Bibliometric Analysis of PPP and PFI Literature: Overview of 25 Years of Research

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Abstract: Academics have been devoting a growing attention to different matters involving public-private partnerships (PPPs), and, as the use of PPPs for delivering infrastructure evolves worldwide, so does the number and type of papers addressing this procurement model. The objective of this paper is to undertake a comprehensive literature review of papers relating to PPPs and private finance initiatives (PFIs), using a bibliometric analysis. More than 600 papers published between 1990 and 2014 were examined. None of the previously existing studies analyzed such a large sample of papers. The research found that PPP studies appear to have a steady momentum toward growth. Engineering journals (and engineering as a research area) have been particularly active in this field. Authors based in Europe and Asia had written almost two-thirds of the papers, with transportation and health sectors at the top of sector-based papers. Most of the existing work is focused on aspects of contract design, risk sharing, and analyzing the contract performance and benefits, and neglects areas such as contract termination and renegotiation. The management of PPPs will be the next big challenge for PPP scholars and professionals. **DOI: 10.1061/(ASCE)CO.1943-7862.0001163.**

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Introduction

Public-private partnerships (PPPs) are a procurement model used to deliver public infrastructure, services, or both, typically in the sectors of transportation, energy, environment, health, security, or education. The economic rationale of the PPP model is that when exposed to risk, or with the probability of losses, the private sector can achieve a higher level of efficiency, thus increasing the value for money of the projects (Bennett and Iossa 2006; Meda 2007; Cruz and Marques 2014). The development of PPPs is built upon the possibility of achieving higher efficiency gains and the access to private capital in a context of public funding shortage, providing an alternative for governments in developing their infrastructure development plans. But these potential upsides are not free of charge. There are many costs, or pitfalls, the most relevant being the vulnerability of long-term contracts to uncertainty, often renegotiated, with severe impacts on the public sector, directly on users, or both (e.g., increases in fares, decreases in the level of quality of the service, and similar impacts) (Hart and Moore 1988; Guasch 2004; Cruz and Marques 2013).

PPPs have been mentioned in the literature with different acronyms, for example: PPP, P3, P, or private finance initiative (PFI). The most popular and most used worldwide, is PPP, although PFI was the very first term adopted by the British government and the term used in the first published paper addressing the subject in 1950, questioning the role of private financing in hospitals (Mignon 1950). Since then, according to the Web of Science (2015) database, fewer than 70 papers were published until 1991. In particular, after 2000 the literature on PPPs has expanded significantly, with a stronger growth rhythm over the last five years. The theory has followed the practice in the case of PPPs, considering that it was in the late 1980s and early 1990s that the model became more used. This paper intends to provide a unique overview of the evolution and trends of PPP papers in academia. This type of analysis is highly conditioned by the database used (existing databases, simple search over the web, and other means) and for the purposes of this paper, a well-established repository, namely the Web of Science, was adopted to decrease the discretion of the search. Historically, there have been papers addressing literature reviews on PPPs although with limited focus (sample), areas, and industries, or type of analysis. A summary of these papers is presented in Table 1.

This bibliometric analysis has identified all of the publications in the Web of Science on PPP and PFI since 1990, a total of more than 600 papers, in more than 300 high-quality journals. This provides the largest database ever used. The papers were analyzed and classified into 14 topics, almost double the size of the widest attempts of previous papers.

