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Article

Knowledge map of stakeholder management in construction projects

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ABSTRACT

Stakeholders are an important part that can affect the conditions and performance of construction projects or be affected by project conditions and performance. Stakeholder support plays a crucial role in the success of construction projects. Understanding and meeting stakeholders' expectations and goals can only be achieved through stakeholder management, which also involves organizing and managing their internal relationships. This study provides a comprehensive understanding of the development of stakeholder management in a global context by using bibliometric analysis. The study aims to explore stakeholder management's role within the broader concept of project management and its relationship with other management concepts within different time periods. Bibliometric analysis will be used to create a knowledge map in the field of stakeholder management. Data was collected from the Scopus and Web of Science databases and analyzed using the "VOSviewer" software. The output is utilized to develop a knowledge map about stakeholder management in the construction management literature. The results indicate that researchers have been addressing stakeholder management-related topics since 1985, with 762 articles published during this period. Key topics are examined in-depth, considering different time periods, and a research model presents the evolution of stakeholder management worldwide. The analysis identifies that new trend topics in construction projects are related to stakeholder management. Additionally, this analysis is an ongoing process that can be updated with future publications, providing a reliable foundation to visualize the evolution of stakeholder management over time.

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INTRODUCTION

The notion of the stakeholder was firstly developed in the management field by Stanford Research Institute in 1963, where stakeholders were defined as any groups or individuals who have great importance on the survival of the organization (Freeman, 2010). Since there is a wide variety of stakeholders in terms of profession, culture, educational level, and gender, each stakeholder affects the outcome of projects. These stakeholders generally offer a wide range of interests on the project, which are to be met throughout the process (Oppong et al., 2017).

Construction projects contain many uncertainties because of their long periods of outdoor production (De Meyer et al., 2002). All construction projects are complex, unique, and composed of multi-stakeholders (Cleland and Ireland, 2004). Some of the stakeholders in the construction projects are defined as the internal stakeholders (the owner, design group,

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consultant, contractor, subcontractor, and supplier) who are either affected from or affect the project directly, while some of them are described as the external stakeholder (central and local governments, etc.) who are affected from or affect the project indirectly (Aaltonen et al., 2008). Savage et al., (1991) categorized stakeholders as *supportive, non-supportive, mixed blessing, and marginal*. Newcombe (2003) emphasized that even though marginal stakeholders may have fewer impact on the project, they should not be underestimated because of their connection to other stakeholders, which may lead to different types of disruptions.

Stakeholder management emerges stakeholder concerns to the surface. It helps an effective approach for developing stakeholder relationships in complex projects (Olander, 2007). Stakeholder relations play an important role in the completion of the project because stakeholders and their relations effect project's outcome positively or negatively. (Liu et al., 2016; Waghmare and Bhalerao, 2016). Generally, a lack of managing the stakeholders' increase conflicts and controversies on the implementation phase of construction projects (Olander and Landin, 2005). Non-supportive stakeholders need to be managed for the purpose of removing their negative effects on project success (Harris, 2010). Supportive stakeholders not only build trust in the project but also prevent budget and time overruns. They enhance the quality of the project and increase safety in the project area (Harris, 2010). Stakeholder management is a dynamic process and must be updated on each phase of projects. The importance of this issue has been revealed by the bibliometric studies, realized with certain periods (Mok et al., 2015; Oppong et al., 2017; Xue et al., 2020; Yang et al., 2009, 2011). For these reasons, stakeholder management studies in construction projects have been increased in the recent years.

Bibliometric analysis is defined as "the analysis of publication data (author, citation, sources, subjects, country, year, etc.) using statistical methods in any discipline" (Small, 1999). Bibliometric analysis is tailored for a method to summarize studies in the literature in terms of specific indicators (Thelwall, 2008).

