

## A SYSTEMATIC REVIEW OF THE PUBLIC-PRIVATE PARTNERSHIP LITERATURE PUBLISHED BETWEEN 2012 AND 2021

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**Abstract.** After approximately 30 years of development, public-private partnership (PPP) has attracted increased attention as an alternative procurement paradigm. However, fresh research on PPP has emerged in the last decade that needs to be summarized. This study selects publications on PPP that were published in recognized journals between 2012 and 2021 from the Scopus database. In target publications, methodologies employed, contributions made, and fields applied are summarized. Social network analysis is used to summarize five core topics in PPP from a multidisciplinary perspective; they are risk management, contract management, CFFs and CSFs, economic and financial issues, and performance management. Additionally, the research limitations and future development direction of PPP are also examined. This study can shed some light on future research on PPP and can contribute to the practice of PPP.

**Keywords:** PPP, literature review, risk management, critical factor, contract, economic, performance.

### Introduction

Public-private partnership (PPP) is a type of procurement strategy that was first adopted in the early 1980s in the United Kingdom in response to the worldwide economic crisis (Sadka, 2007). Paris' 1992 water PPP project is a significant occasion. Internationally, developed countries such as the UK, Australia, Portugal, and Spain then began adopting PPP projects in the late 1990s; in recent years, it has become more common in developing countries (Tang et al., 2010). PPP has been widely used in infrastructure and public services, such as transportation, water sewage, energy, environmental protection, and public health (Tang et al., 2013). In PPP projects, public sectors want more cooperation (Citroni et al., 2013; Koops et al., 2017; Ysa, 2007), improved risk management (Aladağ & Işık, 2019; Burke & Demirag, 2015; Wibowo & Alfen, 2013; Zhang et al., 2021), and optimized financial management (Akomea-Frimpong et al., 2021; El-Kholy & Akal, 2021; Firouzi & Vahdatmanesh, 2019) with reduced costs but high-quality services; private sectors plan, build, own, and ultimately run PPP projects to generate revenue (Tang et al., 2010).

Research on PPP shows accelerated growth recently. Scholars argue that PPP projects have become an essential mode for providing infrastructure and public services that benefit public sectors, private sectors, and consumers. However, translating a multi-participant concept into actions is a difficult task. Some study indicates that many players are unable to be successful partners due to internal challenges, or external uncertainty (Ma et al., 2019), resulting in PPP failure and a waste of scarce resources. Additionally, because PPP projects often take 20–30 years to finish, they are more susceptible to higher unpredictability, which makes them more difficult to manage. PPP has attracted multidisciplinary attention, spanning from engineering science to public administration. Scholars from these fields work to ensure that PPP projects are initiated, constructed, operated, transferred, and maintained effectively; Engineering science discipline focuses on risk management (Rybnicek et al., 2020; Tallaki & Bracci, 2021) and critical success factors (Alteneiji, 2020; Osei-Kyei & Chan, 2015; Tang et al., 2013), while the public administration discipline concentrates on politics and

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governance (Xiong et al., 2019). These studies concentrate on specific application areas, such as urban housing (Fell & Mattsson, 2021), construction industry (Jayasuriya et al., 2019; Tang et al., 2010), water management (Jensen, 2017), health (Almeida, 2017; De Pinho Campos et al., 2019; Parker et al., 2019), garbage disposal industry (Wang et al., 2019b) and infrastructure industry (Petersen, 2019). However, literature over the previous decade reveals that, besides engineering science and public administration, disciplines such as business, finance, and economics have also paid attention to PPP during the last decade. Some progress has been made in this new field.

So, this research concentrates on the following key disciplines: engineering science, public administration, business, finance, and economics; to make the literature review more authoritative, this study chose peer-reviewed journals in major disciplines that published at least two publications with JCR (in 2021) from 2012 to 2021. To keep this review contemporary, it focuses on the most recent studies over the previous decade, from 2012 to 2021. This study aims to make the following contributions to the PPP research published in the last decade:

- (1) What research methods are used, where are they applied, and who are the main contributors to research on PPP?
- (2) What are the most often discussed topics in PPP?
- (3) What are the limitations of PPP’s research and future development directions?

### 1. Methodology

This study adopts a systematic review methodology to summarize prior research on PPP since a systematic review allows for a more precise selection procedure

(Akomea-Frimpong et al., 2021; Jayasuriya et al., 2019). The phases of this procedure are depicted in detail in Figure 1.

#### 1.1. Retrieving papers

The Scopus search engine is adopted in this study. Scopus is a major search engine that covers a greater range of topics and provides a more precise search capability than Web of Science, PubMed, or Google Scholar (Alteneiji, 2020; Hong & Chan, 2014; Tober, 2011). Additionally, the Scopus search engine has been widely adopted in the PPP literature and utilized to identify relevant journal articles (Alteneiji, 2020; Darko & Chan, 2016; Xue et al., 2010). Typically, keywords describe the interests and objectives of researchers or reviewers of the literature (Hsieh et al., 2006). This study also employs a similar search approach, identifying target papers on PPP through keywords.

#### 1.2. Selection of targeted papers

Stage 1: Time frame construction. The UK inaugurated the world’s first PPP projects in 1992, and PPP has undergone precisely three decades’ worth of development, by the year 2021. Most notably, in the third decade, basic research on PPP was done, and produced new study topics. So, our study covers the years from 2012 to 2021; more recent eras may feature better-developed research topics (Jayasuriya et al., 2019).

Stage 2: Journal selection. 19 target authoritative journals published more than 4 papers on PPP from 2012 to 2021, as indicated in Table 1, which was further divided into three fields, engineering science, public administration, business, finance, and economics. In the search engine, the document type chosen was “article”; the language chosen was “English”.