Methodology and Data

The first step of the research was to define which of the existing scientific repositories to use. Previous works, such as Al-Sharif and Kaka (2004), Ke et al. (2009), and Tang et al. (2010) have elected to use a sample of specific journals, whereas others such

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Table 1. Summary of Recent PPP Literature Reviews

Paper	Number of journals analyzed	Number of papers	Period of analysis	Research categories	Type of research	Research area	Geographical scope
Al-Sharif and Kaka (2004)	4	34	1998–2003	3	No bibliometric	Construction journals	Not specific
Weihe (2008)	—	—	—	4 (approaches)	No bibliometric	Not specific	Not specific
Kwak et al. (2009)	—	—	—	—	No bibliometric	Not specific	Not specific
Ke et al. (2009)	7	170	1998–2008	7	No bibliometric	Construction journals	Not specific
Tang et al. (2010)	6	107	1998–2007	—	No bibliometric	Construction journals	Not specific
Papajohn et al. (2011)	—	—	—	—	Questionnaire	Transportation	United States
Marsilio et al. (2011)	—	298	2008	—	Bibliometric analyses[a]	Not specific	Not specific
Andon (2012)	≥ 25 Google Scholar	97	2010	—	Partial bibliometric analyses[b]	Accounting	Not specific
Garvin and Gross (2012)	140	278	1997–2010	8	Bibliometric analyses[c]	Transportation	Not specific
Chen et al. (2015)	—	95	2002–2014	5	Meta-analyses	Transportation	Not specific
Current research	310	575	1991–2014	14	Bibliometric analyses[a]	All areas	All regions

[a]ISI Web of Science (2015).
[b]Specific journals and Google Scholar's search samples.
[c]Google scholar.

as Chen et al. (2015) preferred to define the sample using their work experience based on journal papers, government reports, conference papers, independent studies, dissertations, and seminar discussion papers. Although there were other academic digital databases available, the chosen one was the Web of Science database, because of its comprehensiveness and scientific robustness. Although Andon (2012) and Gavin and Gross (2012) have resorted to the Google Scholar search engine, the approach preferred for this paper was to follow the experience of Marsilio et al. (2011) in adopting the Web of Science database. The chosen temporal interval was from 1990 to 2014. Appendixes S1 and S2 provide the list of papers for PPP and PFI respectively. The last inquiry of the Web of Science's webpage was made March 6, 2015. After the identification of all papers, a database was created in order to catalog the papers' information according the following criteria: date of publication, title, authors, journal of publication, research country origin, geographic scope, project sector, research area, main findings, and research topics. The database analysis identified papers without basic information such as the publication date, author's name, researchers' origins, research areas, or even the abstract. The database includes a total of 626 papers. However, 51 papers were excluded because they did not meet the necessary conditions to be selected and analyzed, due to several reasons including double registration in the Web of Science's webpage and not being related to the research (papers that just mention PPP as the procurement model adopted in their searches cannot be related to any of the research topics' analysis). After this, the final sample resulted in 575 papers: 455 for PPPs and 120 for PFIs (Table 2).

Literature Analysis

The literature analysis will look at the evolution of the quantity of papers, the main publishing journals, research areas, research origins (countries where the authors of the analyzed papers are affiliated), geographic scope (data or case study relating to geographic provenience, location, or both), project sector, research topics (main issue addressed based on the 14-category classification proposed in this paper), and a list of most cited papers.

Number of Papers

The results show that, for the acronyms PPP and PFI, there is a growing number of papers as a result of increasing attention that academia is devoting to this subject (Fig. 1). Since 2002, the growth has been almost exponential and it is likely that it will continue over the next decade, despite the slight decrease in the number of papers verified in 2014, particularly taking into account that over the last 10 years the number of projects developed worldwide has increased substantially.

The number of publications with the acronym PPP has increased consistently, but the same does not happen with PFI. It would probably be the result of a more generalized use of the PPP term by British-influenced authors that used the acronym PFI in the past and are progressively abandoning the term.