Bibliometric analysis is preferred for the purpose of performance analysis and science mapping. Performance analysis indicates authors' or institutions' studies and publications' reviews. Science mapping examines the scientific research structure and dynamics. This mapping comprises classification and visualization (Boyack and Klavans, 2013). Three methods are used in bibliometric studies – focusing on the structure, focusing on the dynamics, and focusing on a narrow research question (Zupic and Čater, 2015). Focusing on structure analyzes authors, institutions, publications, and their relation to each other. Focusing on dynamics divides publications into several time periods and depicts the structure of the field for each period. Focusing on a narrow research question also addresses researcher's specific question and proves researcher's claims (Zupic and Čater,

2015). To compare the pace of scientific development and to determine periodic changes, focusing on the dynamics of the literature has been preferred in this study.

Knowledge maps, also known as concept maps or cognitive maps, are visual representations of the relationships between different concepts or ideas within a specific domain or field of knowledge. They provide a panoramic view of the key concepts, activities, and their interconnections, allowing researchers and practitioners to gain a comprehensive understanding of a particular subject area (Wang, 2022). Using a knowledge map, the studies of stakeholder management can be categorized into different periods to understand the evolution of the field over time. This categorization allows for a systematic analysis of the trends, theories, and methodologies that have emerged in stakeholder management research throughout the years.

There were some researchers conducted in-depth analysis on stakeholder management in previous studies (Mok et al., 2015; Oppong et al., 2017; Xue et al., 2020; Yang et al., 2009). Yang et al., (2009) provided an overview of previous studies in the field of stakeholder management until 2009. The review was handled manually, and they grouped the outcome in terms of descriptive, instrumental, and normative with manual review. The impact and definition of the stakeholder in the project were emphasized. Mok et al., 2015 analyzed existing stakeholder management approaches focusing on the initial planning of the construction project phase and suggested that a multi-purpose stakeholder management model can be integrated with the entire project life cycle. This study covers stakeholder interest and influences, the stakeholder management process, stakeholder analysis methods, and stakeholder engagement between 1997 and 2014. Traditional stakeholder analysis adopted in mega construction projects. Oppong et al. (2017) pointed out the lack of comprehensive tools to improve stakeholder management performance in construction projects and presented a cognitive model to manage and measure the performance of the stakeholder management configuration. The study's findings offer researchers and professionals the opportunity to benefit from increased flexibility in adapting project stages, project types, and project nature to enable more efficient management. This flexibility facilitates them to tailor their approaches and to better align with stakeholder needs, ultimately enhancing the overall project management process. Xue et al. (2020) have explored stakeholder management bibliographic research with different method contraries to traditional literature review approaches. Previous studies were evaluated on seven topics, including stakeholder concept, method, identification, assessment, management, influence, and complexity. As a result, society, sustainability, tool, and project were determined to be the most studied stakeholder management research topics until 2017.

All previous studies, in general, aimed to conduct a situation assessment of stakeholder management. Yang et al., 2009 revealed a critical review of stakeholder management. Before 2009, very few methods and tools were defined to analyze stakeholders and their interests; previous studies remained

mostly theoretical frame. No assessment has been made regarding the relationship between stakeholder management and other factors influencing the project, as well as the managerial relationships associated with it. Mok et al., 2015 indicated a need to determine the impact of national culture on the discipline and revealed that traditional stakeholder analysis methods were predominantly adapted to mega-construction projects. Moreover, an emphasis was made on the necessity of social network analysis for managing stakeholder relationships. However, in their study, selective articles were chosen between 1997 and 2014. Most of the study was conducted in the domestic market. Oppong et al., 2017 suggested a conceptual model for managing project performance indicators and success factors. Their study focused only on obtaining the checklist of performance parameters related to stakeholder management. Although there were many more publications on stakeholder management until 2016, the study has been limited to 110 articles. Xue et al., 2020 examined 752 peer-reviewed academic papers until 2017 in Web of Science (WOS). The study has concluded that there is a lack of research on stakeholder engagement in sustainable urban projects. It has also identified that stakeholder studies in complex projects cannot be easily generalized and can be limited to implementation in uncertain project environments.

This study provides a comprehensive understanding of the development of stakeholder management in a global context using bibliometric analysis. It seeks to explore stakeholder management's role within the broader concept of project management and its relationship with other management concepts within different time periods. Bibliometric analysis will provide the means to create a knowledge map in stakeholder management. The knowledge map that has been generated indicates three phases of stakeholder management in construction. These stages encompass (1) gathering and generating data along with constructing a stakeholder management framework and database for each period; (2) identifying the trends of stakeholder management in construction projects toward which topics; and (3) unveiling the insufficiently explored topics.