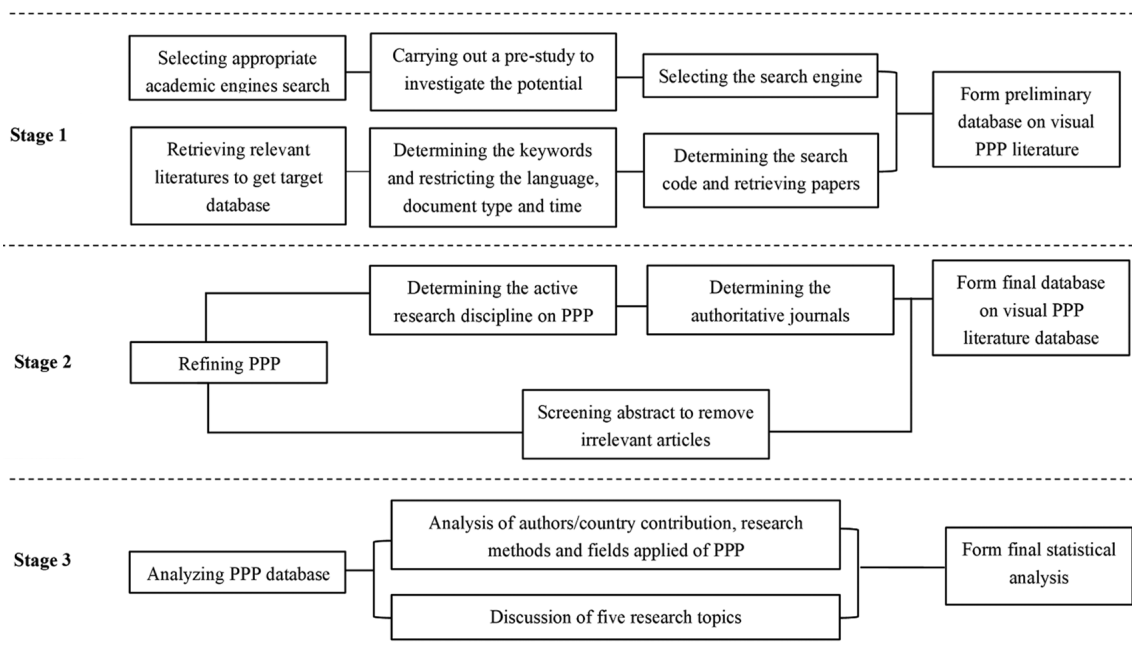


Figure 1. Methodology

Table 1. The number of publications of targeted journals

Discipline	Journal	No.
Engineering science	Journal of Construction Engineering and Management	67
	Journal of Management in Engineering	56
	International Journal of Project Management	52
	Engineering, Construction and Architectural Management	49
	Construction Management and Economics	36
Public administration	Public Management Review	26
	Public Administration	12
	Local Government Studies	14
	Australian Journal of Public Administration	12
	Public Administration and Development	3
	American Review of Public Administration	3
	Canadian Public Administration	3
	Journal Of Public Administration Research and Theory	5
Business, finance, and economics	Public Administration Review	4
	Research in transportation business and management	7
	Critical Perspective on Accounting	6
	Journal of Business Ethics	5
	Accounting Forum	4
Socio-Economic Planning Sciences	4	

**2. Analysis of contributions, research methods, and fields applied to PPP projects**

This study selects 368 papers in 19 authoritative journals between 2012 and 2021. The findings and conclusions are divided into three major sections: 1) contributions, research methods, and fields applied to PPP projects, 2) main topics, and 3) research gap and future development directions.

**2.1. Analysis of contributions of countries/regions and individual scholars**

Table 2 summarises the top ten countries/regions by the number of publications during the previous decade. Findings indicate that PPP research has remained popular since the early 1990s (Song et al., 2016). Chinese PPP researchers are ahead of others; the US, Australia, UK, and Hong Kong then followed. While the number of research centers and researchers from Portuguese is minimal, the number of publications is up to 17. Belgium and Spain contribute the fewest publications.

To ascertain the authors' contributions, this study adopts a quantitative technique developed by Howard et al. (1987); this technique is used to determine the contribution of each author to a co-authored article. This formula assumes that the first author contributes more than the second, and the second author contributes more than the third. This technique has been frequently utilized in several literature reviews to determine the author's contribution (Akomea-Frimpong et al., 2021; Darko & Chan, 2016; Osei-Kyei & Chan, 2015). The formula is shown below:

$$\frac{1.5^{n-1}}{\sum_{i=1}^n 1.5^{i-1}} \tag{1}$$

Table 2. Top 10 countries or regions by the number of publications

Countries/regions	Research centers	Number of researchers	Number of publications
China	36	69	97
United States	22	52	70
Australia	20	38	60
United Kingdom	16	29	51
Hong Kong	4	8	38
Netherlands	7	11	21
Italy	3	7	16
Portugal	3	3	17
Belgium	4	9	15
Spain	5	8	15

From Table 3, this study identifies authors who score at least two points, and 15 authors are finally selected. Scores from single-authored or multiple-authored publications are both valid and are considered to contribute to this country. With ratings of 5.12, 5.06, and 4.8, respectively, Zhang, X. from Hong Kong, Marques, R. C. from Portugal, and Chang, C. Y. from the United Kingdom had higher scores. Chinese scholars' individual highest score is 3.19, only ranking fifth. Marques, R. C. and Cruz, C. O., both from Technical Lisbon, have made significant personal contributions; they have collaborated on five articles over the last decade, establishing a strong collaborative partnership.