Journals

The two most relevant journals publishing papers regarding PPPs are the *Journal of Construction Engineering and Management*

Table 2. Profile of the Analyzed Publications

Profile	Number of papers	Percentage (%)
Total publications in Web of Science with the topics PPP and public-private partnership (filter use of the term Article)	488	78
Total publications in Web of Science with the topics PFI and private finance initiative (filter use of the term Article)	138	22
Total papers before analysis	626	100
Papers excluded for having abstracts are written in languages other than English	10	1.60
Papers excluded for not having abstracts	14	2.24
Papers excluded for being registered twice	06	0.96
Papers excluded for not being related to the research area[a]	10	1.60
Papers removed from the initial list because the objectives, conclusions, or both, have not been clearly presented or do not exist	11	1.76
Total papers excluded before analysis	51	8.15
Total papers analyzed in this research	575	100

[a]Papers that cited the expressions PPP, PFI, or both, but in fact do not explore the theme. It was noticed, mainly in papers that come from medical, chemistry, telecommunications, and biological areas, where reference to the terms usually was made just to point out the sort of model that had financed its projects.

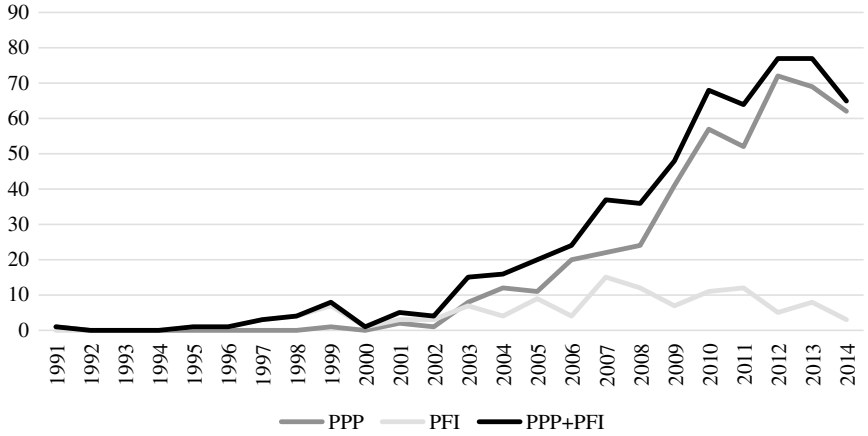

Fig. 1. Number of papers per year

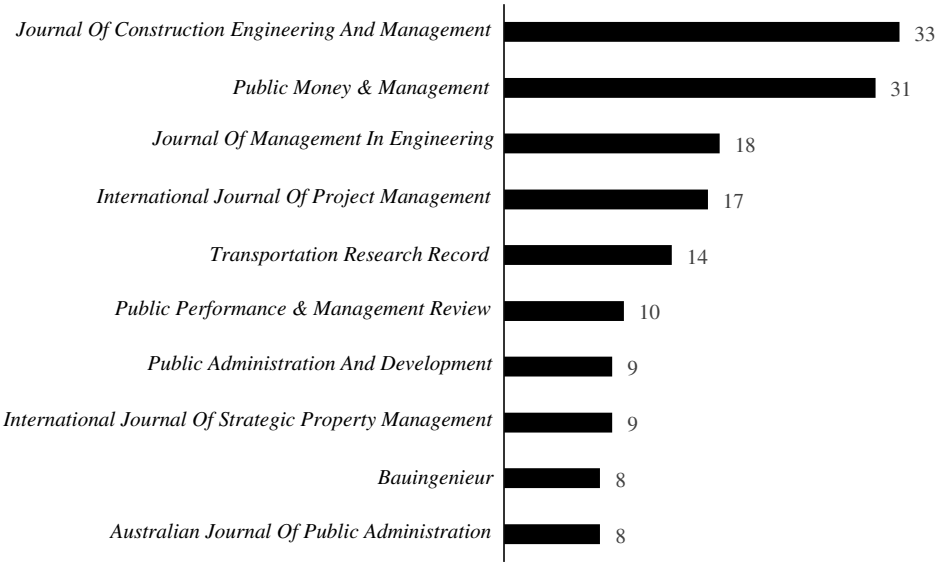

Fig. 2. Ranking of top 10 journals publishing PPP and PFI papers

(ASCE), which published 33 papers, and *Public Money & Management*, with 31 papers published. Considering the list of research areas cataloged by the Web of Science, the journal in first place belongs to the area of engineering and the second place journal to the area of business and economics. Another finding is that these two research areas dominate the top 10 journal rankings, each with four journals with the greatest number of publications regarding PPP and PFI (Fig. 2).