It will provide a basis to draw a path where the stakeholder management evolved in time while analyzing the stakeholder management in construction projects articles, carried out between 1985 and 2023 for researchers. This study helps in identifying relevant resources and exploring the boundaries of research, subsequently presenting recommendations for forthcoming studies and other researchers. Nearly, every part is utilized to establish clustering relationships within the knowledge map through cluster analysis, to identify the current state and potential research directions of stakeholder management in the construction field. Thus, future researchers can benefit from the trends identified in the periodization and knowledge map of stakeholder management studies in their research subjects.

RESEARCH METHODOLOGY

During the past two decades, there has been an increase in the use of bibliometric analysis (Mukherjee et al., 2022). Bibliometric analysis consists of several mathematical and statistical methods for utilizing bibliometric data (Donthu et al., 2021). This analysis technique aims to explain the mutual affinity among journal citations and demonstrates the present research topic. The data, widely utilized in a bibliometric analysis, can be retrieved from different citation indexes such as Scopus and WOS. For instance, it evaluates the impact and the quality of scientific literature, sources, research institutions, and researchers depending on the citations (Meyer et al., 2018). The bibliometric analysis examines the quantitative evaluation of article attributes (i.e., publications, citations, keywords, territories, years, and publishers) and their relationship with each other. In other words, bibliometric analysis is beneficial for revealing and mapping the cumulative scientific knowledge, and it also explains the meaning of the unstructured data on large scales regularly. Eventually, bibliometric researches can give some opinions for the development of a special field, identifing knowledge gaps, generating new ideas for investigation, and setting their contributions to the specific field (Donthu et al., 2021). Unlike the manual review, bibliometric analysis is used when the data are too broad. To obtain considerable results in bibliometric analysis, at least 200 papers are suggested for review (Rogers et al., 2020). Keyword filtering, trial and error methods, and sample size are adequate for bibliometric analysis (Glänzel, 2003).

The succeeding subsections, describing the research framework of this study, are shown in Figure 1.

One of the most important steps is choosing an appropriate database to extract the data from the literature in the bibliometric research. The data in this research were collected from the Scopus and WOS database. *The important feature*
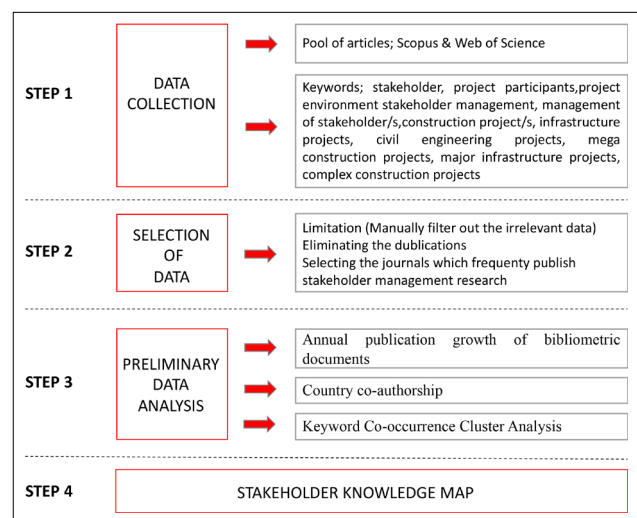

Figure 1. Research framework.

of these databases is that they are the most comprehensive database and they include all article types, and index all authors, institutional addresses, and bibliographic references for each article (Mongeon and Paul-Hus, 2016). Using the keywords listed in Figure 1, search was run in both databases. The initial number of articles was 2229. In the second stage, limitation was applied to eliminate the irrelevant data. First, the articles which have the inappropriate use of keywords were eliminated manually. Second, publications were eliminated based on their coverage of the topic. The publications which have sporadic articles in SM were also eliminated. That elimination provides the top-ten journals that cover SM recurrently. Within this pool of journals, 661 articles from Scopus and 312 articles from WOS were retrieved. Afterward, 271 articles were eliminated because of the duplication in both databases.