Table 3. Top 15 authors by contributions

No.	Authors	Countries / regions	Number of publications	Contributions
1	Zhang, X.	Hong Kong	12	5.12
2	Marques, R. C.	Portugal	13	5.06
3	Chang, C. Y.	United Kingdom	6	4.8
4	Cruz, C. O.	Portugal	7	3.75
5	Xiong, W.	China	8	3.19
6	Liu, J.	China	7	2.79
7	Boyer E. J.	United States	5	2.75
8	Liu, T.	China	6	2.62
9	Carbonara, N.	Italy	5	2.61
10	Chan, A. P. C.	Hong Kong	9	2.46
11	Pellegrino, R.	Italy	6	2.43
12	Verhoest, K.	Belgium	7	2.31
13	Garvin, M. J.	United States	7	2.26
14	Tariq, S.	Hong Kong	4	2.2
15	Reynaers, A. M.	Spain	3	2.2

**2.2. Summary of research methods**

368 selected articles were used to analyze the methods. As described in Figure 2, 8 research methods were identified; there are case study, model construction (game theory, system dynamics, real option, game theory, AHP, NPV, for example), questionnaire survey and interview, content analysis(factor analysis, data description), literature review, Qualitative Comparative Analysis (QCA), theoretical analysis and Social Network Analysis(SNA). Among those methods, case study, model construction, questionnaire survey and interview, content analysis, and literature review are the mainstream research methods in recent ten years, ranking top five. Besides, it is worth noting that QCA and SNA have been applied to PPP research since 2015.

QCA was introduced in the late 1980s, and since then it has been widely used (Rihoux, 2006). QCA is a research method between qualitative research and quantitative research; which is suitable for small and medium-sized sample research. Each PPP project can be seen as a case, and multiple cases can form a small sample, which is suitable for adopting the method of QCA. From Figure 2, QCA increases dramatically in 2021, and it can be predicted that QCA may become the mainstream research method of PPP research in the future.

SNA also deserves attention. Figure 2 shows SNA's rising attraction since 2019. SNA is an approach to examining and displaying social structures using network and graph theories to assess individual and overall network properties. It is used to analyze the connections between individuals in the network through nodes (individual actors) and links (relationships) (Castles, 2017). PPP is a long-term and complex model with various stages, stakeholders, and risk factors, making SNA more appropriate. For instance, Zhu et al. (2019) adopt SNA to investigate conflicts of different stakeholders in different stages of PPP. Wang et al. (2018) adopt SNA to conduct a literature review on PPP.

**2.3. Summary of fields applied to PPP**

Figure 3 reports 11 kinds of fields applied, including transportation, water, healthcare, housing, education, waste, agriculture, tourism, correctional facilities, energy, and sport. Transportation, health, housing, education, and waste are the top five priority applied areas. This research dissects the area of transportation in greater detail. As seen in the pie chart on the right of Figure 3, toll roads garner the most attention in the PPP sector, accounting for more than half of the transportation sector. Following these fields are subways, light rail, ports, bridges, and tunnels. The total of fields applied to PPP more than 368 is due to several studies covering more than one field applied.