Research Areas

As mentioned earlier, the two leading areas are engineering and public administration, with 161 and 144 papers, respectively. In third is business and economics with 120 papers. Thenceforth, the other sectors together represent a little more than one-third of the total of papers (Fig. 3). This outcome is evidence of the multidisciplinary nature of PPP research, involving typically technical contents (engineering) and public policy concerns, given that they are used to develop and manage public services (public administration), but also includes complex financing mechanisms and business models (business and economics).

Research Origins

Among the 72 countries with researchers publishing papers regarding the PPP theme, the United Kingdom stands out at the top of the list with 122 papers. China appears in second place, followed by the United States, with 72 and 62 papers, respectively. Australia is in the fourth place, with 34 papers published, followed by Portugal, Germany, Switzerland, Italy, Spain, India, Brazil, Netherlands, Taiwan, and Belgium, publishing between 10 and 15 papers each (Fig. 4).

Geographic Scope

Regarding the geographies addressed as case studies, the United Kingdom stands out at the top of the list with 97 papers. China appears in second place, followed by Korea, with 51 and 38 papers, respectively. The United States was in fourth place, with 32 papers published. After this, came Australia with 22 papers, and it is worth mentioning India and Brazil with 17 and 13 papers, respectively, followed by Portugal with 12 papers published (Fig. 5).