While conducting a bibliometric analysis, performance analysis, bibliometric mapping, and network analysis are priority issues. The performance analysis is a descriptive method for evaluating the publication and citation-related metrics. Bibliometric mapping provides the analysis of the influences and strengths of relationships among different article attributes which are depicted by the co-occurrence weight, and total link strength of the items. It may include citation analysis, co-citation and co-authorship analysis, bibliographic coupling, and keywords analysis. Bibliometric mapping outcomes can be enhanced through network analysis, where the evaluation of network metrics, clustering, and visualization are commonly used.

Moreover, bibliometric mapping and network analysis were performed with the file extracted from the data source using a computer program called VOSviewer (ver.1.6.18). This software was designed by van Eck and Waltman for the purpose to help the creation and visualization of bibliometric maps (van Eck and Waltman, 2010). Through this software, all data can be analyzed easily in terms of publications, keywords, countries, co-authors, and co-citations (Nielsen and Nielsen, 2018). Nevertheless, this study was limited by documents, the country, keywords, the co-authorship, and journal publishing analyses for the bibliometric mapping, and the visualization of the network analysis.

The network visualization, overlay, and density are types of visualization of VOSviewer software. In this study, the network and the overlay visualizations were used. While the network visualization shows the co-occurrences of words, co-authorship, or country of origin, the overlay visualization expresses the date of publication. VOSviewer depicts the mutual keywords within these attributes, and the line between two attributes in the visualization approximately indicates the connection (Romero and Portillo-Salido, 2019).

DATA ANALYSIS

This study comprised the two essential searching terms. One was stakeholder-related words such as "stakeholder," "project participants," "project environment," and "stakeholder management." The other one was construction project words, including "construction projects," "infrastructure projects," "civil engineering project," etc. All the keywords in previous review studies (Mok et al., 2015; Oppong et al., 2017; Xue et al., 2020; Yang et al., 2009, 2011) were included in this study to take a holistic assessment. All keywords and searching limitations are summarized in Figure 2.

The performance analysis was investigated using Scopus and WOS to create bibliometric map. In this study, the productivity of publication, total citations per-year, most cited articles, and most relevant articles collected from Scopus and WOS. The relevant articles in Scopus were extracted in a ".csv" file, where WOS was extracted in a ".xls" file. These two formats were combined in a ".csv" file for further analysis. In the initial stage of the research, there were 2229 publications retrieved about SM in construction projects in 604 different journals since 1985. Although many journals covered variety of research topics about stakeholder management in construction projects, 34% of articles were published in ten journals, as shown Table 1.

Stakeholder Publications' Annual Trend of Bibliometric Documents

The principle understanding of the performance of a publication in a particular field is to observe the annual publication frequency of scientific articles. In Figure 3, the annual publication rate of articles within 762 articles since 1985 is displayed.

Figure 3 indicates that the number of studies in stakeholder management studies in construction project publications have increased steadily per year. Based on the trend slopes, stakeholder management publication progress is divided into three periods, which are Period I: *initial exploration*
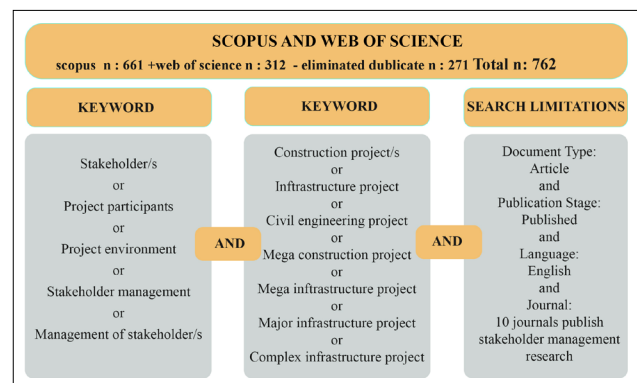

Figure 2. All keywords and search limitations for data collection in Scopus and Web of Science.