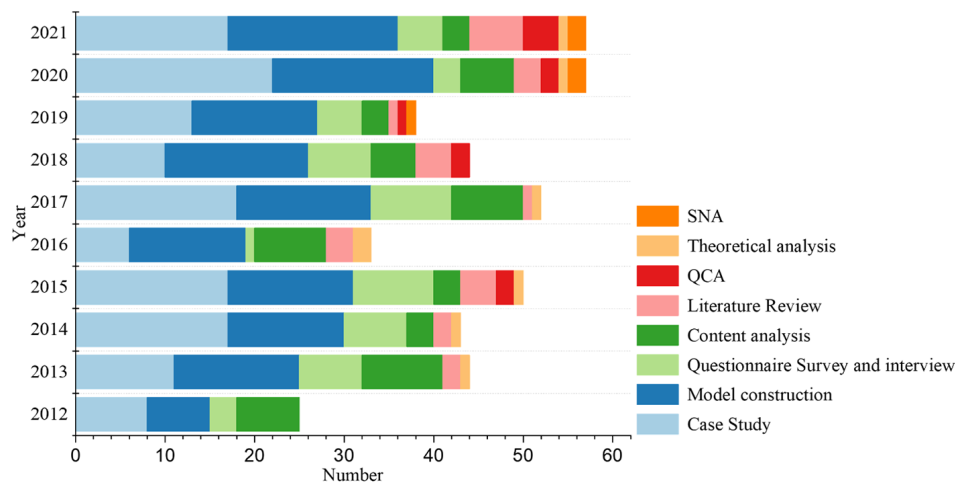


Figure 2. Summary of research methods

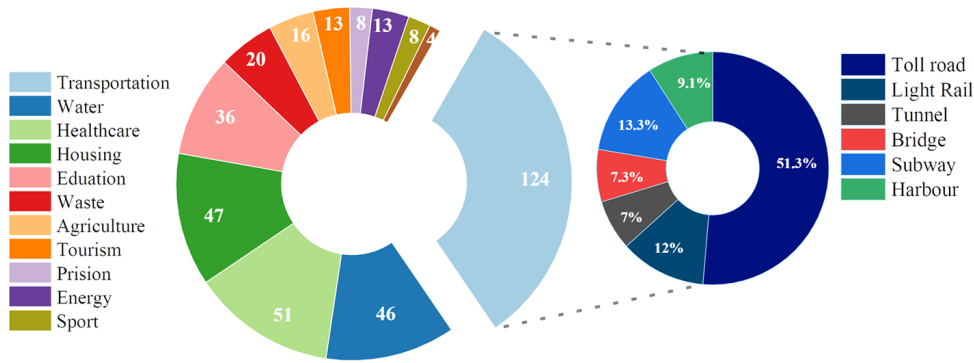


Figure 3. Summary of fields applied to PPP

### 3. Discussion of research topics

This study describes research topics by displaying the co-occurrence of these keywords through SNA. Co-occurrence of these keywords means that some keywords co-occur in the same paper. A higher frequency of co-occurrence keywords means scholars more attention. Only keywords related to the topic were selected. Similar keywords also merged. For instance, “public sector procurement” and “public procurement” into “public procurement”. Keywords that appear only more than twice are included, and then this study constructs a co-occurrence matrix of these keywords. The UCINET software is adopted to visualize the co-occurrence frequencies. A social network produced by the UCINET comprises nodes (individual actors) and links (relationships). The nodes are the keywords and the size of the nodes represents the frequency of keywords; the line between nodes indicates the relationship or flow between two keywords. The numbers in the network mean the co-occurrence frequencies.

### 3.1. Risk management topics in PPP

Risk identification and risk assessment, as well as risk transfer, are the two major focuses of risk management (Almari et al., 2019; Zhang et al., 2016a). From Figure 4, Risk identification (frequency = 3), Risk analysis (frequency = 2), Risk allocation (frequency = 14), Risk assessment (frequency = 3), Risk transfer (frequency = 6), Fuzzy set theory (frequency = 2), Governance (frequency = 2), Monte Carlo simulation (frequency = 3), Residual value risk (frequency = 3), Relationships (frequency = 2), COVID-19 (frequency = 2), Optimization (frequency = 2), Corruption (frequency = 2).

Prior studies in the first two decades focused on identifying the critical risk factors of PPP projects and allocating them between private and public sectors. Research in the prior decade pays more attention to PPP risk management in different countries, at different stages, and in different application areas (Nguyen et al., 2018); some research identifies risk factors of PPP projects in emerging

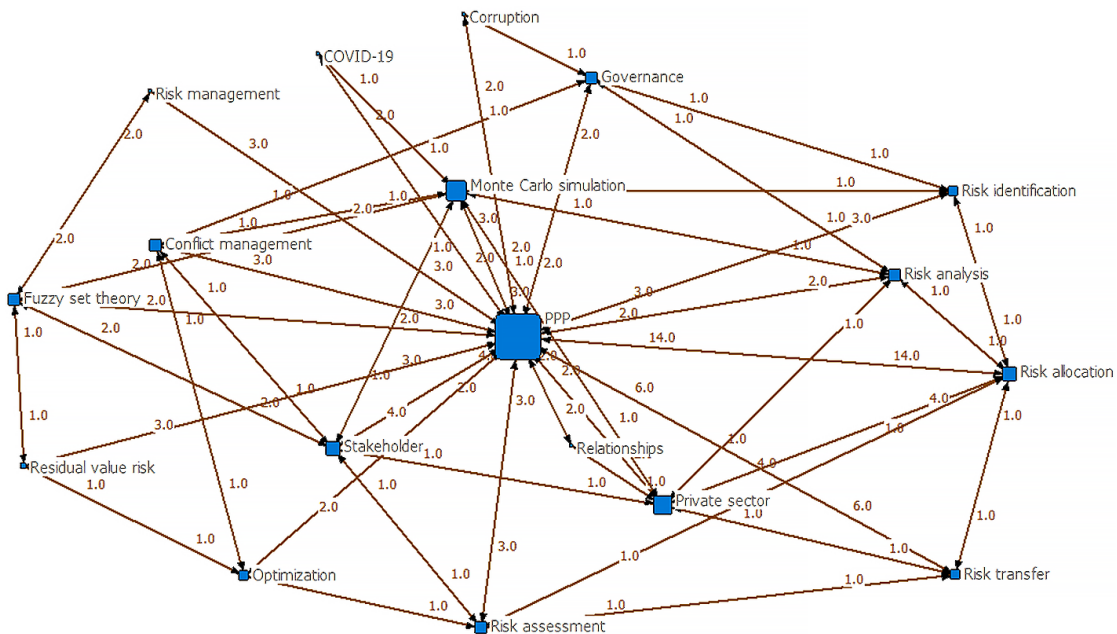


Figure 4. Risk management topics in PPP

countries (Rebeiz, 2012); some research analyses risk allocation strategies in Taiwan, Singapore, China, the United Kingdom, and Indonesia (Chou & Pramudawardhani, 2015); and some research explores the risk management in the development phase of PPP projects (Sundararajan & Tseng, 2017). Besides, recent research identifies some new risk allocation criteria, such as governance environment (corruption, government, legislation, and regulatory quality) (Wang et al., 2019a), public support (Pellegrino, 2021), SPV partners (Burke & Demirag, 2019) and risk cost (Almarri et al., 2019). Risk management is also incorporating novel theories and methodologies, including fuzzy set theory (Ameyaw & Chan, 2015; Mazher et al., 2018), bargaining game theory (Li et al., 2017), Monte Carlo simulation (Carbonara et al., 2014), Natural Language Processing (Erfani et al., 2021). As PPP practices evolve and the external environment changes, new risks like Residual Value Risk (RVR) (Yuan et al., 2015, 2018a) and the COVID-19 pandemic (Casady & Baxter, 2020) emerge. Assessing risk allocation is also a critical component of risk management. Scholars have recently begun evaluating the risk management of PPP projects and discovered that existing risk distribution techniques are far from optimal (Shrestha et al., 2018), and this inefficient risk allocation might harm stakeholder relationships (Burke & Demirag, 2017).