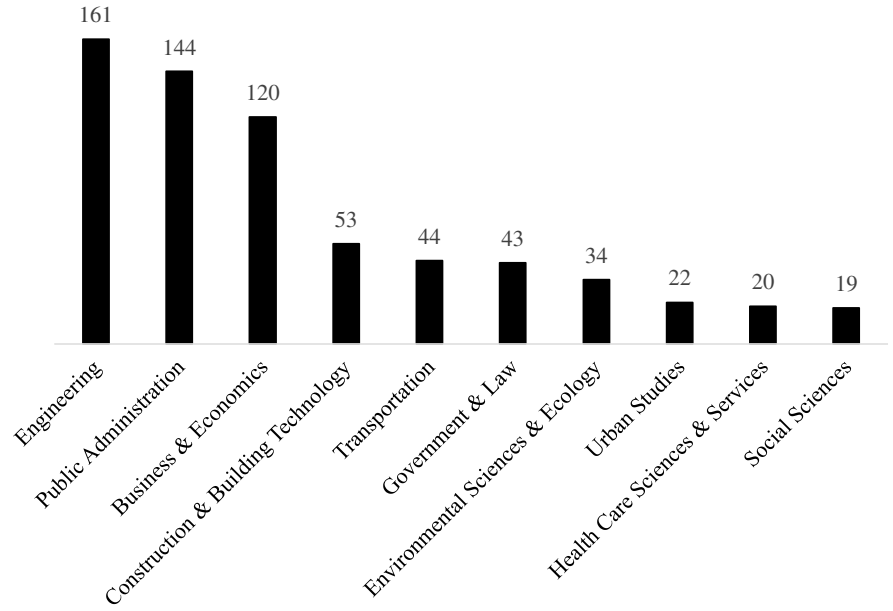

Fig. 3. Number of papers in the top 10 rankings by research areas

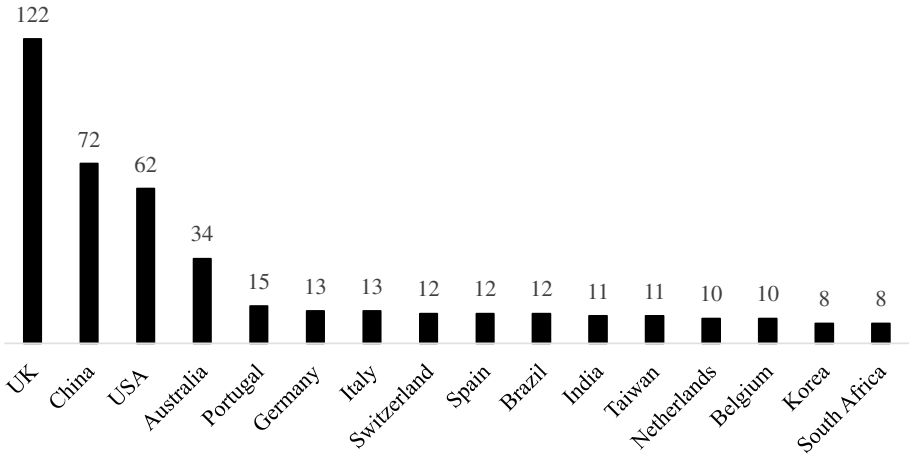

Fig. 4. Number of papers per country

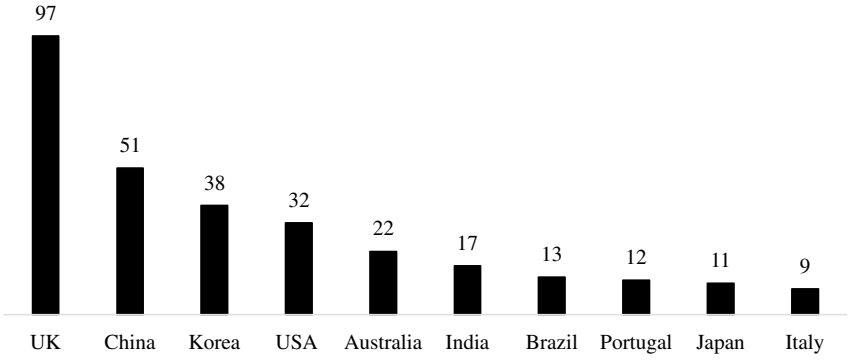

Fig. 5. Number of papers by rank of countries' geographic scope

Table 3. Number of Papers per Project Sectors

Projects sector	Number of papers	Ranking
Transportation	98	1
Health	91	2
Environment	52	3
Education	25	4
Housing	15	5
Energy	11	6
Agriculture	10	7
Communication	9	8
Security	9	9
Urban regeneration	6	10
Tourism	5	11
Sports	3	12
Mining	1	13
Not identified	249	—
Total	355	—

Project Sector

In this section, the primary sector of the papers was analyzed. The 13 sector classifications selected were: transportation, health, environment, education, housing, energy, agriculture, communication, security, tourism, sports, urban regeneration, and mining. The results shows that the two leading sectors are transportation and health, with 98 and 91 papers, respectively. Over the last two decades, governments have been investing significantly in roads, railways, light rails, ports, airports, and hospitals, which has justified the academic attention to these fields. Transportation and health were also the first sectors to experience the use of PPPs. In third and fourth place are environment and education, with 52 and 25 papers, respectively. Thenceforth, the other sectors together represent one-fifth of the total papers classified (Table 3). The total of papers is lower than the full database number because some papers were not applied to a specific sector or were essentially conceptual, theoretical, or both.

Research Topics

In this section, the papers were classified according to a list of research topics, previously elaborated by the authors of this paper. The idea to classsify the papers in topics, themes, or categories, was previously used by other researchers. Al-Sharif and Kaka (2004), Weihe (2008), Ke et al. (2009), and Gavin and Gross (2012), and more recently, Chen et al. (2015), have also created their own categories and classified their samples accordingly. The number of categories varies from author to author, as presented in Table 1. This paper attempts to create a list that could cover the majority of the present PPPs' themes, exhaustively covering the various topics of PPP/PFI, and not limiting the scope to PPPs researched from the construction engineering perspective. The classification resulted in 14 research topics depicted in Table 4.

