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MANAGING THE MULTI-STAKEHOLDER COMPLEX IN P3 PROJECT DECISION-MAKING: A MIX-METHOD REVIEW

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Abstract. Managing stakeholders in a public-private partnership (P3) project is complex; it involves uncertainties, variations, and intricacies. A typical P3 system has a dynamic multi-stakeholder system requiring active project management to avoid delays, conflicts, and partnership failures. Presently, limited research has explored stakeholder management in P3 projects. The current study uses bibliometric and scientometric analyses to identify stakeholder-related issues in P3 decision-making. A keyword co-occurrence and clustering reveal that project stakeholders strongly influence significant P3 decision-making in risk management, concession design, procurement, and sustainability. Therefore, a detailed content analysis is conducted to discuss this in detail. The study reveals that poor structuring of roles and responsibilities, public opposition, information asymmetry, principal-agent problems, knowledge management, and corruption are crucial stakeholder issues in decision-making. Further, a systems thinking framework is used to study the stakeholder dynamics for early engagement and relationship management for P3 projects. Lastly, the study findings are summarised as a conceptual framework of stakeholder-related issues with corresponding stakeholder management process steps. The review contributes to inclusive stakeholder management for P3 projects, helping early-stage researchers and practitioners. They can develop a more profound domain knowledge of P3 stakeholder-related issues, decision-making aspects, and stakeholder management elements.

Keywords: stakeholder management, P3, decision-making, review, scientometric, bibliometrics.

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1. Introduction

Using integrated contracts such as public-private partnerships (P3) became attractive for the delivery of large infrastructure projects in the perspective of budget deficits and sustainability-related policies of governments worldwide. However, long-term contract projects are tricky because of their high risks, multi-stakeholder nature, and complex implementation (Ampratwum et al., 2022). Moreover, many countries have suffered economically due to the current global circumstances surrounding COVID-19, and existing P3 projects have suffered failure (Casady & Baxter, 2020). In particular, the complex actions and decisions of public, private, and external stakeholders, the complicated interactions and interrelationships between several stakeholders, and segregated project teams can lead to conflicts, litigations, and even failure (Malaeb & Hamzeh, 2021; Zhang & Tariq, 2020). The consequences of such failures may negatively influence the interests of all primary stakeholders, including the public and private sectors' project ambitions and contractual commitments, as well as the general public's (the users') trust in P3 projects. However, an opportunity in these circumstances to overcome the funding deficits is to revamp the P3 model in line with

the current public demands and stakeholder issues (Cheng et al., 2021b). The successful delivery of such projects is not possible without efficient stakeholder management.

In this regard, a stakeholder in the context of project goals and objectives is an unresolved dilemma in large infrastructure projects, especially P3 (Malaeb & Hamzeh, 2021). P3 projects are multi-stakeholder systems in which a consortium is formed to handle the project over the entire concession period, usually 15–20 years. Over this concession period, stakeholder involvement, preferences, interests, power, and information levels will vary along with the project's life. Over time, this change in the stakeholder attributes creates emergent behavior that leads to conflicts, disputes, and project failure (Nguyen et al., 2018). For example, stakeholder misalignment and stakeholder disputes are the main failure drivers in four of the 26 reviewed transportation projects in the USA (Zhang et al., 2020). Moreover, stakeholder-related barriers related to responsibility misallocation and corruption were highlighted as the main hindrances in sustainable P3 project delivery (Bakhtawar et al., 2022). Thus, a detailed study on stakeholder management for P3 projects is required. Though several studies have reviewed the P3 literature (Cheng et al., 2021b; Hodge & Greve, 2018; Jensen, 2017; Ullah et al., 2016; Yu et al., 2018), none of them has comprehensively addressed the stakeholder management of P3 projects. The current study, therefore, addresses this gap in detail. The three main objectives of the review are as follows:

1) To conduct a review of the stakeholder-related research in the domain of P3 projects. The objective includes the study of publication trends using bibliometric analyses to understand the structure of research in the domain related to P3 stakeholders.
2) To classify the stakeholder-related themes in P3 research. The objective includes the study of themes and sub-themes related to the study topic using both a clustering and content analysis approach. Using the thematic approach can help understand the role of stakeholder issues in different aspects of P3 project development.
3) To delineate the stakeholder management process aspects in context of P3 project life. The objective includes identifying the stakeholder management steps, stakeholder analysis methods and studying the important steps using a systems thinking approach.

In the end, inferences are developed, and a framework is proposed to further the stakeholder management process in P3 projects. The study findings help guide future researchers and decision-makers in new directions to solve stakeholder-related issues in P3 projects. The study's knowledge contributions can serve as a basis for developing sophisticated and inclusive policies and processes for stakeholder management to implement P3 projects effectively.

2. Research methodology

The study adopted a mixed-method approach for the current review. Bibliometric analyses like keyword analysis and keyword clustering were used to understand the role of stakeholder aspects in P3 decision-making areas like risk management, procurement, and sustainability. Further, a co-citation and co-author analysis revealed important journals, citations, and sources related to P3 stakeholder research. These analyses contributed to the study's first objective, which was to understand the publication trends. Afterwards, a detailed content analysis focused on the other two goals using manual assessment. Each article was read in detail to understand the focus, gaps, and future directions. Further details about the bibliometric and content analyses are elaborated in this section, and the detailed methodology is presented in Figure 1.

2.1. Article selection

Searching for relevant articles related to stakeholder issues and management from the P3 literature base required a detailed article selection because of the rich research database on P3 projects. The steps for the article selection are detailed in this section. First, the keywords were selected carefully based on past review papers on P3 (Hodge & Greve, 2018; Song et al., 2016; Ullah et al., 2016). To consider the stakeholder-relevant articles in P3 projects, Xue et al. (2020) and Mok et al. (2015) recommend using stakeholder-related keywords like "stakeholder", "project participant", and "project environment" in the search design. The final search design consisting of both stakeholder and P3-related keywords was as follows: (*"PPP" OR "BOT" OR "Public Private Partnership" OR "DBFM" OR "Build operate transfer" OR "PFI" OR "private finance initiative" OR "long-term infrastructure contracts" OR "large infrastructure projects" OR "complex projects" OR "complex construction projects"*) *AND* (*"construction" OR "construction projects" OR "infrastructure" OR "projects" OR "project management" OR "construction management" OR "construction industry"*) *AND* (*"stakeholder management" OR "relationship management" OR "stakeholder identification" OR "stakeholder analysis" OR "stakeholder satisfaction" OR "stakeholder" OR "project stakeholders" OR "project participants"*, *"external stakeholders" OR "stakeholder engagement"*). The search design was used for further screening and focused review of articles published from 1990 to 2021 using Web of Science (WOS). WOS is a leading source of published records (Li et al., 2018). It can be regarded as one of the high-performance data sources for similar topics of study (Long et al., 2024; Osei-Kyei et al., 2023). Also, it has most of the core journals related to P3 and infrastructure research listed with it (Song et al., 2016). Moreover, the WOS can be easily used for analysis on bibliometric software for scientometric study. Thus, WOS is a suitable database for the current review.

However, a broader search design resulted in many irrelevant articles from other disciplines due to the similarity of abbreviations. The selected search design resulted