### 3.2. Contract management topics in PPP

From Figure 5, contract management topics mainly focuses on public procurement issues and concession period issues (Cui et al., 2018; Pu et al., 2021). Issue of public procurement: public procurement (frequency = 18), Tendering periods (frequency = 2), Transaction cost (frequency = 8), Local government (frequency = 5), Government Bidding (frequency = 3). Issue of concession period: Early termination (frequency = 4), Pricing (frequency = 2), Renegotiation (frequency = 7), Minimum revenue guarantee (frequency = 3), Trust (frequency = 2), Project delivery (frequency = 2), Concession contract (frequency = 2), Subsidy (frequency = 2), Real options (frequency = 2), Government's guarantee (frequency = 4), Contracting out (frequency = 12).

The public procurement (government bidding) period is a significant issue in contract management (Tang et al., 2013), and plays a vital role in project innovation (Callens et al., 2021). PPP projects' tendering periods are always longer than traditional procurement models, which can increase transaction costs and risks (Carbonara et al., 2016). For reducing transaction costs, 15 procurement-related factors in the briefing stage (Tang et al., 2015) and 14 procurement-related factors in the procurement stage are recently emphasized in contract management (Liu et al., 2016b). PESTEL (political, economic, social, technological, environmental, and legal) are proposed for procurement innovation (Weisheng et al., 2013), and end users' bid assessment criteria are proposed to increase co-operation innovation in contract management (Mouraviev

& Kakabadse, 2015; Torvinen & Haukipuro, 2018). To secure private capital activeness in the process of public procurement, scholars also argue that the public sector also should control the dominance of oligarchic private capital in the contract (De Clerck & Demeulemeester, 2016). Globally, scholars have shown that public procurement determinants differ for each project, but the most important factors mentioned in the contract can be concluded as laws, regulations, internal characteristics, and advice from consultant agencies (Pu et al., 2020).

The concession period is also an important topic in contract management. Research in the prior decade has focused on what factors influence contract success in the concession period and real options models were often utilized to optimize concession periods (Chen et al., 2018). The main factors mentioned in these models mainly include stakeholders (Hanaoka & Palapus, 2012; Zhang et al., 2018), the public (Song et al., 2015), government subsidies (Guo et al., 2021), financial interests (Jin et al., 2019; Mirzadeh & Birgisson, 2015), social benefits and costs (Zhang et al., 2016b). Because of the many factors involved in the concession period, it is difficult to accurately forecast the parameter fluctuation with dynamic nature because of long-term operation. So, the flexible concession period decision method has been adopted increasingly. Faced with the failure of the contract during the concession period, contract renegotiation during the concession period also got some attention. To reduce renegotiation, experts suggest toll adjustment, contract extension, and yearly subsidy or unitary payment adjustment (Sun & Zhang, 2015; Xiong & Zhang, 2014).

### 3.3. CSFs and CFFs topics in PPP

From Figure 6, there are fewer studies on this topic in the last decade compared to other topics, which can be divided into two main categories: critical success factors (CSFs) and critical failure factors (CFFs) in PPP projects. Institutional factors are specifically mentioned, such as institutional environment (frequency = 4), Institutional maturity (frequency = 2), and path analysis (frequency = 3) of success or failure. Topic on the CSFs: CSFs (frequency = 8); Topic on the CFFs: CFFs (frequency = 2); Failure mechanism (frequency = 2).

Scholars have summarized the CSFs of PPP projects from different stages, such as design stages (Raisbeck & Tang, 2013), feasibility stages (Ng et al., 2012), briefing stages (Tang et al., 2013) and the whole lifecycle (Liu et al., 2015a). Apart from studying CSFs at various stages, scholars also summarized CSFs from diverse perspectives, such as CSFs in relationship management (Zou et al., 2014), macroenvironment (Wibowo & Alfen, 2014), and various countries (Chou & Leatemia, 2016; Chou & Pramudawardhani, 2015). Risk distribution and sharing, strong corporate consortium, government backing, community/public support, and transparent procurement are widely regarded as the top five factors (Osei-Kyei & Chan, 2015).

