

Research Trends in Public Private Partnerships (PPPs): A Bibliometric Study (2010-2020)

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Abstract

This paper has adopted a holistic approach to conduct a bibliometric analysis of PPP literature published during 2010 to 2020. Using Scopus database and VOSviewer software, this study conducted a bibliometric analysis based on author-provided keywords, co-authorships, and authors' host country. Along with that publication trend analysis was done to identify the leading journals publishing PPP research, most prolific authors and influential papers using citation analysis. The study concluded that there is an ongoing interest in conducting PPP research. Authors from emerging countries have started making more contributions as the usage of PPP shift towards emerging and under-developed countries.

1. Introduction

There is no ambiguity among researchers and practitioners about the role and significance of infrastructure in deciding the economic growth trajectory of any country. Historically, the government was expected to invest in the infrastructural assets both at federal and state levels. However, as the public sector failed to cope up the growing demand of infrastructural assets, the need for private sector involvement in developing and maintaining the infrastructural resources gained momentum (Srivastava and Kumar, 2010; Chotia and Rao, 2018). The private sector investment in public assets is done using Public-private partnerships (PPPs) under which the private firm develops and/or operates the public assets covered under a gamut of contractual obligations (Srivastava and Kumar, 2010). Under PPPs, various operational structures are used like Built-Operate-Transfer (BOT), Built-Own-Operate-Transfer (BOOT) and Design-Build-Finance-Operate (DBFO), to name a few.

Investment through PPP projects is on the rise since 2014, although there was a dip in 2016. The annual number of new PPP projects have average nearly 400 while the investment amount is in the range of ~\$100 billion (Figure 1).

Figure 1: Investment Commitments in Infrastructure Projects with Private Participation in Emerging Market and Developing Economies (EMDEs), 2010-2019 (Investment in \$ billion)



Source: PPI 2019 Annual Report, World Bank

The present paper is structured in six sections with first section providing an introduction, followed by section 2 presenting the objectives of the paper. Section 3 details the research study design and methodology used for the paper. The publication trend analysis is presented in section 4, while bibliometric analysis is presented in section 5. Section 6 concludes the paper.

2. Study Objectives

With rising infrastructure investment occurring using PPPs across the globe, research has explored various facets of PPPs (Grimsey and Lewis, 2002; Chan et al, 2010). Researchers have explored the various domains of PPPs like risk management (Hurk and Verhoest, 2014), feasibility analysis (Wibowo, 2004), resource procurement (Zhang, 2005), and critical success factors (Osei-Kyei and Chan, 2015).

As the practical usage of PPP model is on the rise, there is a need to provide the future researchers with an overview of recent trends in research to support in designing future research strategies. As the research directions keep evolving, this bibliometric review paper of PPP studies is undertaken with the following objectives:

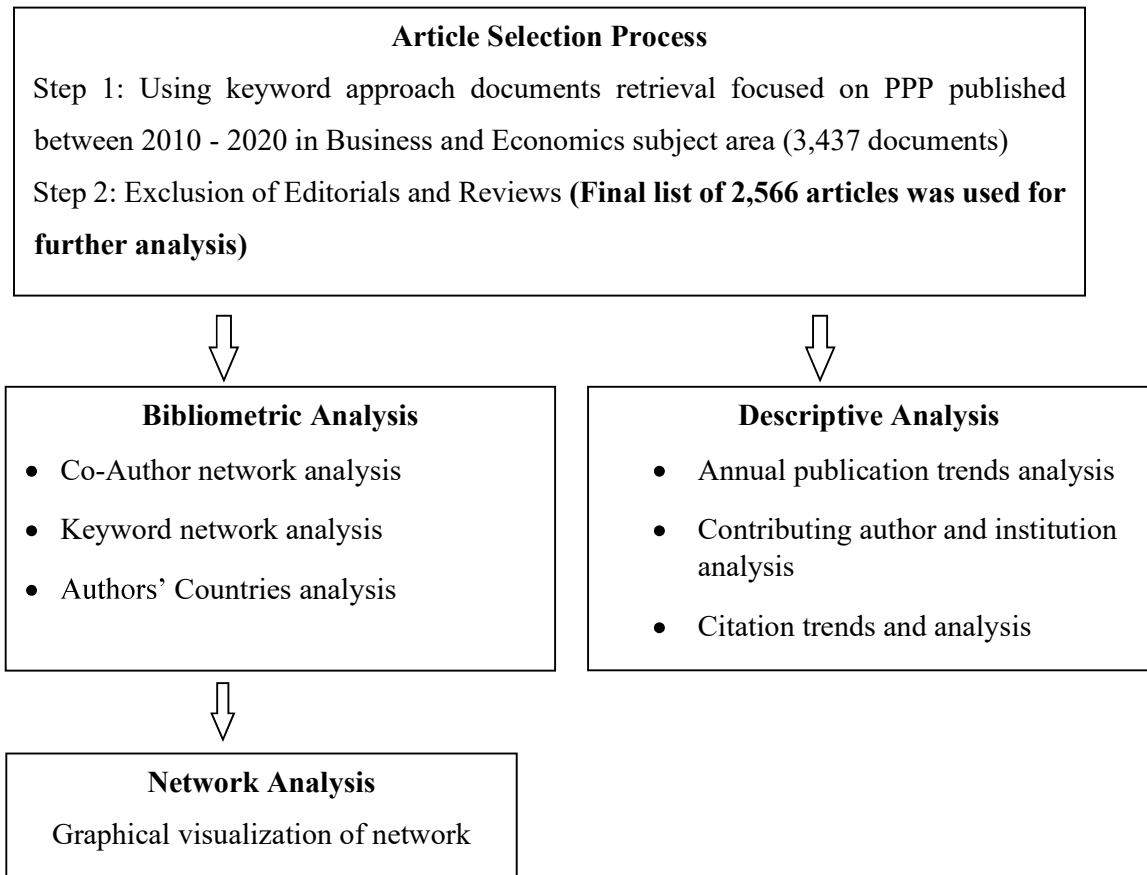
1. To explore the evolution of PPP research during 2010-2020;
2. To identify the main sources, significant articles, and leading contributors during 2010-2020; and

3. To identify various trends in key words, co-authorship, and authors' countries using bibliometric coupling.

3. Research Study Design and Methodology

The research study design adopted for the study is presented in Table 1.

Figure 1: Research study design



Source: Authors' Representation

3.1 Article Selection

To conduct the study, a keyword driven search approach was used as such approach has been extensively used in conducting bibliometric analysis (Pattnaik et al, 2020; Pinto et al, 2020). A search based on keywords “PPP” or “Public Private Partnership (s)” or “PFI” or “Private Finance Initiative (s)” was conducted on Scopus database. As compared to other sources like Google scholar and Web of Science, Scopus database is considered superior source due to wide and diverse coverage of research publications (Chadegani et al, 2011; He et al, 2017; Oraee et

al, 2017). After applying various filters for time-period (2010-2020), language (English only), domain (Business Management and Economics) and type (articles only) on the initial documents sourced, a final list of 2,566 documents was generated.

3.2 Methodology

The study has used a bibliometric analysis approach. Bibliometric analysis is a quantitative approach to analysis the bibliographical data (Nicholas and Ritchie, 1978; Sureka et al, 2020). Using microlevel relationships between various domains of a specific research topic, bibliometric analysis is considered better than other approaches to literature review due to objective and structural analysis without any biases (Cobo et al, 2011; Chen and Xiao, 2016; Aria and Cuccurullo, 2017).