The two most popular topics are contract performance and qualitative costs and benefits, with 135 and 115 papers, respectively. In third, fourth, and fifth positions are contract design and risk sharing, PPP/PFI political and institutional issues, and value for money tests, respectively. Thenceforth, the other sectors together represent a little more than one-fifth of the total papers as shown in Table 4. The total of papers is higher than the full number of the database because some papers were classified in more than one topic. As mentioned previously in this paper, the top three countries

Table 4. Research Topics, Related Description of Issues, and Number of Papers

Research topics	Summary description	Number of papers
Contract performance	Comparative costs; time and client requirements; performance case studies; operational performance; success rate; projects performance; key performance indicators	135
Qualitative costs and benefits	Applicability of the model; expected cost and benefits examination; overall opportunities, problems, and challenges in the PPP market; PFI's attractiveness to the private sector; projects sector's experience reviews; PFI's effectiveness of delivering government objectives; procurement methods mechanisms comparison; the challenges of firms participating in models	115
Contract design and risk sharing	Risk sharing; design contract achievement of public goals; assessment of risk-related issues; risk analysis; risk factors in case studies; procedural fairness and cooperation; evaluation of government guarantees	95
PPP/PFI political and institutional issues	Governmental strategies; legal framework; governmental marketing strategies; PPP regulation; country political risk analyses	89
Value for money tests	PSCs past projects analyses; PSCs models; practices of ex-ante evaluation; VFM's case studies evaluations; feasibility studies; VFM and economic analysis; problems of VFM analysis; VFM's projects solutions; concession price determination	73
Stakeholder management	Cooperative relationship; stakeholder's engagement and compliance culture; stakeholder's management; stakeholder's participation and influence	41
Contract management	Lifecycle project management; critical management factors; critical success factors and best practices	28
Accountability	Role and effects of accounting; accounting issue: record information on balance sheet; public expenditure analysis; taxation issues	17
Financing PPP/PFIs projects	Availability and cost of capital; financing capacity	19
Procurement model	Bidding process; information management in tenders; process improvement	13
Renegotiation and dispute resolution	Drives for renegotiation; costs of renegotiation; equilibrium models in renegotiation; dispute resolution	10
Literature review	Literature review	8
Environmental issues	Environmental issues	5
Contract termination	Project effect at the contract termination; early contract termination	2
Total		650

contributing to PPP research are the United Kingdom, China, and the United States, respectively. Fig. 6 shows these countries' number of papers per research topic. Among the topics, contract performance is the most popular among the United Kingdom researchers with 32 papers, followed by qualitative costs and benefits with 23, and political and institutional issues with 19 papers. In China, contract design and risk sharing is most popular with 20 papers, value for money tests with 15, and qualitative costs and benefits with 12. In the United States, the most published areas are: value for money tests with 15 papers, political and institutional issues with 12, and qualitative costs and benefits with 12.

These results also show that all three countries have prioritized qualitative costs and benefits studies. The focus of the research has been more to evaluate the costs and benefits of using PPPs, in ex post empirical analysis both on the results of the model in terms of delivering expected outcomes, as in the success in attracting private partners. The results also show that the United Kingdom and the United States share the preference for political and institutional issues. This category preference is shown throughout the researchers' increasing interest in studing governmental strategies, legal framework, and what the countries find relevant in considering their PPPs' regulations. Finally, although value for money tests does not appear in the United Kingdom's top 3 theme it comes in fourth with 15 papers published, which is the same number of papers published in China and the United States. Researchers in these two countries (China and the United States) are increasingly concerned with investigating the public sector comparator (PSC) models and its past projects analyses. Value for money (VFM)