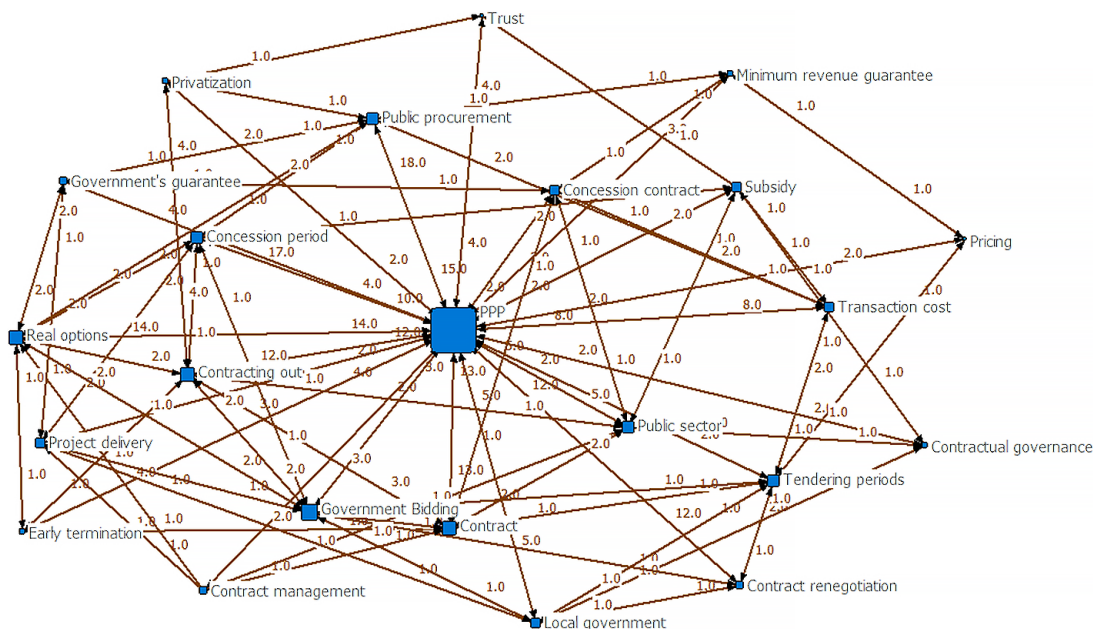


Figure 5. Contract management topics in PPP

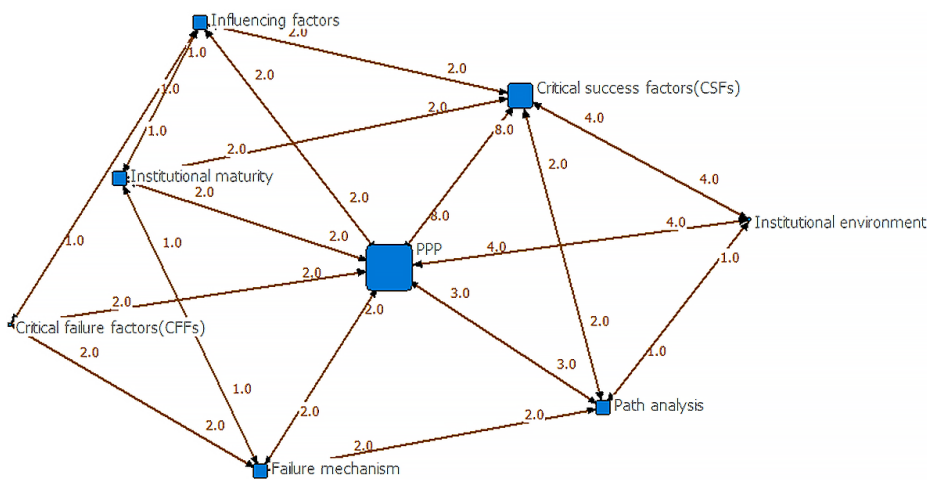


Figure 6. CSFs and CFFs topics in PPP

Additionally, scholars summarized these factors into three categories, external environment (including institutional environment), internal project characteristics, and partnership-related factors (Wang, 2015). Institutional influences are frequently highlighted among these factors (Delhi & Mahalingam, 2020; Opara et al., 2017). Besides, scholars also created a dynamic framework that proposes PPP models adapt according to current changes to CSFs (Wang, 2015). This study demonstrates the need for future research in identifying CSFs depending on external factors, rather than just replicating prior findings.

Research on CFFs is scarce and has not yet shown consistent results. Prior studies have mostly summarized from a broad perspective (Tariq & Zhang, 2021b) or a few cases (Tariq & Zhang, 2021a) and have not conducted in-depth studies to develop a categorization system.

### 3.4. Economic and financial topics in PPP

From Figure 7, the keywords related to economic and financial topics are as follows: VFM (frequency = 7), Financing (frequency = 4), Capital structure (frequency = 4), Concession period (frequency = 5), Private finance (frequency = 3), Subsidy (frequency = 3), Funding (frequency = 2), Economic factors (frequency = 2), Financial viability (frequency = 2), Private capital (frequency = 2), Financial restructuring (frequency = 2), Game theory (frequency = 2), System Dynamics (frequency = 2), MCS (frequency = 2).

PPP projects require a large amount of capital input and expect more returns by selling products to the public. Therefore, economy and finance are essential issues. The impact of the external economic environment on PPP projects is often mentioned. Whether or not a coun-

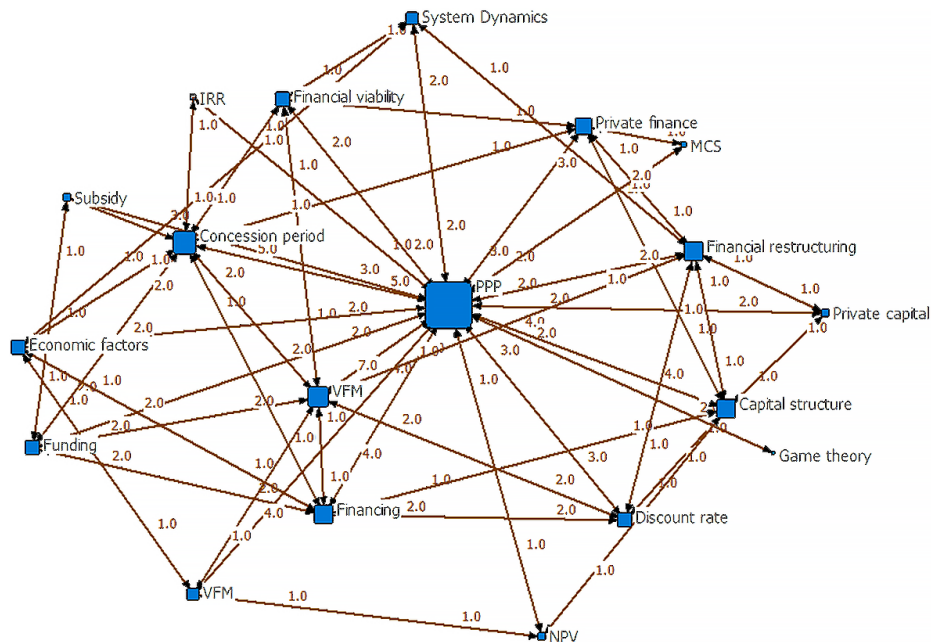


Figure 7. Economic and financial topics in PPP

try adopts PPP projects and how they evolve are inextricably linked to the country's economic progress. Indeed, contemporary PPP projects are more concerned with economic growth (Hodge et al., 2017). For example, in times of economic uncertainty, it is difficult to establish adequate amounts of risk transfer in public procurement (Reeves, 2013). Throughout the concession era, the economic slump affects the concessionaires' business performance (Vassallo et al., 2012).