Table 1. Journals that frequently publish stakeholder management research

| No	Journal	#of Articles
1	Journal of Construction Engineering and Management	132
2	Engineering Construction and Architectural Management	104
3	International Journal of Project Management	85
4	Journal of Management in Engineering	83
5	Sustainability	81
6	Construction Management and Economics	67
7	International Journal of Construction Management	65
8	Built Environment Project and Asset Management	53
9	Buildings	49
10	Automation in Construction	43
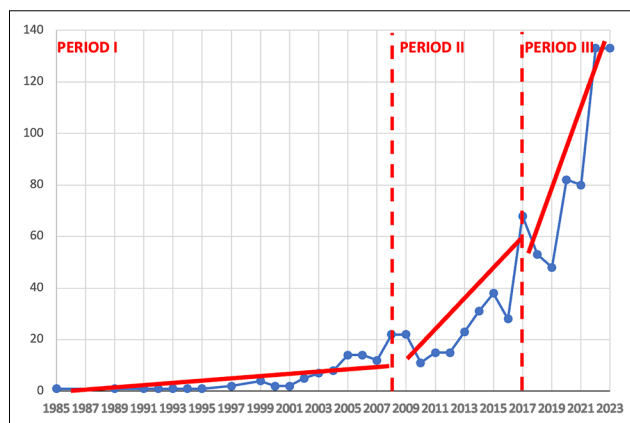
Figure 3. Annual publication growth of stakeholder management articles since 1985.

stage (1985-2007), Period II: *steady development stage* (2008-2016), and Period III: *booming growth stage* (2017-2023). Period I contains 77 articles, Period II 205 articles, and Period III 481, respectively. In other words, 63% of the articles about stakeholder management in construction projects were published within the past 6 years.

Although the number of articles published in Period I is fewer than other periods, this period is the reference period in regard to stakeholder management studies in construction management literature (Figure 4). Therefore, total citations in Period I are as high as other periods. Most cited articles in each period are displayed in Table 2. In period I, articles on project success indicators, critical success factors, and stakeholder impact in construction projects were most cited. This period is defined as *initial*

exploration stage because studies in this period focused on the importance of stakeholder management in construction project success. Even though similar studies continued in Period II, studies evolved in model building on stakeholder management such as BIM and social network. On the last period, as BIM studies advanced Internet of Things (IoTs) and fuzzy techniques were used with BIM in Period III. In this period, the number of studies increased the topic of sustainability and sustainable project management issues within stakeholder management apparently.

Country Co-authorship

VOSviewer was used to visualize country co-authorship (international collaboration) for stakeholder management in construction projects since 1985. In Period I 22 countries, in Period II 42 countries, and in Period III 74 countries contributed to the stakeholder management studies through international collaboration.

A large proportion of articles' co-authorship in stakeholder management come from Hong Kong, Australia, China, the United Kingdom, the Unites States, and Canada. However, in recent years, the article was published from other countries such as Turkey, the Netherlands, and Nigeria. To demonstrate international influence, countries were grouped into six groups, which in Figure 5 indicates with stacked columns. In Figure 5, it can be seen that more than 85% of the articles published in stakeholder management are from Hong Kong, Australia, China, the United Kingdom, and Canada in Period I. Interestingly, the number of articles from the United States increased compared to Canada in Period II. However, the dominance of these countries in this issue fell from nearly 85% in Period I and II to about 55% in Period III. Country co-author geographic spread shift toward other countries indicates that stakeholder management studies are in the attention to many international scholars and growing as a research field.

Keyword Co-occurrence Cluster Analysis

Keywords are highly beneficial in terms of the bibliometric analysis while looking forward for the information about specific academic fields (Zhang et al., 2016). The main objective of including keywords into articles is increasing their accessibility for the ease of academic studies (Vargas-Quesada et al., 2017). The frequency of the keywords is extracted from articles in the dataset and keyword co-occurrence analysis was utilized.