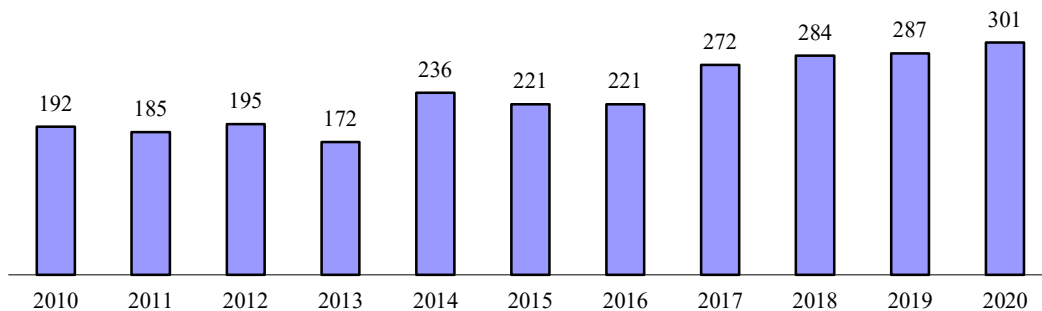
To conduct bibliometric analysis, *VOSviewer*, text mining software tool, was used. The usage of *VOSviewer* has been gaining traction in conducting bibliometric based literature review (Park and Nagy, 2018, Nicolas et al, 2020; Pattnaik et al, 2020; Pinto et al, 2020)

4. Publications Trends

This section presents the publication and impact trends based on the final list of 2,566 articles sourced from Scopus database using keyword-driven search strategy. To understand the publication and impact trends, descriptive analysis was done on various categories like annual publications, author, country, and source.

4.1 Annual publications

Figure 2: Number of journal articles published annually, 2010-2020



Source: Author's Calculations

The annual publication of PPP research articles is presented in figure 2. The annual publication indicates a rising interest in research in PPP domain. Although there has been a small dip in

2015, but the overall annual publication trend is on the rise with annual publications rising to 301 in 2020 as compared to 192 in 2010.

4.2 Source

Table 1 provides the list of top 20 journals publishing PPPs articles during 2010 to 2020. These 20 journals have accounted for ~30% of the total articles published during the time period. There are four journals which have published more than 50 articles with Applied Economic Letters (Taylor & Francis) accounting for 73 articles, followed by Journal of Construction Engineering and Management (American Society of Civil Engineers) with 57 articles. Applied Economics (Taylor & Francis) and International Journal of Project Management (Elsevier) both have published 55 articles each.

Table 1 Leading journals publishing research in PPP domain, 2010-2020

Journal	Publisher	No. of articles published
Applied Economics Letters	Taylor & Francis	73
Journal of Construction Engineering and Management	American Society of Civil Engineers	57
Applied Economics	Taylor & Francis	55
International Journal of Project Management	Elsevier	55
Journal of Management in Engineering	American Society of Civil Engineers	49
Engineering Construction and Architectural Management	Emerald	41
Journal of Cleaner Production	Elsevier	40
Construction Management and Economics	Taylor & Francis	37
International Journal of Construction Management	Taylor & Francis	37
Public Works Management and Policy	Sage	37
Research in Transportation Economics	Elsevier	37
Public Money and Management	Taylor & Francis	34
Public Management Review	Taylor & Francis	32
Utilities Policy	Elsevier	32

Journal of International Money and Finance	Elsevier	29
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Table 1 Leading journals publishing research in PPP domain, 2010-2020 (contd.)

Journal	Publisher	No. of articles published
Journal of Financial Management of Property and Construction	Emerald	28
Cities	Elsevier	27
ENR Engineering News Record	BNP Media	24
International Journal of Strategic Property Management	Taylor & Francis	22
Economics Bulletin	Vanderbilt University	21

Source: Author's Compilation

4.3 Authors

The list of authors having more than 10 publications in PPP domain are presented in table 2. Albert P. C. Chan (The Hong Kong Polytechnic University, HK) is leading author with 45 articles published during 2010 to 2020. His colleague, Robert Osei-Kyei (The Hong Kong Polytechnic University, HK) has made 20 contributions during the same period. Carlos Oliveira Cruz (Technical University of Lisbon, Portugal) and Yongjian Ke (Tsinghua University, China) have both authored 14 articles each.