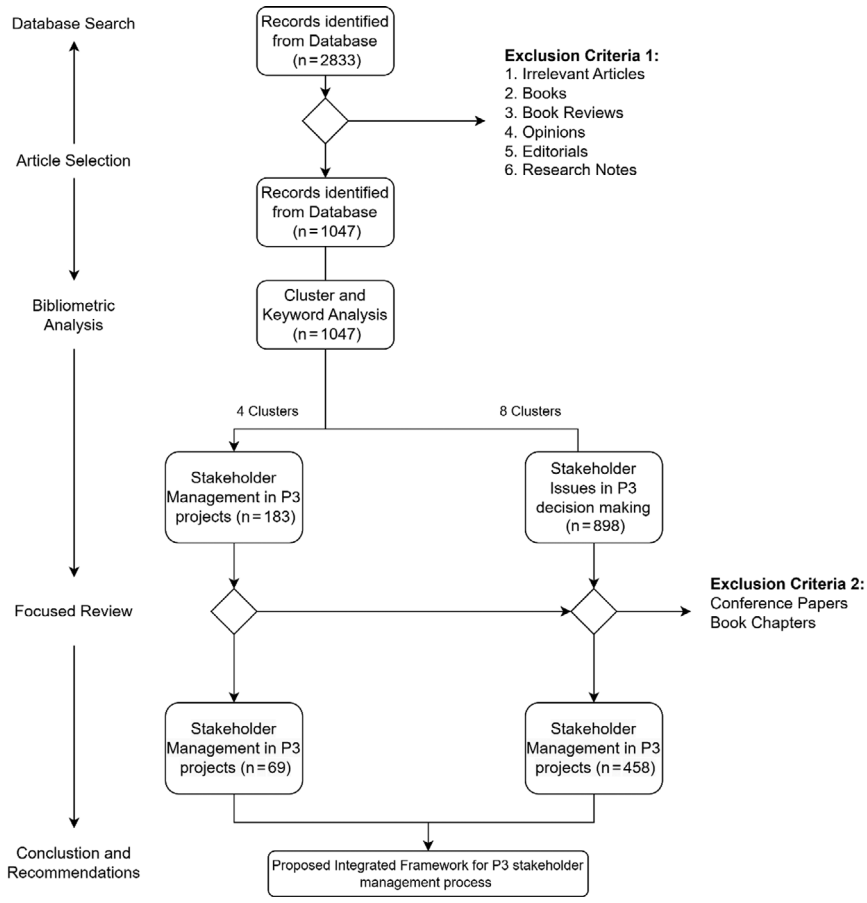

Figure 1. Research methodology

in 2833 articles. For example, PPP also stands for power purchasing parity, plant-derived phenylpropanoids, and Precise Point Positioning, which are economics, chemistry, and geography concepts. Articles related to such irrelevant terms are excluded using complete forms of such specific abbreviations. Irrelevant subjects related to basic sciences and surgery were also omitted from the search using subject filters in Web of Science. To limit the published literature to only peer-reviewed publications, the selected articles also eliminated book reviews, editorial notes, research notes, and opinions. The automated screening using WoS gave 1047 articles purely related to P3 projects related to infrastructure and related services. The full details of the papers in the dataset, including citation information, are then downloaded for further bibliometric analysis.

2.2. Bibliometric analysis

A social network analysis (SNA) technique using software tools VOSviewer, HistCite™, and Gephi was used for the bibliometric study of the dataset. SNA is an effective technique to reveal generic patterns in social networks (Hewa Welege et al., 2021). A keyword co-occurrence and keyword cluster analysis show the stakeholder relevancy for P3 research. Overall, keywords reflect the main research themes of an article; they are the pivots around which an article revolves, and they inform about the direction of the research. The keyword co-occurrence network provides a graphical way to analyse the relationship between these research themes. An appropriately connected mapping of related keywords helps better understand the relationships, trends, and intellectual organisation of the research domains captured through the creation and dissemination of scientific knowledge over the years (Hasan et al., 2021). Further, a direct citation analysis was used to identify the top journals and articles in the relevant study area. Moreover, a co-author analysis was used to identify the top institutions and countries relevant to the stakeholder research for P3 projects (Akram et al., 2019). Association strength was selected as the clustering parameter while conducting the SNA with layout parameters 1 and 0 (attraction and repulsion). The results were optimised to reveal valuable results. The total link strength between the nodes (articles) was used for analysis. Details of the bibliometric analysis results are further presented in Section 3.

2.3. Classification of research themes

Using a detailed content analysis for focused review, a representative subset of the data set was created using manual screening and classification. The classification was done using the results of the clustering analysis, and the subset consisted of all the published articles that had the keywords like stakeholder management, relationship man-

agement, stakeholder identification, stakeholder analysis, satisfaction, stakeholder, project stakeholders, project participants, external stakeholders, stakeholder engagement in their titles and keywords. For example, Burke and Demirag (2017) explicitly focus on stakeholder relationships in P3 projects. Thus, this subset of 183 articles can be called the stakeholder management subset. The remaining 898 articles implicitly address stakeholder management at a secondary or tertiary level. For example, some studies on risk management in P3 projects also study stakeholder risk perception and behavior (Ke et al., 2013; Park et al., 2020; Shrestha et al., 2018). However, such articles need further study on how they address stakeholder-related issues in other decision-making aspects of P3, like contract management, risk management, or sustainability. Articles related to stakeholder-related issues are further discussed in Section 4, while the articles explicitly focusing on stakeholder management of P3 projects are covered in Section 5. After the classification, a year-wise evolution of the research domain was studied to observe the main research patterns and trends of publications for the total (1047) vs stakeholder management (183) papers. Afterwards, the clustering analysis was coded to show a clear distinction for the two main themes: 1) Stakeholder-related issues in P3 decision-making and 2) Stakeholder management in P3 projects and further content analysis was carried out for discussion on these areas. A similar methodology of using the bibliometric and content analysis in a complementary way for review is adopted in a recent review (Long et al., 2024).

2.4. Focused review

For a detailed content analysis, only the journal articles were included for thorough reading and discussion. As many generic review articles have been published on the subject of P3 project decision making e-g, critical success factors, risk management, sustainability and contract management as a whole, the particular focus of the review was kept on the stakeholder issues of P3 projects (He et al., 2020; Osei-Kyei et al., 2023; Song et al., 2016; Hewa Welege et al., 2021). Considerations for P3 stakeholders are further elaborated in Section 4 of the study. Further, a detailed review is presented in Section 5 for the stakeholder management-related research. The complex steps of stakeholder engagement and relationship management are further elaborated using a systems thinking framework. A framework combining findings of stakeholder-related issues and stakeholder management process over project life is also presented. The conceptual framework can further develop a practical P3 stakeholder management decision-making framework.

3. Overview of stakeholder-related research in P3 projects

Direct citation analysis (DCA) was conducted using HistCite™ software to provide the researchers with the best available information source in P3 stakeholder management. In this study, DCA realised the field's most prominent journal sources and articles, as shown in Tables 1 and 2. Global citation and local citation scores were calculated where the international citation score represents the overall citation of an article/source, and local citation represents the citation within the domain of P3 stakeholder management. The articles/sources were ranked based on the local citation score due to the influence on the current body of knowledge. Table 1 illustrates *Construction Management and Economics* as the most prominent journal, followed by the *Journal of Construction Engineering and Management* and *Built Environment Project and Asset Management*. These are among the top journals publishing high-quality original research in the broader area of construction management. Despite no concerted efforts to publish in P3, *Construction Management and Economics* and the *Journal of Construction Engineering and Management* have published almost 500 papers each in this area. On the other hand, the *Built Environment Project and Asset Management* ran two special issues on P3, first in 2019 (Jayasena et al., 2019) and the other recently in 2021 (Laishram & Devkar, 2021). This shows the focus and popularity of outlets for publishing P3-related research.

Apart from the influential journal, the most significant articles are also identified. As given in Table 2, Yuan et al. (2010) is the most influential research article. Published in 2010, this article is one of the first to address the stakeholder issue in large infrastructure projects. The average year of publication of influential articles coincides with the most influential one, 2010. This way, considering 2021 as the base year, the average age of the significant articles is 11 years. This echoes the average age of all the retrieved published papers for this review. Thus, the sample of the most influential articles not only represents the overall population of the selected P3 articles but also leads the population regarding their approach, content, and insight.

Based on the total link strength, co-author analysis was conducted for the bibliometric data using a VOSviewer. In doing so, the country and institution were analysed.

Table 1. Influential journal sources

Journal	LCS	CS	Ranking
Construction Management and Economics	90	35	1
Journal of Construction Engineering and Management	63	65	2
Built Environment Project and Asset Management	53	78	2
Journal of Management in Engineering	43	377	3
Engineering Construction and Architectural Management	35	12	5
Journal of Financial Management of Property and Construction	31	14	6
International Journal of Project Management	28	75	7
Transport Policy	20	4	9
Journal of Property Investment & Finance	18	2	10

Table 2. Influential journal articles

Articles	LCS	GCS	Ranking
Yuan et al. (2010)	43	151	1
Dixon et al. (2005)	17	61	2
Roumboutsos and Anagnostopoulos (2008)	17	81	3
Zhang (2005)	16	56	4
Cheung and Chan (2011)	16	63	5
Chou et al. (2012)	16	61	6
Tiong et al. (1992)	15	67	7
Yuan et al. (2020)	15	56	8
Yuan et al. (2012)	15	70	9
Babatunde et al. (2015)	15	33	10

In the country-wise study, China is the most productive country with the most significant cluster size and shares a strong collaboration with Australia, as shown in Figure 2a. Regarding institutional contributions, Figure 2b reveals that The Hong Kong Polytechnic University has been instrumental in addressing the stakeholder problem in P3 projects. The findings are in line with the top contributing countries. Chinese and Hong Kong universities are significantly contributing to this body of knowledge. Overall, with the number of links > 2, 5 main clusters of research collaborations exist globally, and the largest cluster has seven links.