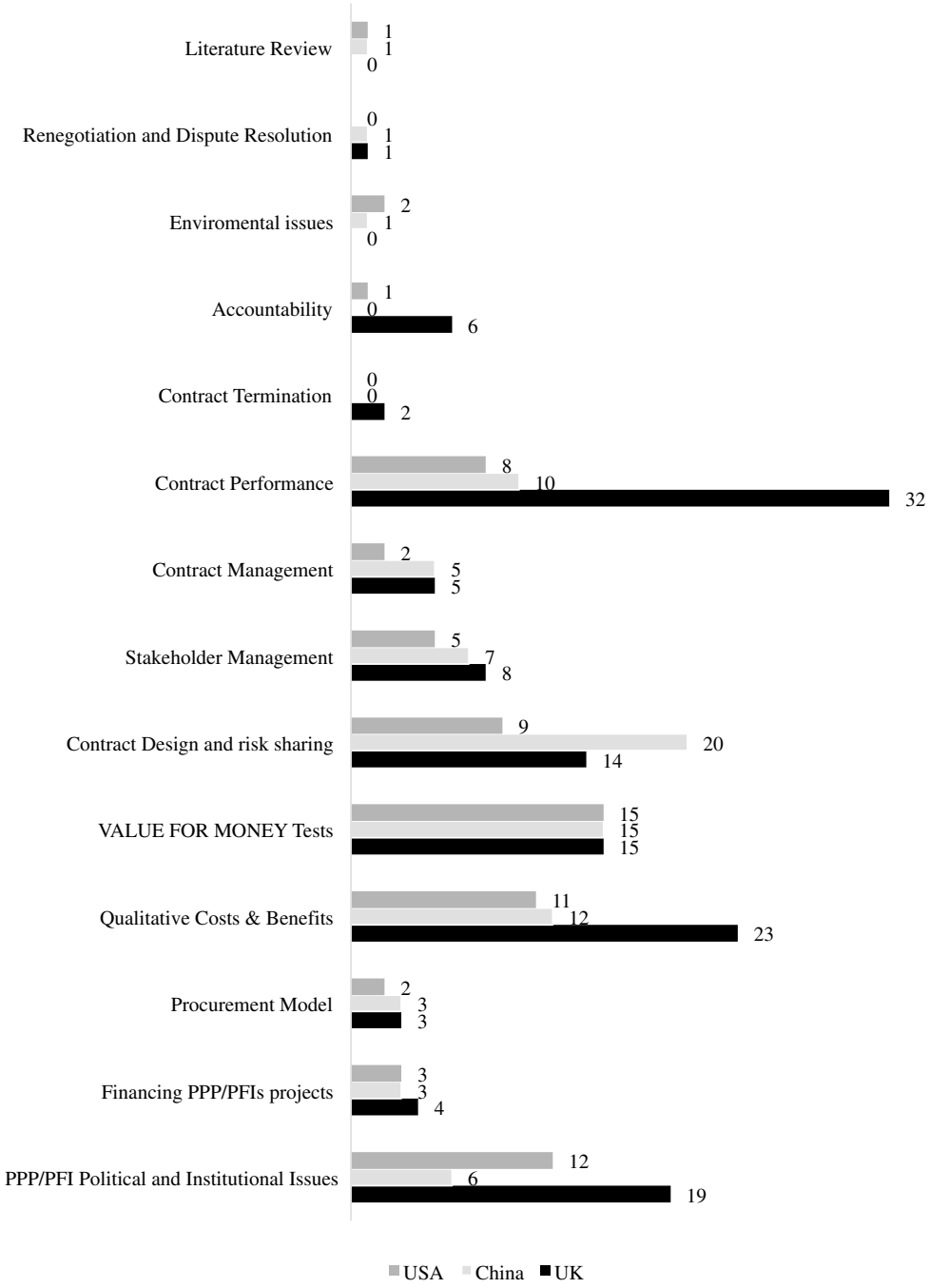

Fig. 6. Number of papers per topic of the United Kingdom, China, and the United States