Table 2: Leading contributors in PPP research, 2010-2020

Author	Host Institution	No. of articles published
A. P. C. Chan	The Hong Kong Polytechnic University, HK	45
R. Osei-Kyei	The Hong Kong Polytechnic University, HK	20
C. O. Cruz	Technical University of Lisbon, Portugal	14
Y. Ke	Tsinghua University, China	14
R. C. Marques	Technical University of Lisbon, Portugal	13
W. Xiong	Tongji University, China	13
M. J. Skibniewski	University of Maryland, US	12

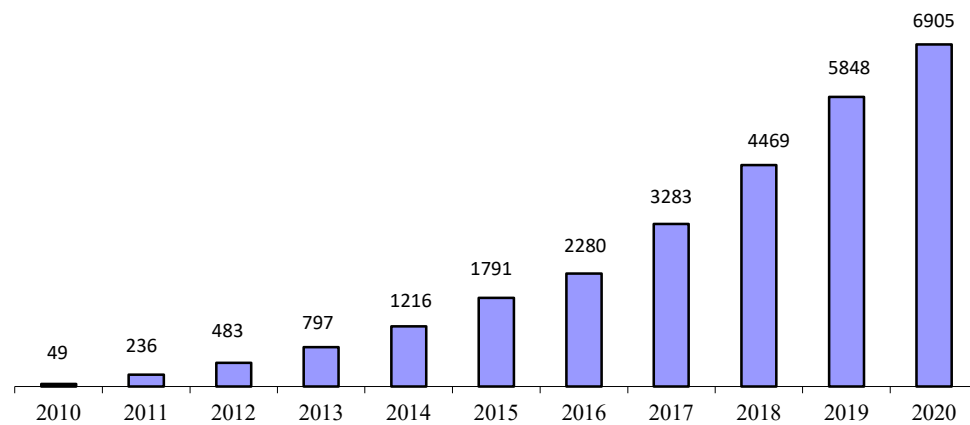
I. Demirag	Queen’s University Belfast, UK	11
J. Liu	Xiamen University, China	11
P. Stapleton	The University of Manchester, UK	11

Source: Author’s Compilation

4.4 Citation Analysis

Figure 3 highlights total citations of 2,566 selected PPP papers during 2010 to 2020. The total citations of these selected papers increased from 49 in 2010 to 6,905 in 2020, and the total citations of these papers 27,357 during the study period. This indicates that the research on PPP domain is on the rise and these papers are very influential in the further research.

Figure 3: Trend in annual citations of PPP articles, 2010-2020



Source: Author’s Compilation

Table 3 presents the top cited articles having minimum of 100 citations. Emerson et al (2012) is the most influential paper with 795 citations till 2020. Apart from this, five more articles have more than 200 citations each – Firnkorn and Muller (2011): 265 citations; Osei-Kyei and Chan (2015): 259 citations; Ke et al (2010): 234 citations; Tang et al (2010): 209 citations; and Chan et al (2010): 203 citations.

Table 3: Top cited articles in PPP domain, 2010-2020

Article Title	Authors	Year	Total Citations
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An integrative framework for collaborative governance	Emerson K., Nabatchi T., Balogh S.	2012	795
What will be the environmental effects of new free-floating car-sharing systems? The case of car2go in Ulm	Firnkor J., Muller M.	2011	265

Table 3: Top cited articles in PPP domain, 2010-2020 (contd.)

Article Title	Authors	Year	Total Citations
Review of studies on the critical success factors for public-private partnership (PPP) projects from 1990 to 2013	Osei-Kyei R., Chan A.P.C.	2015	259
Preferred risk allocation in China's public-private partnership (PPP) projects	Ke Y., Wang S., Chan A.P.C., Lam P.T.I.	2010	234
A review of studies on Public-Private Partnership projects in the construction industry	Tang L., Shen Q., Cheng E.W.L.	2010	209
Critical success factors for PPPs in infrastructure developments: Chinese perspective	Chan A.P.C., Lam P.T.I., Chan D.W.M., Cheung E., Ke Y.	2010	203
The role of Big Data in explaining disaster resilience in supply chains for sustainability	Papadopoulos T., Gunasekaran A., Dubey R., Altay N., Childe S.J., Fosso-Wamba S.	2017	180
Public private partnership projects in Singapore: Factors, critical risks and preferred risk allocation from the perspective of contractors	Hwang B., Zhao X., Gay M.J.S.	2013	175
Empirical study of risk assessment and allocation of public-private partnership projects in China	Chan A.P.C., Yeung J.F.Y., Yu C.C.P., Wang S.Q., Ke Y.	2011	152