3.1. Significance of stakeholder decision-making in P3 projects

For example, a strong relationship between public-private partnerships and stakeholders can be observed. Based on the review of 1047 articles, it is evident that the stakeholder management issue substantially overlaps with other areas of P3 decision-making, as shown in Figure 3. Some areas highlighted in the network are risk management, sustainability, value for money, and project management. For example, Farooq et al. (2018) explored the effect of stakeholder behavior and perception on risk assessment and allocation. Yuan et al. (2020) explored the importance of social aspects on the sustainability of P3 projects. More details about these overlapping research outputs are depicted in Figure 6 and discussed in the adjoining section. Gephi was used to extract the author keyword co-occurrence network using fractional counting as the method of analysis and setting five as the minimum number of co-occurrences of keywords. After removing generic and duplicate terms, 51 keywords were shortlisted as they meet the inclusion criterion, as depicted in Figure 3. The number of articles in which any two keywords appeared together forms the basis of the relationship between them as represented by the thickness of links between such keywords. The thicker the line, the stronger the relationship.

Further, to understand the influence of every single keyword on other keywords, 'degree of centrality' and 'weighted degree of centrality' were calculated using Gephi. The degree of centrality computes the number of links each keyword has with other keywords. In contrast, the weighted degree provides an idea of the average link strength of keywords compared to all other keywords (Grandjean, 2015). Keywords were then ranked based on the weighted degree of centrality, the top ten of which are given in Table 3.

This ranking revealed some interesting findings and limitations of the literature. For example, most papers in the 'public-private partnership' literature have some discussion or involvement of 'stakeholders' in delivering 'infrastructure' projects. And since the body of knowledge is mainly project-centric, the keyword 'project management' has found its due place. Since P3s are mainly about

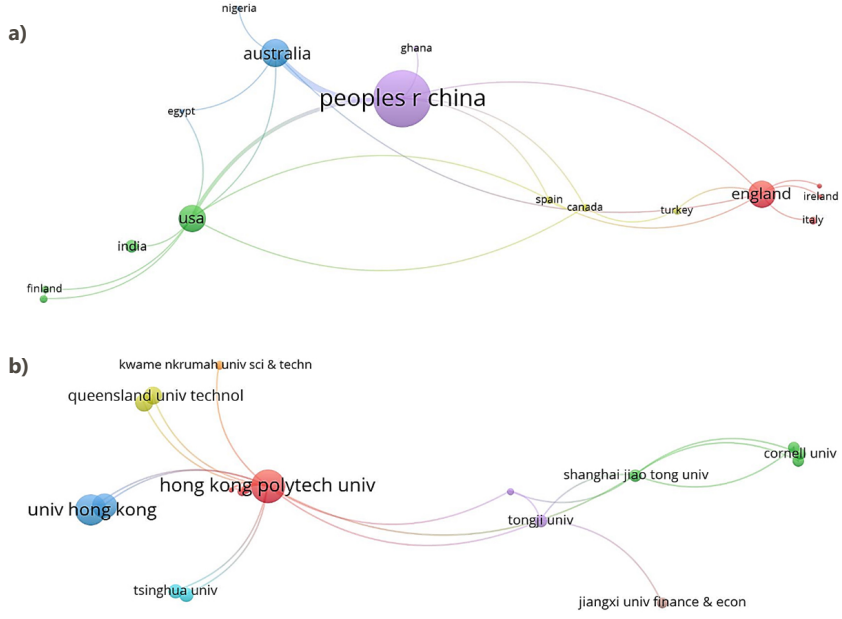

Figure 2. a – Country-wise analysis; b – Organization-wise co-author analysis

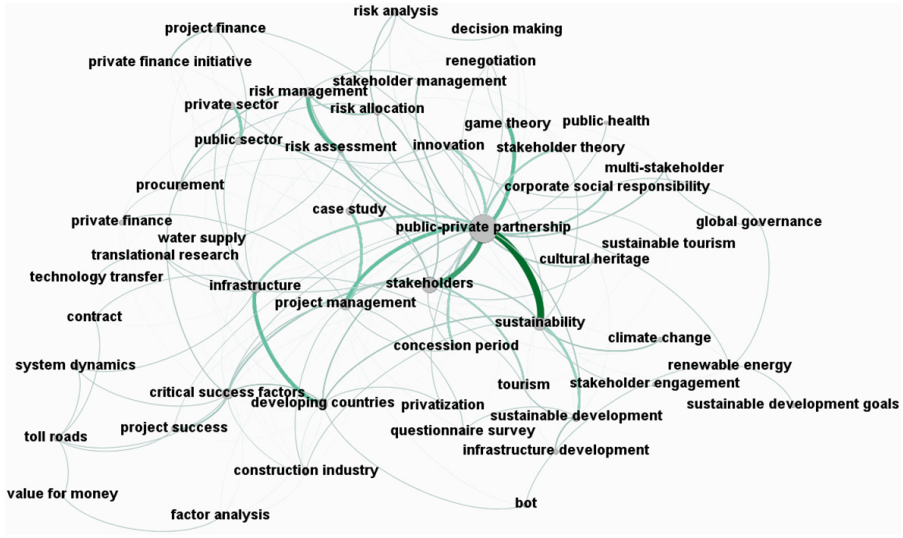

Figure 3. Keyword co-occurrence network

Table 3. The relative influence of keywords

Label	Degree	Weighted Degree	Relative Influence
public-private partnership	37	57.9997	1
stakeholders	22	27.9998	2
infrastructure	20	17.9997	3
project management	19	17.9998	4
critical success factors	19	15.9998	5
risk management	17	16.9998	6
developing countries	17	15.9998	7
sustainability	16	22	8
procurement	13	8.9999	9
case study	12	7.9997	10

optimum risk-sharing between stakeholders (Shrestha et al., 2019), this critical aspect of project management has found its due place in the literature. However, not all the elements and goals of project management can find their due place. For example, despite being the most important outcome, 'project success' is ranked relatively low. This shows that stakeholder relationships' effect on project success is not fully explored, missing the opportunity to close the loop that starts at P3 project procurement.

Furthermore, sustainable development as a point of interest has received a lot of attention in research and many countries are advocating for green construction, including circularity in the building sector (Bilal et al., 2020), sustainable housing (Khan et al., 2020), green buildings (Abdelaal & Guo, 2021; Azeem et al., 2017), green supply chain management (Ahmed et al., 2019; Mojumder & Singh, 2021), etc. However, managing stakeholder relationships to achieve sustainable development needs more research attention. Similarly, other keywords representing essential areas such as 'water supply', 'public health', and 'sustainable development goals' are ranked much lower in relative importance (not shown in Table 1), indicating an inadequate knowledge database from the social infrastructure perspective. Though it does not portray an abject scarcity of research on these topics, it hints at the need for more work. For example, despite a few promising publications exploring the application of P3 in water projects (Bao et al., 2019; Shrestha et al., 2018, 2017), 'water supply' occupies a much lower rank. Another interesting keyword, 'value for money', is the main reason for implementing P3s, and it is ranked much lower. This presents research opportunities to improve the understanding and evidence on value for money through effective stakeholder management. These two concepts share a two-way relationship in which better value for money improves stakeholder management. The stakeholders may become eager to engage if they see attractive value for money. Henjewele et al. (2012) reported that a client, a primary stakeholder, affects the value for money of P3 projects through their post-award decisions. Better stakeholder management can resolve value for money and other affiliated issues (Jayasuriya et al., 2020; Mok et al., 2015). From the above examples, keyword analysis is an exciting tool to observe the patterns of any research domain. However, the actual disposition of the literary works can only be realised after the full-text analysis. Thus, the study has conducted a detailed content analysis of the dataset in later sections to understand how stakeholder dynamics affect P3 decision-making.

3.2. Stakeholder-related themes in P3 research

A cluster analysis was performed using author keywords on CiteSpace software to study the themes and sub-themes of stakeholder-related research in P3 projects. The cluster analysis grouped keywords that appeared together using an MI estimate. Overall, the cluster analysis resonates with the findings of the previously discussed keyword analysis. It further guides recognising the field's different research directions in developing content analysis. As shown in Table 4, the dominant keywords in Cluster 1 are those concerning project success using effective concession design.