A hundred forty-three keywords used in articles were included in the analysis after the cut-off point of 5 references, and this amounted to 5096 keywords. While the keywords were being determined, general conceptual words such as "stakeholder management," "construction project," and "stakeholders" and irrelevant words were ignored in this study. The number of keyword citations increased in

Table 2. Most cited articles in each period

No.	Period I		Period II		Period III	
	Article	# of Citation	Article	# of Citation	Article	# of Citation
1	Causes of delay in large construction projects (Assaf and Al-Hejji, 2006)	927	BIM implementation throughout the UK construction project lifecycle: An analysis (Eadie et al., 2013)	437	Prefabricated construction enabled by the Internet-of-Things (He et al., 2017)	222
2	Understanding the key risks in construction projects in China (Zou et al., 2007)	540	Beyond the 'iron triangle': Stakeholder perception of key performance indicators (KPIs) for large-scale public sector development projects (Toor and Ogunlana, 2010)	345	Mapping the managerial areas of Building Information Modeling (BIM) using scientometric analysis (He et al., 2017)	202
3	Critical success factors for different project objectives (K H Chua et al., 1999)	416	Stakeholder management studies in mega construction projects: A review and future directions (Mok et al., 2015)	338	Sustainable project management through project control in infrastructure projects (Kivilä et al., 2017)	178
4	Exploring critical success factors for partnering in construction projects (Chan et al., 2004)	317	Social network model of construction (Chinowsky et al., 2008)	261	Megaproject Management Research: The Status Quo and Future Directions (Yuan et al., 2021)	14
5	Evaluation of stakeholder influence in the implementation of construction projects (Olander and Landin, 2005)	317	Trust in projects: An empirical assessment of owner/contractor relationships (Pinto et al., 2009)	249	Governing Behavioral Relationships in Megaprojects: Examining Effect of Three Governance Mechanisms under Project Uncertainties (Zheng et al., 2019)	138
6	Factors affecting cost performance: Evidence from Indian construction projects (Iyer and Jha, 2005)	299	Quantifying performance for the integrated project delivery system as compared to established delivery systems (Asmar et al., 2013)	214	Improving Information Sharing in Major Construction Projects through OC and POC: RDT Perspective (Zhang et al., 2020)	138
7	Stakeholder impact analysis in construction project management (Olander, 2007)	265	Assessing risk and uncertainty inherent in Chinese highway projects using AHP (Zayed et al., 2009)	207	From BIM to extended reality in AEC industry (Alizadehsalehi et al., 2020)	133
8	Stakeholder management for public-private partnerships (El-Gohary et al., 2006)	260	Quantifying schedule risk in construction projects using Bayesian belief networks (Luu et al., 2009)	186	Strategic responses to external stakeholder influences (Nguyen et al., 2023)	132

Table 2. Most cited articles in each period (Cont.)

| No.	Period I		Period II		Period III	
	Article	# of Citation	Article	# of Citation	Article	# of Citation
9	From client to project stakeholders: A stakeholder mapping approach (Newcombe, 2003)	236	Review of the application of social network analysis (SNA) in construction project management research (Zheng et al., 2016)	174	Fuzzy Synthetic Evaluation of the Critical Success Factors for the Sustainability of Public Private Partnership Projects in China (Deng et al., 2021)	121
10	Critical factors affecting schedule performance: Evidence from Indian construction projects (Iyer and Jha, 2006)	155	Stakeholder salience in global projects (Aaltonen et al., 2008)	172	Stakeholder Management-One of the Clues of Sustainable Project Management-As an Underestimated Factor of Project Success in Small Construction Companies (Klaus-Rosińska and Iwko, 2021)	117
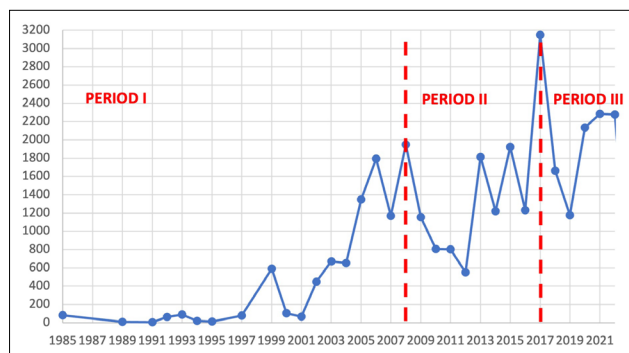
Figure 4. Annual total citations of articles.

Figure 5. Country of co-authorship.

three periods consecutively from 13 citations (1985–2007) to 40 citations (2008–2017) and finally to 90 citations (2017 to present). The distribution of keywords is displayed in Figure 6. As can be seen from the figure, risk management, cost, decision making and contractors are used commonly in all periods while others are actively used only in one or two periods.