Does cross-sectoral partnership deliver? An empirical exploration of public service effectiveness, efficiency, and equity	Andrews R., Entwistle T.	2010	153
The short-term impact of unconditional cash transfers to the poor: Experimental evidence from Kenya	Haushofer J., Shapiro J.	2016	143
Household food waste behaviour in EU-27 countries: A multilevel analysis	Secondi L., Principato L., Laureti T.	2015	135
Price indexes, inequality, and the measurement of world poverty	Deaton A.	2010	139

Table 3: Top cited articles in PPP domain, 2010-2020 (contd.)

Article Title	Authors	Year	Total Citations
International regulation without international government: Improving IO performance through orchestration	Abbott K.W., Snidal D.	2010	139
Risks, contracts, and private-sector participation in infrastructure	Marques R.C., Berg S.	2011	138
Addressing food waste reduction in Denmark	Halloran A., Clement J., Kornum N., Bucatariu C., Magid J.	2014	124
Identifying the critical success factors for relationship management in PPP projects	Zou W., Kumaraswamy M., Chung J., Wong J.	2014	125
Cross-country comparisons of key drivers, critical success factors and risk allocation for public-private partnership projects	Chou J.-S., Pramudawardhani D.	2015	120
Modelling optimal risk allocation in PPP projects using artificial neural networks	Jin X.-H., Zhang G.	2011	120
Hierarchical structuring of PPP risks using interpretative structural modelling	Iyer K.C., Sagheer M.	2010	114

Flexible contracts to cope with uncertainty in public-private partnerships	Cruz C.O., Marques R.C.	2013	108
Understanding PPPs and PPP-based national accounts	Deaton A., Heston A.	2010	109
The effect of foreign direct investment and stock market growth on clean energy use across a panel of emerging market economies	Paramati S.R., Ummalla M., Apergis N.	2016	107
The simple microeconomics of public-private partnerships	Iossa E., Martimort D.	2015	107
The Level and Distribution of Global Household Wealth	Davies J.B., Sandstrom S., Shorrocks A., Wolff E.N.	2011	106
Accountability and corporate governance of public private partnerships	Shaoul J., Stafford A., Stapleton P.	2012	104

Table 3: Top cited articles in PPP domain, 2010-2020 (contd.)

Article Title	Authors	Year	Total Citations
Developing a fuzzy risk allocation model for PPP projects in China	Xu Y., Chan A.P.C., Yeung J.F.Y.	2010	104
Private finance for public goods: Social impact bonds	Warner M. E.	2013	101

Source: Author's Compilation

5. Bibliometric Analysis

For conducting bibliometric analysis, *VOSviewer*, text mining software tool, was used. The bibliometric analysis was conducted to understand the keywords occurrence analysis, co-authorship analysis, trend in author' countries in PPPs research.

5.1 Keyword Analysis

Keywords indicate the specific domains of research with the broad areas (Su and Lee, 2010). To understand the pattern and connection between various research studies, keyword analysis is used (Eck and Waltman, 2014). To understand the major themes in PPP research during 2010 and 2020, the occurrence of author-provided keywords were analysed using *VOSviewer*. To extract the maximum occurrence of keywords, minimum occurrence was set at 2 on author-

provided keywords. Table 4 presents the most occurred author keywords during 2010 and 2020 with minimum occurrence of 30.