Table 4. Cluster analysis details

No.	Top keywords	Theme	Mean year	Silhouette
Cluster 1: Public and private party dynamics during concession design	concession period; P3 infrastructure projects; system dynamics; overarching effects; critical success factors; optimal finance distribution; economic positioning; public-private partnership; project ecosystem; infrastructure; critical factors; P3s; revenue uncertainty; imperfect information bargaining model; determining concession period; critical factors; criteria; enhancement; P3 infrastructure projects; comparative case study; profit distribution	Stakeholder-related issues in P3 decision-making	2011	0.835
Cluster 2: Stalekeholder role and perception on P3 project success	public-private partnership projects; success criteria; stakeholders' perspectives; risk assessment; toll road projects; adaptive fuzzy cognitive map; managing issues; Ghana; fuzzy synthetic evaluation analysis; public-private partnership infrastructure projects; P3 projects; Australia; output-based specifications; lessons; facilities management; risk assessment; toll road projects; adaptive fuzzy cognitive map; managing issues; Ghana	Stakeholder-related issues in P3 decision-making	2012	0.844
Cluster 3: Stakeholder management for P3 projects	local government; stock; case; public-private partnership projects; China; private sector; value conflicts; stakeholder analysis approach; megaproject scholarship; role; P3 projects; managing issues; stakeholder management strategies; impact; traditional authorities; case study; role; stock; case; public-private partnership projects	Stakeholder management in P3 projects	2014	0.974
Cluster 4: P3 risk propagation and stakeholder roles	public-private partnership projects; network perspective; rethinking risk propagation mechanism; managing public-private partnerships; underlying dynamics; public-private partnerships; determining project performance; evidence; private partners; investigating critical factors China; risk assessment; fuzzy synthetic evaluation analysis; straw-based power generation; canvas model; performance estimation; role; evidence; P3 projects; benefit analysis	Stakeholder-related issues in P3 decision-making	2015	0.68
Cluster 5: Organisational & Governance issues	public-private partnerships; alignment; divergent organizational cultures; A15 highway DBFM project; fuzzy set; modeling; projects; critical factors; road constructions; institutional framework; qualitative comparative analysis; fuzzy set; road constructions; P3 infrastructure projects; producing satisfactory outcomes; Netherlands; implementation phase; institutional framework; strategic governance; modeling	Stakeholder-related issues in P3 decision-making	2010	0.8
Cluster 6: Moral hazards for P3s in developing countries	case; public-private partnerships; adoption; Tanzania; readiness assessment; developing countries; risk assessment; P3 projects; toll road projects; housing projects; adverse selection; P3 projects; moral hazards; Ghana; empirical examination; case study; Kenya; housing projects; case; public-private partnerships	Stakeholder-related issues in P3 decision-making	2015	0.739
Cluster 7: Sustainability of P3 road projects	Nigeria; investigation; case; sustainability practices; risk assessment; P3 projects; bot road projects; housing projects; P3 infrastructure projects; Kenya; developing countries; analysis; P3 infrastructure projects; financial close delay; traffic revenue risk factors; bot road projects; bot transportation projects; public-private partnership contracts; enforcing concessionaire performance; public-private partnerships	Stakeholder-related issues in P3 decision-making	2012	0.912
Cluster 8: Public interest	case; traditional procurement; comparing P3; Ireland; schools' procurement; public-private partnerships; Tanzanian affordable housing schemes policy; solutions; pitfalls; delivering housing projects; Tanzania; delivering housing projects; validation; development; public-private partnerships framework; developing countries; housing projects; Kazakhstan; managing stakeholders' value creation; root causes	Stakeholder-related issues in P3 decision-making	2013	0.892
Cluster 9: P3 Stakeholders' evaluation and selection	value; public-private partnership; lesson; money assessment method; Malaysian approach; P3 projects; integrated risk management system; fuzzy risk allocation model; China; P3 stakeholders; evaluation criteria; performance objectives; selection model; stakeholders; feasibility evaluation	Stakeholder management in P3 projects	2005	0.942
Cluster 10: Stakeholder risk management	partnership; keys; effective risk management; building; risk management; sustainability risks; risk stakeholders; risk management framework; risk management; sustainability risks; risk stakeholders; partnership; keys; risk management framework; effective risk management; building	Stakeholder-related issues in P3 decision-making	2011	0.956

End of Table 4

No.	Top keywords	Theme	Mean year	Silhouette
Cluster 11: Early stakeholder engagement for project success	modular integrated construction projects; critical success factors; ranking; quantitative evaluation; critical risk factors; management; early stages; prefabricated prefinished volumetric construction project life cycle; management; early stages; prefabricated prefinished volumetric construction project life cycle; critical risk factors; ranking; modular integrated construction projects; critical success factors; quantitative evaluation	Stakeholder management in P3 projects	2017	0.928
Cluster 12: Stakeholder interaction issues in P3 projects	evaluation; ensuring value; money; public-private partnerships; life-cycle performance prism; modeling; inter-organizational coordination; P3s infrastructure project; South Africa; distribution; governance; modeling; three-party interactional risks; public-private partnerships; public-private ties model; Indonesia; international capital budgeting; localisation	Stakeholder management in P3 projects	2012	0.93

In Cluster 2, the dominant keywords are those related to post-project evaluation. In Cluster 3, the dominant keywords are related to practical risk assessment and stakeholder management. In Cluster 4, the dominant keywords are related to network analysis and risk propagation in projects. In Cluster 5, the dominant keywords are those concerning P3 implementation. In Cluster 6, the dominant keywords are related to readiness assessment and adverse selection. In Cluster 7, the dominant keywords are related to sustainability and road infrastructure projects. In Cluster 8, the dominant keywords are related to housing projects and value creation. In Cluster 9, the dominant keywords are P3 stakeholders, evaluation, and selection. Cluster 10 is all about stakeholder risks. In Cluster 11, the dominant keywords are related to modular and prefabricated construction. In Cluster 12, the dominant keywords are related to evaluation and interactional analysis. Lastly, in Cluster 13, the dominant keywords relate to environmental collaborations and future directions. Regarding the mean year, Cluster 9 represents the oldest keywords on average from 2005, followed by Cluster 13 (2007) and Cluster 5 (2010). The latest average representation of keywords is from 2017 in Cluster 11.

Interestingly, the names of many developing (most African) countries like Ghana, Tanzania, Kenya, and others, as well as some developed countries like Australia, appear as keywords in several clusters. This represents the research focus on the case studies of these countries that present insightful and actionable policy guidelines for the relevant authorities and stakeholders. Countries that do not have such a research culture run the risk of not receiving such insightful suggestions from researchers, and, therefore, the decision-making may remain deprived of an informed basis. Lastly, the clustering is validated through a very high silhouette score for each cluster. The silhouette score represents the degree of similarity of an object (keyword, in this case) to its cluster compared to other clusters. It is a measure of cohesion versus separation. The silhouette score ranges between −1 and +1, where a high value indicates that the object is well-matched to its cluster and poorly compared to neighboring groups (Shahapure & Nicholas, 2020). A high silhouette score for most things validates the clustering configuration, as given in Table 4.

On the contrary, if many points have a low or negative value, then the clustering configuration is not appropriate and points to too many or too few clusters (Rousseeuw, 1987). Table 4 shows that though Cluster 13 has the highest silhouette score of 0.997, followed by Cluster 3 (0.974) and Cluster 10 (0.956), all clusters have a positive score closer to +1. The average silhouette score is 0.879. Thus, this study's cluster analysis is valid and can be used to draw meaningful insights.

3.3. Publication trends and classification

In P3 research, stakeholder management is an emerging area due to limited research catering to stakeholder-related issues in P3. Figure 4 shows a clear difference between the frequency of implicit and explicit research on this topic. The implicit research is related to stakeholder-related issues in P3 decision-making, and the explicit research is related to the stakeholder management of P3 projects. Stakeholder management has seen yearly progression, with the number of publications per year steadily increasing. The average publication year of these papers is 2009, giving an average age (considering 2021 as the base year) of approximately 12 years of the published works. It can be seen from Figure 4 that there is a visible surge in this increasing pattern after the year 2008. It is also noticeable that none of the studies published before 2008 explicitly focused on 'stakeholder management in P3 projects' but only contributed towards a related dimension. For example, Zhang (2005) notably focuses on risk management and stakeholder management in P3 projects. This newly found interest can be attributed to a shift in global focus towards adopting stakeholder-inclusive approaches in decision-making. This change can also be attributed to the realisation that 'stakeholder satisfaction' is one of the most significant critical success factors in P3 projects, and 'poor stakeholder engagement' is one of the significant factors causing failures.