Investment and cost in PPP projects are also mentioned. Three crucial questions are addressed in this issue. How much investment is required during the PPP's life? Where did the investment come from? And how can a decent rate of return on investment be achieved (Zhang et al., 2016a)? In those issues, the completion cost (including design, building, and installation), the operating cost, the pricing of the services or goods, government subsidies, the funding structure, and the financing cost are often mentioned. These factors mentioned above are always dynamic, and difficult to foresee. As a result, researchers develop dynamic models to address these problems. For instance, a model based on the Stackelberg game theory is built to help public agencies develop payment methods for PPP transportation projects (Shang & Aziz, 2020); the System Dynamics approach is applied to develop a model for concession pricing (Xu et al., 2012). Cost overruns are common in big public infrastructure projects, and there is continuous discussion over the underlying causes of these risks and the most effective mitigation strategies (Zhang et al., 2020b). Scholars create cost models and find that the scale of projects, as well as the specific maintenance and rehabilitation operations, are the primary factors causing cost overruns (Anastasopoulos et al., 2014). Financial models are also critical to this issue (Wibowo et al., 2012).

Many studies have constructed financial risk models using Monte Carlo simulation (MCS), Net Present Value (NPV), or Internal Rate of Return (IRR) techniques and concluded that significant factors are high-interest costs, massive construction costs, cost overruns, and increased market risk (Akomea-Frimpong et al., 2021). Besides, the validity of a project's evaluation model (Jeong et al., 2016), the importance of the option to postpone construction startup (Doan & Menyah, 2013), and stochastic modeling of maintenance flexibility in Value for Money assessments (Zhang & Yuan, 2021) are also emphasized. From different stages of PPP projects, some models are constructed for these issues; models for maximizing bid-winning potential and capital structure (Iyer & Sagheer, 2012), models for evaluating the value of the concession period (Ashuri et al., 2012; Wu et al., 2012), and models for calculating the impact on stakeholders of an early project termination (Sharafi et al., 2021).

### 3.5. Performance management in PPP

Due to the expansion of the field of study, scholars began to pay attention to the performance evaluation of PPP, thus forming the literature review of PPP performance evaluation. The prior study focused on evaluating the cost, quality, and Value for Money (VFM) (Petersen, 2019). From Figure 8, In addition to the "PPP", "Performance", and "Performance management", have no explanation meaning. Among those keywords, VFM (frequency = 3), Lifecycle performance evaluation (frequency = 3), Dynamic performance (frequency = 3), IFC (frequency = 2), BIM (frequency = 2), Equity investment (frequency = 2), Joint-contract functions (frequency = 2). Research on these keywords is described below.



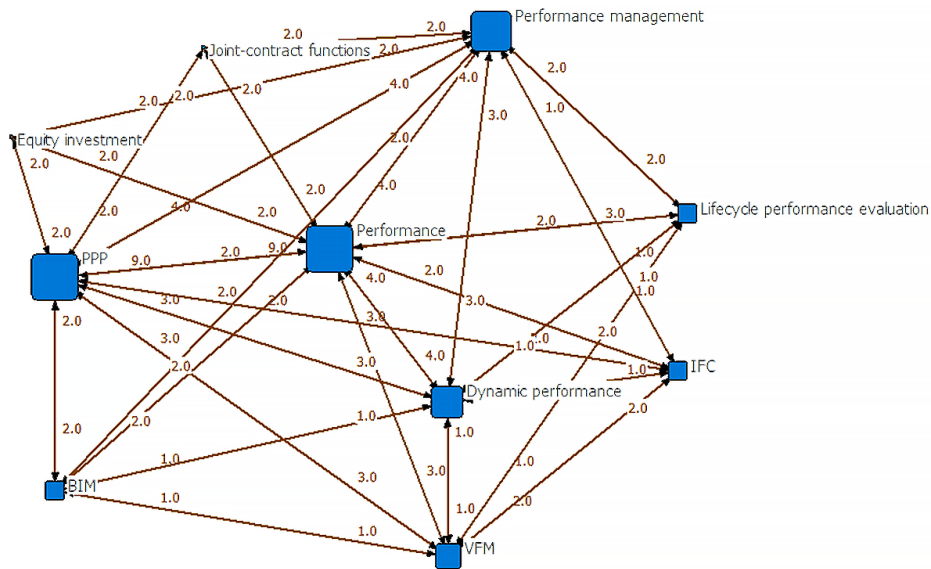


Figure 8. Performance management topics in PPP

The development of PPP ultimately depends on the performance management of PPP projects (Wang et al., 2018), and performance assessment is critical in the investigation of PPP projects. From the study of performance evaluations on PPPs during the last two decades, most studies concentrate on ex-ante and post-event evaluations (Higgins & Huque, 2015). Value for money (VFM) is a critical ex-ante performance metric used to determine whether to adopt PPP projects. In post-event performance evaluation, most prior research concentrates only on time, cost, and quality (TCQ). However, scholars have argued that current performance evaluation approaches should not be limited to financial metrics since they might foster short-termism and do not promote continual improvement (Haponava & Al-Jibouri, 2012; Okudan et al., 2020). As a result, scholars argue that we should employ multi-dimensional performance evaluation indicators (Cong & Ma, 2018). For example, stakeholder satisfaction (Tripathi et al., 2021) and human resource management (Indridason & Wang, 2008) need to be considered to boost the overall project's performance. However, initial agreement on performance assessment indicators cannot account for all variances; in particular, the more changing corporate environment has a detrimental influence on the efficacy and efficiency of existing performance evaluation indicators. Some scholars also have proposed that a useful performance indicator should focus on processes rather than just finished products (Liu et al., 2015b). As a result, dynamic performance incentive models for the PPP projects are required to account for unanticipated changes over the operating time. A new performance metric known as lifetime performance evaluation then has been implemented in recent years (Liu et al., 2016a).