Table 5. Top 10 Papers in Number of Citations

Ranking	Paper	Topics	Number of citations
1	Backstrand (2008)	Accountability	80
2	Gesler et al. (2004)	Stakeholder management	77
3	Bovaird (2004)	Qualitative costs and benefits	76
4	Zhang (2005)	Contract management	70
5	Bennett and Iossa (2006)	Contract termination	58
6	Froud (2003)	Contract design and risk sharing	54
7	Brereton and Temple (1999)	Stakeholder management	49
8	Grout (1997)	Value for money tests	49
9	Ke et al. (2010)	Contract design and risk sharing	36
10	Kwak et al. (2009)	Contract performance	36

is a popular theme among these countries' papers that sought to investigate the VFM's analysis, problems, case studies evaluations, and determined concessions prices.

Most Cited Papers

In this section, the idea was to create a list of the most cited papers for PPP and PFI in the literature and the topics of those papers. The classification resulted in the top 10 papers for each term depicted in Table 5.

Research Limitations

This type of literature review is not immune to criticism and it contains some limitations regarding the use of Web of Science as the search tool. Although Web of Science is considered the world's leading citation database, offering a high level of accuracy and detail on a multidisciplinary scale, it does not capture the entire diversity of the publications. The search criteria adopted in this paper's bibliometric analysis also identified a number of false positives which required manual analysis and some papers' exclusion.

Conclusions

The objective of this paper was to undertake a broad literature review of the PPP research. The review undertaken in this paper uses a bibliometric analysis to select a sample of more than 600 papers from the Web of Science, considered the largest and most reliable source for academic publications. The database of PPP papers built is more than double the amount of the widest previous literature studies but the main difference from previous studies is the level and depth of analysis, particularly concerning the categorization of existing studies, allowing readers to track how and where the literature has evolved. This analysis also allowed identifying the main gaps and opportunities in PPP research, highlighting the main opportunities for future research in this promising field. Despite the slight decrease verified in 2014, the number of publications regarding PPP appears to have a tendency to growth. First, because many authors have now established PPPs as their primary research area and second because the first generation of PPPs (early 1990s) is now reaching the end, providing valuable empirical evidence of successes and failures, and building lessons for improving the performance of this procurement model. Furthermore, the number of PPP projects throughout the world is increasing, with a stronger growth in developing economies, eager to access private financing and private expertise to modernize the countries' infrastructure systems. Among the Web of Science's classification, engineering journals have been taking the lead in PPP research, followed by public administration, and then business and economics, illustrating the multidisciplinary approach to this area. In relation to the Web of Science's research areas classification, it is noticed that, although PPPs have been used in technical systems (engineering), there is a strong dimension of public governance and administration, and also implications from a financial/economical perspective. Another notable conclusion, considering the papers' research origins and geographic scope classification, is that European and Asian research institutions had written almost two-thirds of the papers, which is approximately the same number of papers that had used these geographies as case studies. It would demonstrate that there is a tendency for research institutions to investigate projects on their own geographical areas. The two lists created: project sectors and research topics, contributed to highlighting the sectors and topics with a greater number of papers. PPPs research has been focused on a limited set of topics, which together represent almost 80% of the publications. These topics are contract performance, qualitative costs and benefits, contract design and risk sharing, political and institutional issues, and value for money tests. Academia has been particularly sharp at contributing to the aspects of contract design, risk sharing, and analyzing the contract performance and benefits, but has devoted less attention to the areas of contract termination and renegotiation. The seminal works on PPPs were also aimed at the contract design area (an extremely relevant research area per se in the economics field) and in empirical evaluation studies. Given that some of the main problems in the use of PPP are emerging during a project's life, the areas of contract management, contract termination, renegotiation, and even contract failure are very likely to grow. This is a major gap for governments, and also for the private sector, that are now facing the difficulties of inadequate contract management and dealing with the consequences of early termination of contracts. The future research on PPPs should address this issue and develop robust mechanisms and processes.

Supplemental Data

Appendixes S1 and S2 are available online in the ASCE Library (http://www.ascelibrary.org).

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