Interestingly, this trend is reflected in other publications, such as Construction Management and Economics,

which ran a special issue on stakeholder management in construction in 2008 (Hewa Welege et al., 2021). Also, different editions of the Project Management Body of Knowledge (PMBOK) Guide by the Project Management Institute [PMI] reflect this (PMI, 2013). PMBOK Guide is PMI's leading publication, providing essential resources for effective project management. It is a techno-managerial and professional handbook that contains basic standards, guidelines, and terminology to help practitioners manage multiple projects. PMBOK Guide's 4th edition, released in 2009, did not consider stakeholder management as a knowledge area of project management, reflected by a lack of a corresponding chapter. However, the 5th edition, released in 2013, contained a dedicated chapter on stakeholder management since it added one more area to the existing knowledge areas of project management (Rose, 2013). Though it is impossible to determine who influenced whom the research papers affected the standard-setting body to expand the knowledge areas or if the expansion of knowledge areas triggered more research into stakeholder management, the evolution is evident.

The same has continued and grown such that the recent years after 2017 have witnessed an explosion of research in this domain in the form of the publication of over 100 articles each year. Figure 4 might give a false impression that 2021 contributed less than the previous three years, but that is because the data was retrieved in Oct 2020. Nonetheless, the trend from 2017 to 2021 anticipates more future research contributions in P3 stakeholder management. This strongly justifies reviewing all this research to determine the areas of strength and opportunities that can be explored.

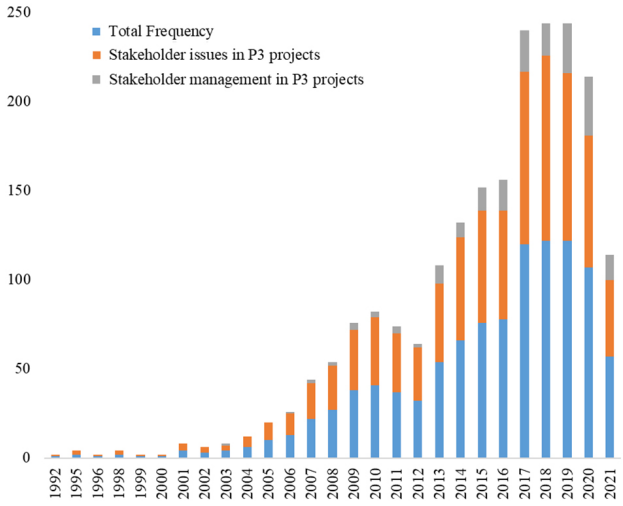

Figure 4. Yearly publication trends

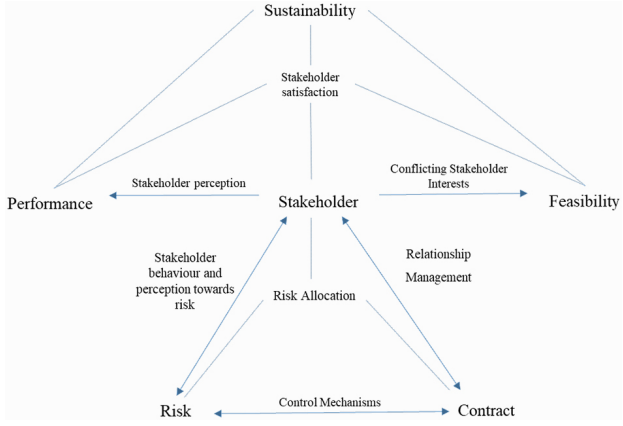

Figure 5. Interpretation of stakeholder problem in P3 decision-making

4. Stakeholder-related 1issues in P3 decision-making

The clustering analysis reveals that stakeholder-related issues are common to all significant aspects of P3 decision-making, as shown in Figure 5. Figure 5 shows a conceptual representation of the clusters related to stakeholder issues from Table 4. This section discusses the main findings in the literature, providing exciting insights into the treatment of stakeholders in major identified areas.

4.1. Consideration of stakeholders in P3 contracts and concession design

In P3 projects, four typical stakeholder roles are a private party, a public party, the general public, and 3rd party (Yuan et al., 2010). The roles and responsibilities of the contracting parties have two primary reflections in the P3 contract: one in the risk allocation mechanism and the other in the relationship management over the contract duration. Moreover, the conflicting stakeholder interests induce renegotiation, default and abandonment, and early termination issues in the contract. Relational aspects like principal-agent problems and information asymmetry of contracts contribute to these issues. Relational contracting can help reduce these problems as the prime aspect of the contracting approach is trust among the parties. A more significant amount of faith can considerably reduce misinformation, asymmetry in information, and moral hazard issues. One way to deal with such problems is to interpret them as corruption and analyse the contractual conditions for better handling them.

Furthermore, to evaluate the concession items (concession period estimation, concession cost estimation, annual traffic volume, and toll prices) in the agreement and to reach optimised solutions, many models have been proposed that consider stakeholder-related issues during the estimation, e.g., negotiation and optimisation of concession periods under different constraints of conflicting stakeholder behavior (Park et al., 2020), government opportunism (Vining & Boardman, 2008), balancing of stakeholder interests (Huque, 2020) and social welfare (Hu & Zhu, 2015). Three methods can be identified in the literature to improve the estimation of the concession period depending on decision-making constraints: modeling and simulation techniques, analytical methods, and scenario analysis techniques. Additionally, Cruz and Sarmento

(2022) researched the valuation of incentive schemes to safeguard the government against opportunistic investor behavior. Patil and Laishram (2016) highlighted the importance of ensuring a socially responsible project. But the concession item of social welfare has not been sufficiently addressed in the literature owing to the weaker role the public has been assigned in decision-making. In this regard, quantitative valuation of the social welfare of the project, incorporating subjective uncertainties like the effect of public opinion, social sustainability constraints of cultural heritage, health, safety, etc., and relating them to the project concession period are essential constraints to explore in concession design.

4.2. Consideration of stakeholders in risk management of P3 projects

The effect of risk on project performance is translated through a suitable risk allocation mechanism – an essential dimension of which is the stakeholder. As the nature and impact of risk vary demographically and culturally, the interpretation of risk will vary with stakeholder risk perception and risk behavior in addition to the context of the application for different sectors (Farooq et al., 2018). Although the role of stakeholders in risk allocation has been highlighted in the literature, there are very few studies dealing with stakeholder risk perception and behavior in particular (Ke et al., 2013; Park et al., 2020; Shrestha et al., 2018). Although the endorsed risk allocation principle in P3 projects is to allocate the risk to a party with the most capacity and will to manage it, misallocation may still occur due to differences in risk impact perception levels among the negotiating parties, as highlighted by Ke et al. (2013) and Shrestha et al. (2018). The studies show that the risk behavior of stakeholders (averse, neutral, seeker) also comes into play in determining the risk perception and, ultimately, the risk prioritisation and management in a project. Another critical dimension in risk prioritisation by stakeholders is the impact on specific project success criteria, which often leads to renegotiation issues during execution when massive hidden positive and negative externalities associated with the project are materialised (Domingues & Sarmento, 2016; Lv et al., 2021; Xiong et al., 2018). A recent review covers risk management in P3 projects in detail (Osei-Kyei et al., 2022).

4.3. Consideration of stakeholders in performance and financial evaluation of P3 projects

Project success and performance of P3 projects are directly linked with stakeholder satisfaction. At the project feasibility stage, a study revealed the most important critical success factor to be the "acceptable level of the tariff" in Hong Kong, which corresponds to public satisfaction (Ng et al., 2012). The study concluded that project success is the satisfaction of all parties, including the public. In China, the "involvement of public officials and leadership" appeared to be the most critical factor for successful tendering compared to Australia (Liu et al., 2016). It is to be noted that just in the case of risk assessment, the ranking of critical success factors (CSFs) will vary with varying stakeholder interests, priorities, perceptions, and capabilities (Ullah et al., 2016). Furthermore, during the financial evaluation of P3 projects, the main question is to optimise a profitable economic model against conflicting stakeholder interests and risk considerations to ensure value for money for all parties from a life cycle perspective (Chi et al., 2017; DeCorla-Souza, 2014; Villani et al., 2017). Other than that, the decision of a private party to invest in the P3 project is also of great importance for initial project success and financial structuring (Kaminsky, 2018; Liu et al., 2017; Ye et al., 2018). For the case of P3 projects, ex-post evaluation of the project is carried out with the help of the project team through lessons-learned exercises. Thus, future project success is dependent on the project team.