A dynamic performance incentive model for a flexible PPP projects contract is also explored to ensure operational performance to protect both the private sector and public sector's benefits (Zhang et al., 2020a). Okudan et al. (2020) develop a conceptual life cycle Performance

Measurement System (PMS) based on Key Performance Indicators (KPIs). As the performance evaluation research becomes more elaborate, more attention is paid to the performance evaluation of a different process, different sectors, or different stakeholders' interests, such as the operating performance (OP) (Yuan et al., 2018b), a performance comparison between different sectors (Henjewe et al., 2014) and performance from different stakeholders (Wang et al., 2020). Besides, scholars also summarize the influence of some specific factors on performance evaluation. Such as government equity investment (Hu et al., 2021), and joint-contract functions (Cheng et al., 2021). PPP performance evaluation uses more innovative technologies as performance technology develops. Some scholars utilize the Industry Foundation Classes (IFC) extension and the enhanced matter-element method to evaluate PPP project performance accurately and efficiently (Xu et al., 2020). Xu et al. (2020) use building information modeling (BIM) for PPP project performance evaluation.

#### 4. Research limitation and future development direction

This study reviews research on PPP in authoritative journals in the past ten years. A review of prior studies can provide insights for future research agendas. Thus, the following discussions will provide research gaps and development directions based on five research topics.

##### 4.1. Risk management topic

Previous studies have made much effort to develop models to identify and transfer risk factors in PPP projects. However, many models are challenging to operate because of the technologies involved in the model, such as Monte Carlo simulation, Fuzzy set theory. Additionally, while public and private sectors are often discussed in risk management, few studies focus on end-users.

## 4.2. Contract management topic

Most prior research on contract management is discussed in one country context. However, there are significant differences in each country's politics, economy, and culture. Future researchers can compare government procurement contracts in different nations. Especially the rise of PPP projects in developing countries in the last decade, which deserves more attention. Besides, in the evaluation of government procurement efficiency, private sectors or public sectors in the prior study are always mentioned, but stakeholders of end-users and communities also need attention (Torvinen & Haukipuro, 2018).

## 4.3. CFFs and CSFs topics

CFFs and CSFs research in PPP projects has long been a hot issue, with most studies focusing on the CSFs. However, as the number of PPP projects expands globally, there are an increasing number of failures, however, the core causes of failure are rarely discussed (Zhang & Tariq, 2020). Additionally, while earlier research has suggested that the CSFs of PPP projects are changeable, few studies have predicted how they will alter and what dynamic changes will occur.

## 4.4. Economic and financial topics in PPP

As we all know, whether a country adopts PPP projects is related to its economic development. However, scholars ignore how and to what extent would PPP project initiatives affect a country's economy, such as government debt. Additionally, while earlier research has emphasized government and social capital investment, the public as a vital stakeholder has been overlooked. As a result, future studies can incorporate the public's input and output when considering this issue.

## 4.5. Performance management in PPP

Although the current performance evaluation model has shifted from pre-assessment, and post-assessment to dynamic performance. However, more parameters in dynamic performance models need to be considered for adjustment in the dynamic incentive model. Such as subsidy amount, benefit allocation, optimal time, etc. (Zhang et al., 2020a). Besides, although performance management is becoming more refined, the performance indicators of different industries have not yet been standardized, and future studies can classify and formulate performance standards for different fields.

## Conclusions

This study investigates articles on PPP published in authoritative publications in the last decade using a systematic review. The selected articles' research methods, authors' contributions, and hot topics are summarized. Scholars from China, The United States, Australia, the United Kingdom, and Hong Kong are prominent. Case

studies, model construction, questionnaire survey and interview, literature review, content analysis, QCA, and SNA approaches have consistently captured the interest of researchers. Among these methods, QCA and SNA are gaining increasing attraction. Although the scope of PPP applications is expanding, transportation remains the most prevalent PPP application sector. Risk management, contract management, CFFs and CSFs, economic and financial difficulties, and performance management were among the most popular topics over the last decade. In a conclusion, while these publications have made some significant achievements, there are still certain gaps that require more research by future scientists. For example, complex technical applications in risk management are difficult to apply in practice; contract management should be further subdivided into applied fields and countries; CSFs require increased scholarly attention; the impact of PPP projects on local government debt receives little attention, and performance management requires diversification and standardization of performance management indicators.

These results outline the current study on the states, progress, and limitations of PPP projects, which will be helpful to future scholars and can provide some theoretical guidelines for future PPP projects. This study also has some limitations. To ensure the authority of the selected publications, this analysis excludes some PPP-related studies published between 2012 and 2022, which cannot cover all the research. Besides, this study evaluates topics using keyword combinations; occasionally, keywords in some articles are not precisely refined, which may result in some deviation.

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## Author contributions

HS and LF both contributed in organizing the research; KX contributed to data collection, HS; LF and KX both were responsible for data analysis; HS wrote draft of the of the article. LF and KX both contributed to the writing of this paper.

## Disclosure statement

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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