Table 4: Most frequently studied keywords in PPP research, 2010-2020

Author-provided keywords	Occurrence frequency	Total Link strength
Public-private partnerships or public-private partnership or public private partnership	240	584
PPP or PPPs	96	227
Infrastructure	87	297
China	49	141
Procurement	46	169
Purchasing power parity	40	70
Governance	38	116
Partnership	32	119

Table 4: Most frequently studied keywords in PPP research, 2010-2020

Author-provided keywords	Occurrence frequency	Total Link strength
Risk management or risk allocation	32	108
Innovation	31	79
Critical success factor	30	101

Source: Author's Compilation using *VOSviewer*

Most used keywords by authors are “public-private partnerships” or “public-private partnership”. “PPP” and “Infrastructure” are also used extensively by authors. Gradually, the shift is occurring towards the study of “purchasing power parity”, “risk management”, “critical success factors” and “governance” related issues in PPP domain.

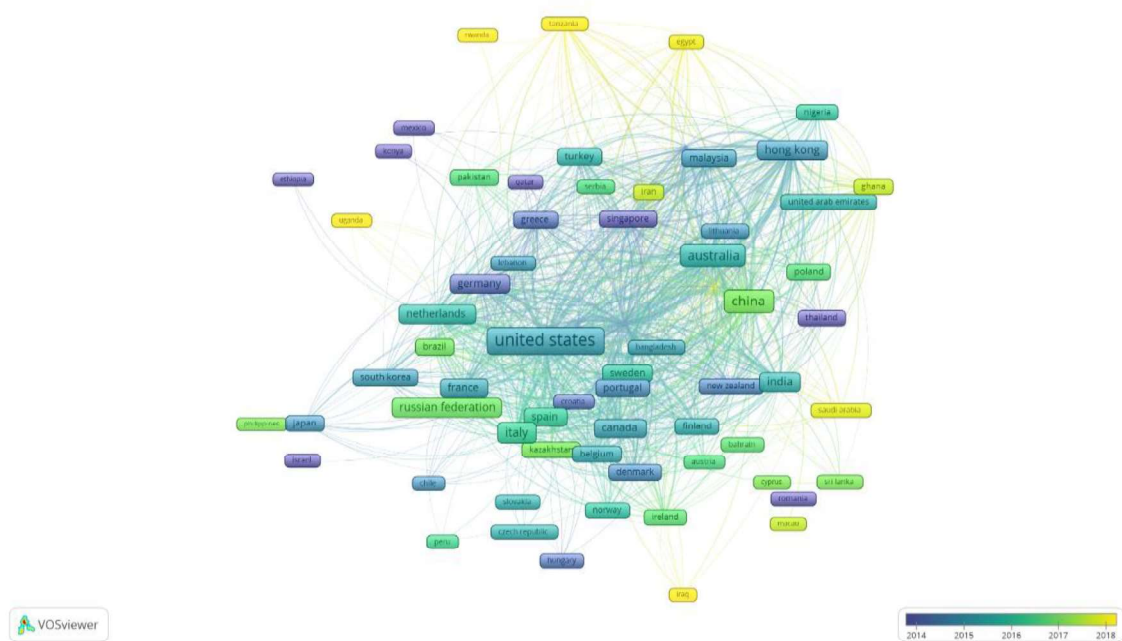
Figure 4 presents the bibliometric coupling map of author-provided keywords. Based on node size and linkages, it is evident that PPP (used in different formats) is frequently used keyword. For sector, infrastructure is the area on which studies have focused. In regions, China has dominated the studies with India and emerging markets also gaining prominence.

Russian Federation	85	553	3348
Netherlands	70	1154	22492
France	66	1212	15888
Germany	61	1335	18041
Spain	58	582	17783
Canada	58	831	14520

Source: Author’s compilation using VOSviewer

It is evident from table 5 that US and UK are the leading author countries with 365 and 226 documents respectively. Among top ten countries only authors from China, India and Russian Federation contribute from emerging nations. The network overlay map (Figure 5) of author countries indicate that the contribution from emerging as well as underdeveloped nations is on the rise in PPP domain as the usage of these models is on the rise in these countries.