4.4. Consideration of stakeholders in the sustainability of P3 Projects

The P3 delivery system has been repeatedly acknowledged for its strong potential to deliver sustainable projects. In this regard, sustainable procurement mechanisms have been explored to include sustainability considerations in the P3 contractual arrangement. The other central aspect is measuring the sustainability performance of P3 projects. Since sustainability is subjective and contextual, identifying suitable qualitative and quantitative indicators for its measurement is integral to sustainability assessment in P3 projects. In this regard, there is limited research on the social life cycle assessment of P3 projects, which is a crucial part of enabling sustainability in P3 projects (Yuan et al., 2020). In the initial planning stages, public hearings can ensure the inclusion of external stakeholders in the process to avoid conflict of interest and damage to the local community's cultural heritage and to manage better relationships between the community and the implementing agency.

5. Stakeholder management in P3 projects

Analysing the entire contents of the 69 articles reveals that the main stakeholder management areas addressed in P3 research are stakeholder identification, stakeholder analysis, relationship management, stakeholder engagement, stakeholder satisfaction, stakeholder integration, and cooperation and coordination (collaboration). New problem foci for stakeholder management, as shown in Figure 6, addressed topics like balancing stakeholder needs and priorities, stakeholder opposition, social capital maximisation, conflict management, and social welfare analysis on the primary level.

The in-depth content analysis revealed various theoretical constructs useful for integrating stakeholders in P3 projects. Five paradigm shifts could be seen in the research perspective in the current domain of study by

exploring the publications on stakeholder management as the central theme, as presented in Figure 7. Examining the publications, a distinct shift in stakeholder management research in P3 projects was identified based on the improved understanding of the stakeholder problem. In complex projects like P3, many modalities for application in various sectors and project types are being developed. The P3 model has a long contract duration, making the dynamic changes occurring during project life crucial to decision-making.

As visible from Figure 7, the body of knowledge has improved to keep up with the evolving needs of P3 project stakeholders. In that, approaches are becoming more dynamic, and more inclusive methods are being explored for managing multiple stakeholders and their interests in P3 projects. Attempts are made to employ the normative aspects of stakeholder theory during stakeholder analysis for a more precise analysis of stakeholder needs and interests. In this regard, relevant stakeholder attributes are power, legitimacy, urgency, and proximity (Parmar et al., 2010).

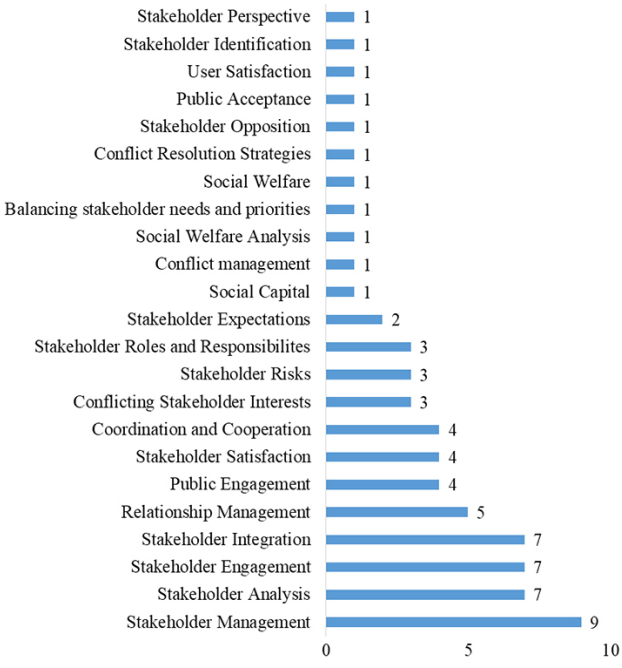

Figure 6. Main research themes of stakeholder management for P3 projects

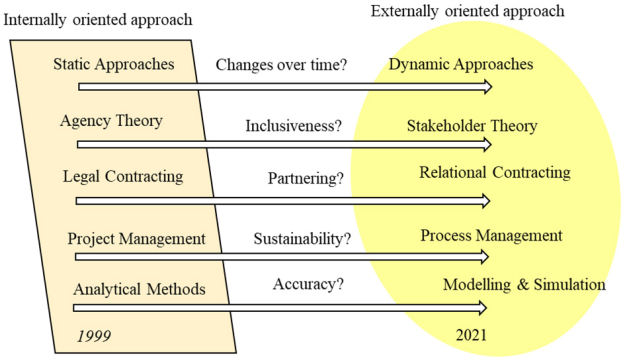

Figure 7. Paradigm shifts in stakeholder management in P3 projects

Assessment of these attributes early in the project can significantly change the outlook of P3 decision-making and help assess the level of influence of any stakeholder (Nguyen et al., 2009). However, few studies offer quantification approaches for such attributes, which is a significant gap in the P3 literature. Also, to improve sustainability, the P3 project and stakeholder management embrace the tenets of process management over those of typical project management. This allows for continuity of engagement which, in long P3 contracts, is a crucial relationship management strategy. The literature must push for more dynamic and relational provisions in the otherwise rigid contractual regimes under which P3 projects are delivered for improved satisfaction of stakeholders.

5.1. Life cycle perspective and dynamic stakeholder management

The P3 project life cycle can be split into several stages of development: briefing, planning, procurement, bidding, implementation, and completion. To understand the position of stakeholder-oriented approaches in P3 decision-making, it can be helpful to first look at the different life cycle stages focused in research, as presented in Figure 8a. Around 40% of the studies consider the whole life cycle perspective necessary for effective stakeholder management, facilitating the shift towards adopting dynamic, process-oriented approaches. However, 60% of the relevant studies focus on individual stages, which can be beneficial in understanding the implications of the project stage on the various stakeholder attributes affecting P3 decision-making. These decision-making aspects include roles, responsibilities, needs, priorities, legitimacy, and satisfaction. Therefore, research contribution in individual project stages is also essential. Moreover, Figure 8b indicates that 38% of the relevant studies acknowledge the dynamic considerations involved in stakeholders' decision-making.

To offer a way forward for intricate stakeholder management, the review's findings are summarised as a possible pragmatic framework for integrated stakeholder management presented in Figure 9. The framework uses a problem-solution approach for conceptual clarity. It has two parts: 1) Stakeholder-related Issues and 2) Stakeholder management process. The stakeholder-related issues have been synthesised and discussed in detail in Section 4. The P3 stakeholder management process steps are discussed in more detail in the current section. Critical identified stages of stakeholder management for P3 projects are stakeholder identification, identification of stakeholder needs and priorities, determining stakeholder attributes, stakeholder influence, stakeholder analysis, and stakeholder satisfaction estimation considering the changing project environment. It has been identified that P3 is a multi-stakeholder complex system for which special considerations of stakeholder management are required. For this purpose, an appropriate selection of stakeholder analysis tools and techniques is critical to efficient stakeholder management.

