlights the interdisciplinary nature of PPPs.

In terms of practical application, first, the analysis of the studied countries/regions reveals the main gaps between developed and developing countries, which provide guidance for the latter. Second, research on the application sectors reveals the application status and future challenges of PPPs in three main industries, namely, hospitals, schools, and housing. Third, the analysis of the research topic responds to the application results and future directions of six major categories. For example, PPPs are conducive to risk transfer and management but remain mixed in terms of financing and economic viability and performance improvement.

This research also provides directions for further study. For instance, future studies can determine the implementation scopes in different sectors and analyze the economic feasibility of the whole project lifecycle, the policy, legislative frameworks, or special tax regulations involved, and the sustainability and innovation of financing mechanisms.

This research achieves its objectives systematically and comprehensively as much as possible. However, this literature review is mainly based on published theoretical findings. Future research should then thoroughly investigate and compare cases that apply PPPs to expand the practical significance of this work.

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