Figure 5: Bibliometric mapping of authors’ host countries in PPP research, 2010-2020



Source: Author’s analysis using VOSviewer

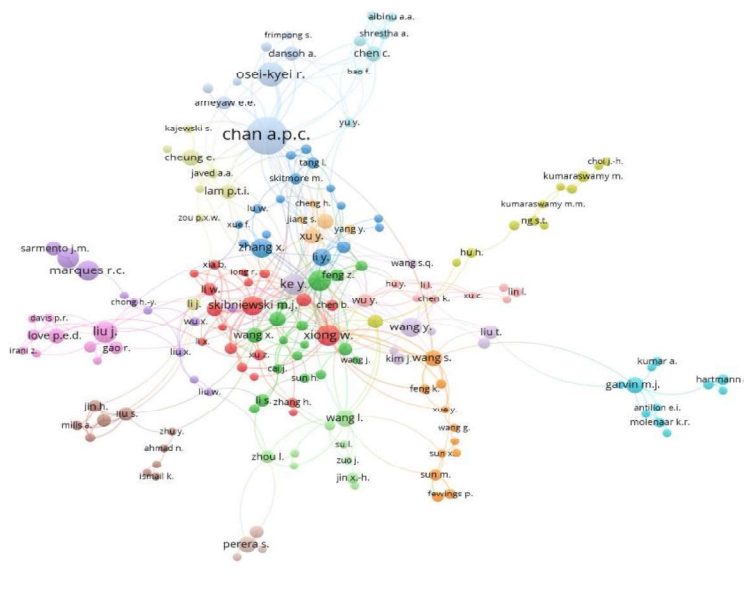
5.3 Co-authorship Analysis

To understand the research associations and collaborations, co-authorship analysis is considered a significant bibliometric analysis approach (Hosseini et al, 2018). Using 2 articles and 20 citations as minimum criteria, bibliometric mapping of co-authorship was done using VOSviewer and the results are presented in figure 6.

Based on figure 6 analysis, it is evident that there are several clusters of researchers indicating strong collaborations in PPP research. Based on node size, the strongest cluster is formed around A. P. C. Chan with R. Osei-Kyei as a very strong collaborator. This is supported by the author contributions as these two authors have contributed collectively 65 articles in PPP research during 2010-2020.

Other significant clusters are centred around X. Zhang with Y Li and F. Xue as joint researchers and Y. Ke with Y. Wang, T. Liu and J. Kim as partners. Other emerging clusters although, relatively smaller by node size, have primary authors as R. C. Marques with J. M. Sarmiento as research partner, and J. Liu with R. Gao and P. E. D. Love as main research collaborators. Another emerging cluster is M. J. Garvin as main researchers and A. Kumar and A. Hartmann as joint researchers.

Figure 6: Bibliometric mapping of co-authorship analysis



Source: Author's analysis using *VOSviewer*

6. Conclusion

Using publication trend analysis and bibliometric analysis approaches, the paper found that research interest in PPPs is growing at a steady pace since 2010. With the help of various parameters like citations, annual publications, leading authors, authors' host countries and

keywords, the research publication in PPP domain was analysed to provide the answers to established research questions. The key findings of the study can be summarized as:

- Annual publications rose from 192 in 2010 to 310 in 2020 indicating an ongoing and continued interest in PPP research across the globe
- Most used author-provided keywords indicate that the research has focused on risk management, critical success factors and governance related issues in PPP structures.
- From region/country specific, China has dominated in author-provided keyword indicating a lot of research has centred around China, but gradually research on emerging markets is also increasing.
- The citation trend also indicate that the interest in PPP research is on an upward trend as the citation of PPP articles has grown multi-fold during 2010-2020.
- In past researchers based in USA and UK have been most prominent authors in PPP research but gradually researchers based in emerging markets led by China and India are also emerging as significant contributors with various research collaborations emerging with authors based at institutions in emerging countries.

Using scientific mapping approach with descriptive analysis, the paper presents a bibliometric analysis of PPP research during 2010-2020 and it will help future researchers in identifying key recent trends in PPP research.

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