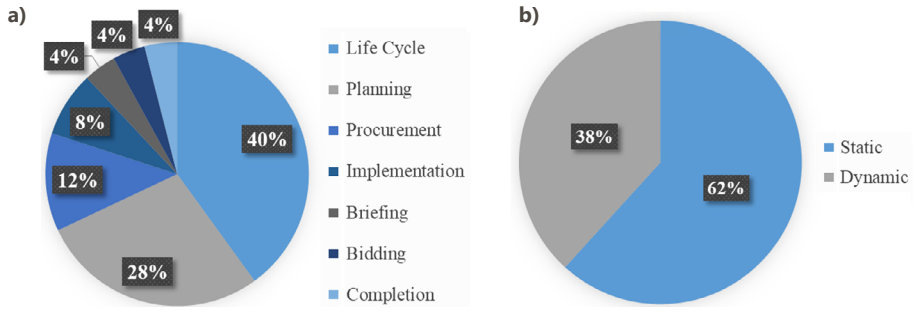

Figure 8. a – Life cycle stages; b – Static vs dynamic treatment of stakeholder

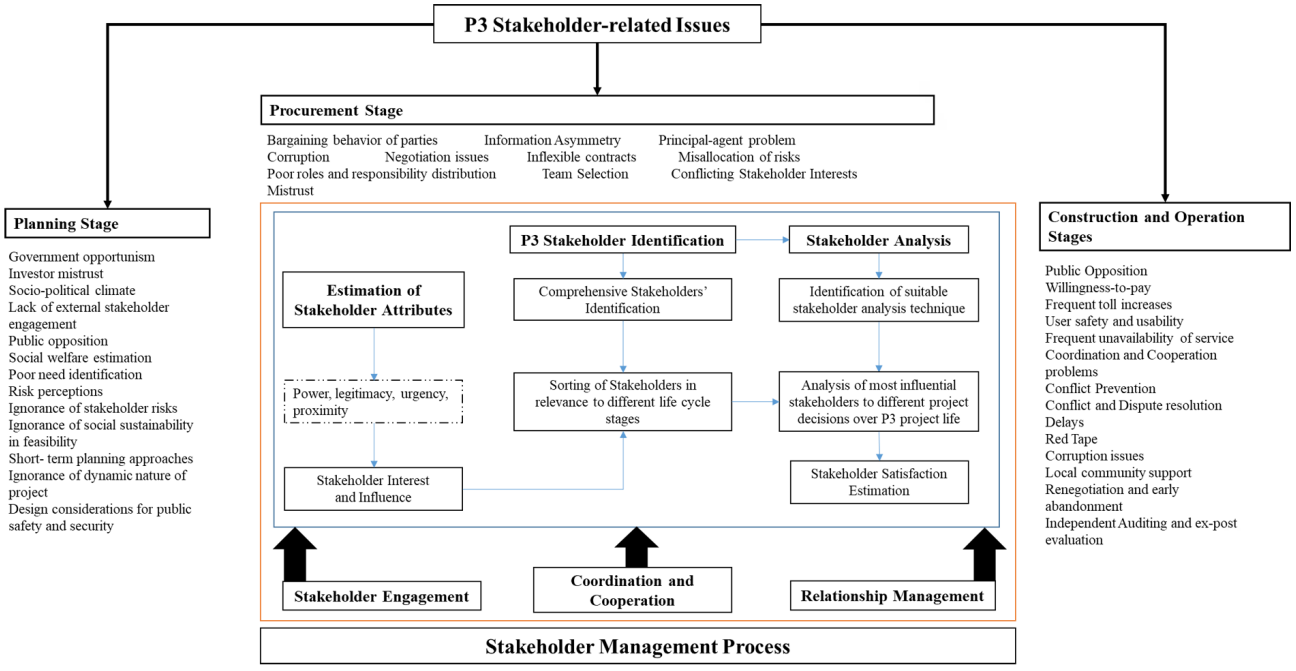

Figure 9. Proposed framework for P3 stakeholder management process during project life

Relevant techniques should incorporate the dynamic nature of stakeholder attributes, taking a life cycle perspective for management. It is also essential to consider the stakeholder relations and conflicting needs. Moreover, early stakeholder engagement can be essential to the project, as shown in Figure 9.

However, optimum methods and techniques for stakeholder management are still unknown. A comparison of the performance of such techniques in terms of their ability to efficiently manage multiple stakeholders in a complex environment can be helpful in this regard. Further, very few studies look at dynamic stakeholder attributes considering stakeholder theory and their impact on project decision-making. Various stakeholder attributes (legitimacy, power, urgency, and proximity) determine the quality of their relationship and orient the stakeholder attitude towards any decision under consideration in opposition or support. The effect of human factors of values, ethnicity, culture, etc., is usually ignored during the decision-making process due to the high level of subjectivity and lack of proper quantification and valuation of such qualitative factors. Some recent studies have attempted to develop methods for quantifying stakeholder influence (Beringer et al., 2012; Nguyen et al., 2009; Thomas, 2017), but their effectiveness is debatable. The current section sheds more light on some aspects of the stakeholder management process.

5.2. Methods and techniques for stakeholder analysis

Most stakeholder-related studies in P3 utilise qualitative case-based approaches to reach meaningful empirical conclusions. In such studies, expert opinion is collected through questionnaires or interviews, and different statistical techniques are employed to make valuable inferences, as reported in Figure 10. For example, Zou et al. (2014) identified critical success factors for relationship management in P3 projects through an empirical questionnaire. Burke and Demirag (2017) used 38 stakeholder interviews on Irish road P3 projects to study the impact of risk allocation on stakeholder relationships. However, techniques like social network analysis, game theory, and system dy-

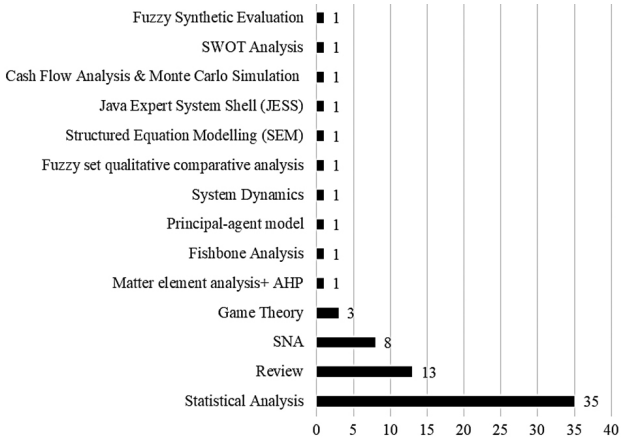

Figure 10. Methods and approaches for P3 stakeholder analysis

namics have been adopted to increase the generalisability of results. For example, using game theory, Sharafi et al. (2021) devised conflict resolution strategies and optimised stakeholder payoffs for renegotiations in the operations stage of P3 projects. Xiong et al. (2015) used system dynamics for stakeholder satisfaction evaluation and studied its effects on project performance.

Moreover, many studies have employed social network analysis (SNA) to study stakeholder interactions. For example, He et al. (2020) used the SNA approach to examine the impact of stakeholder-related factors on the sustainability of water projects. Dong and Liu (2020) used SNA modeling to reveal stakeholder relationship structure and devise optimum relationship governance strategies for an elderly home construction project. Using such modeling and simulation techniques helps analyse the interlinks, interdependencies, and causal chains of stakeholders incorporating the effects of stakeholder attributes, which otherwise can be a limitation in analysis. Such robust analysis better informs decision-making, improving the chances of effective stakeholder engagement and project success.

5.3. Stakeholder engagement and relationship management in P3 projects

During the implementation stage, most of the unforeseen risks are social, and early stakeholder engagement and analysis are considered potential solutions. In earlier studies on stakeholder engagement, stakeholder involvement was emphasised numerously and strongly during the briefing and planning stages (Tang & Shen, 2013). Stakeholder involvement in these studies has been interpreted as 'public involvement' for project success. Analysing managerial perceptions revealed that early engagement benefits both public and private parties (Boyer et al., 2018). Including stakeholder-related factors in bidding and public involvement at this stage can lead to greater transparency, mutual trust, and inclusive decision-making. For successful stakeholder engagement, externally oriented managerial approaches are desired and believed to deliver successful project outcomes, enabling sustainable development, reduced risks, and efficient implementation. Successful stakeholder engagement also leads to greater stakeholder satisfaction in the form of equitable balance among the project stakeholders, a major critical success factor for efficient P3 delivery. For the briefing stage, however, the public party considers public involvement a policy compliance requirement, which can lead to poor stakeholder engagement and project performance in later stages, creating conflicts, delays, and cost overruns (Foo et al., 2011; Tang & Shen, 2013). Earlier studies only focused on adopting stakeholder inclusion (Cuppen et al., 2016; Manos et al., 2014; Murray et al., 2011; Ng et al., 2013). However, the theme of stakeholder integration has recently been explored. For example, Christ et al. (2020) examine the complex sociocultural issues affecting stakeholder engagement, considering the stakeholder interdependencies in a selected P3 case study. Yang et al. (2020) also study stakeholder-associated risks in water services projects using a social network approach, revealing important stakeholder dynamics using interdependencies. The interlinkages between stakeholder-related factors can be further observed from the systems thinking framework (STF) for stakeholder engagement, as shown in Figure 11. These relationships are assessed based on the review of published literature.

The 'timing of involvement' of the stakeholders strongly affects the stakeholder engagement process. Even if early involvement causes delays in contract closing, it improves design clarity on technical and social aspects (Ng et al., 2013). In this case, negative political pressures from interest groups can significantly hamper innovative managerial techniques adopted by the public authority (Azazz et al., 2021; Ibitayo, 2002; Norris & Hearne, 2016). Overall, the process needs to be incentivised for the private party. Contract compliance can result in lethargic efforts on the part of the private party to work towards realising the project's social value and social benefits (Foo et al., 2011). In this regard, the literature reports that adopting the partnering approach can produce the desired outcomes, taking a shift from the legal contracting approaches based on contract compliance strategies (Song et al., 2021), as depicted in Figure 12. Adopting a suitable contract strategy can be instrumental in realising effective stakeholder relationships and foster sustainability and inclusive growth. Furthermore, incorporating partnering approaches demands flexible contracts catering to the dynamic multi-stakeholder complex of the project. Relational and alliance contracting strategies have been tested for successful P3 implementation (Dong & Liu, 2020).

A major hindrance in adopting the partnering approach is the hierarchical organisational structure of participating parties. The partnering approach requires teamwork and a strong dissociation from the 'boss and subordinate culture'. However, this participatory approach is not readily accepted and can lead to reactions and reluctance from higher authorities (Selim & ElGohary, 2020). However, effective teams can be formed through continuous efforts and commitment (Gao & Zhao, 2020). These intricacies must be considered while developing a stakeholder management framework for complex projects (Jayasuriya et al., 2020).

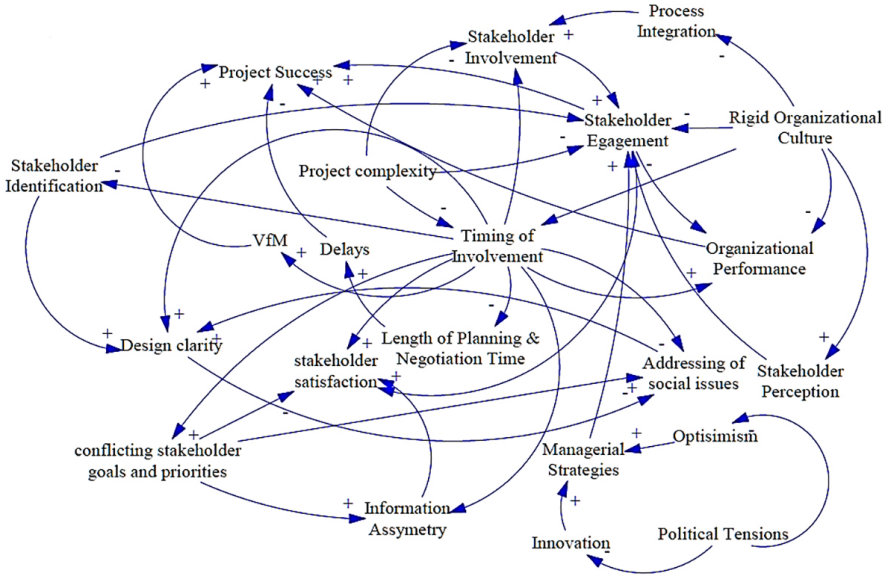

Figure 11. STF for stakeholder engagement

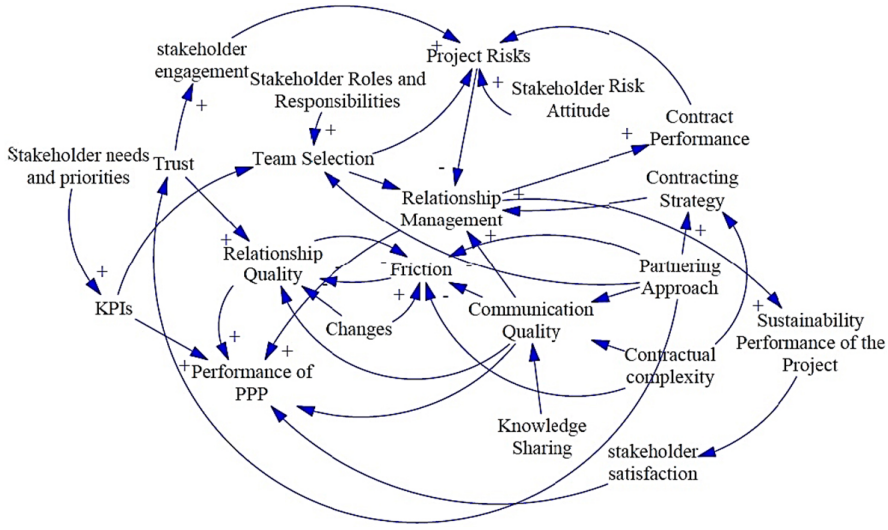

Figure 12. STF for relationship management

In relationship management, subjective constructs, like trust, are used as a metric to assess the relationship quality (Cheng et al., 2021a), which is then used to evaluate the conflict emergence scenarios throughout the P3 life cycle (Azazz et al., 2021). At present, the assessment of qualitative factors is done through indirect indicators of measurement (Wang et al., 2021). However, sophisticated modeling techniques can be used for more accurate assessments.

6. Conclusions and recommendations

The review addresses the multi-stakeholder problem in P3 projects from a dual perspective. It studies the overview and significance of the topic using bibliometric analysis that provides the necessary structure and context to the remaining content analysis. Bibliometric analyses reveal that Yuan et al. (2020) is the most cited research article, and China and Hong Kong are the most critical regions leading contributions in the domain. Moreover, the keyword and clustering analysis reveals two main perspectives of the stakeholder-related research in P3 projects: 1) stakeholder-related issues in P3 decision-making and 2) stakeholder management for P3 projects. The study's main findings include: 1) The study of stakeholder-related issues in P3 projects reveals that project stakeholders strongly influence significant P3 decision-making in areas like risk management, concession design, procurement, and sustainability. 2) From the context of project life, the stakeholder management process can be contextualized as a solution for varying issues over the project life stages. The content analysis in the study explores the stakeholder-related issues relevant to different project life cycle stages and identifies the various stakeholder management elements for the P3 project. 3) For effective stakeholder

analysis, it is vital to consider stakeholder dynamics, such as changing stakeholder roles and the needs and requirements for value creation. 4) Early stakeholder engagement and relationship management are crucial for P3 success. Work in these two areas can provide the starting point for inclusive decision-making in stakeholder management, reducing conflicts and building trust-based contract management systems. A possible limitation of the study is that the bibliometric analysis was done only based on web of science results due to the ease of analysis on different software. As P3 decision-making is a rich area of research, rigid exclusions were applied to the search to limit the number of articles. Thus, only peer-reviewed articles were selected for the review. Overall, stakeholder management has seen some growth in P3 projects. However, much work is still required to address stakeholder-related issues over the life cycle. Firstly, there is an absence of a clear framework for P3 stakeholder management and its terminologies. To offer a way forward in this direction, the findings of the study are summarised in the form of a possible pragmatic framework for stakeholder management presented in Figure 9. Important identified stages of stakeholder management are stakeholder identification, identification of their needs and priorities, attribute estimation, influence estimation, stakeholder analysis, and stakeholder satisfaction estimation considering changing project environment. Future work can be directed to validate the framework further using expert opinion.

The multi-stakeholder nature of P3 projects makes the decision-making space a complex zone of uncertainty that is difficult to manage. Thus, complex system modeling techniques like agent-based and hybrid modeling can be used. Additionally, the dynamic nature of stakeholder problems requires developing conflict prevention strategies to curb various project delays and overruns. This can only be possible by careful stakeholder analysis for different life cycle stages and the early involvement of external stakeholders in the planning process, which is a significant gap in the current P3 domain. For further development, the presented findings can be integrated with stakeholder management theories to identify dynamic decision characteristics related to stakeholder analysis during project implementation. Adopting a problem-solution framework presented in the study over the P3 project life can help identify timely managerial contributions, and a detailed study on the area can help develop a stakeholder management integrated platform for conflict prevention during different project stages. Secondly, the study's findings can also be used to study real cases of P3 projects to trace stakeholder-related failure causes for further study. Thus, study findings can aid researchers and P3 project practitioners in further developing a stakeholder-driven P3 development, creating projects with value creation for the public, financial efficiency for investors, preventing moral hazards while developing concession contracts, and smooth project implementation, avoiding conflicts among different parties.

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Author contributions

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Disclosure statement

Authors declare no conflicts of interest.

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