The evolution in keywords was analyzed further by ranking them by time periods. Although mutual keywords (cost, risk management, decision-making, and contractors) are cited in 3 periods, their total link strength is different in each period. To be comprehensive in keyword co-occurrence clusters, a minimum number of five occurrences per keyword is selected as the threshold in VOSviewer analysis. The dimension of the circles, color, and texts in each cluster represents the strength of their co-occurrence with the other keywords, and the distance of the items and the lines demonstrates the connection and linkages of the keywords, respectively. Accordingly, keywords were displayed the connection and total link strength depending on time variation is presented in Figure 7.
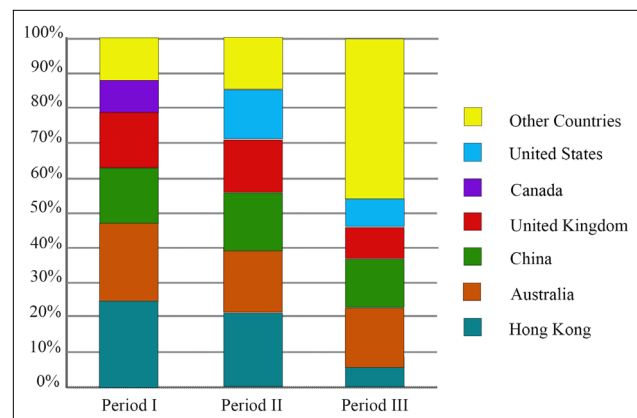
In the first period, only 13 keywords are included for stakeholder management in construction projects because this field has been explored recently. The keyword "contracts" became the most important keyword for this period in terms of total link strength which indicates that stakeholder management in construction projects was explored within contract management (Glagola et al., 2002). This period evolved in the topics of "contractors," "performance" (David Weston I and Edward Gibson Jr, 1993), "scheduling" (Kartam, 1999), "optimization" (X. Zhang and Asce, 2005), which indicate that stakeholder management's effect over the outcome in other words success factors of construction projects. In this period, stakeholder management was studied from project management perspective (Newcombe, 2000).

The keyword co-occurrences network analysis from 2008 to 2016 is shown in Figure 8, which highlights the frequent occurrence of keywords by larger nodes. In this period, project management aspects were intensified, including

Figure 6. Keywords by period.

risk management and human resource management. The keyword occurrence analysis regarding this period indicates that the second period comprises three main topics: Project management (Zheng et al., 2016), type of stakeholder (Hanna, 2016), and project life cycle (Liu et al., 2015). In this period, as stakeholder management evolves contextually, the research methods used in studies also evolved with various models and analysis. In this period, along with project management principles, stakeholder management studies were also influenced by the developments in management science literature (Osipova, 2015). Furthermore, most of the studies focused on contractors who are one of the major stakeholders in projects. Moreover, it is observed that the project life cycle approach was considered a necessity for the success of stakeholder management (Park, 2009)

In the third period, 90 keywords within 2856 keywords met the threshold for the publications in keyword occurrence analysis since 2017. Figure 9 presents the keyword occurrences depending on time variation for Period III. While 33% of these keywords were the continuation of previous periods, 67% of them were the new keywords

used in this period. "Design/methodology/approach" is commonly used keywords. This period consists of five main topics. Besides the topics of project management, type of stakeholder, and project life cycle, which were addressed in Period II, waste management, relation management, knowledge management, Blockchain, supply chain management, modular construction concepts, and Covid-19 were discussed from stakeholder management perspective. These keywords were discussed from the concept of stakeholder management perspective along with the following topics;

- Modular construction (total link strength is 42) was examined with a critical success factor (Mignacca and Locatelli, 2021), risk management (Enshassi et al., 2020), and blockchain (Jiang et al., 2023).

- Waste management (total link strength is 37) was evaluated with public participation (Wang et al., 2022), sustainability (Omotayo et al., 2020), system thinking (Omotayo et al., 2020), design-build projects (Yu et al., 2021), risk allocation (Wang et al., 2022).

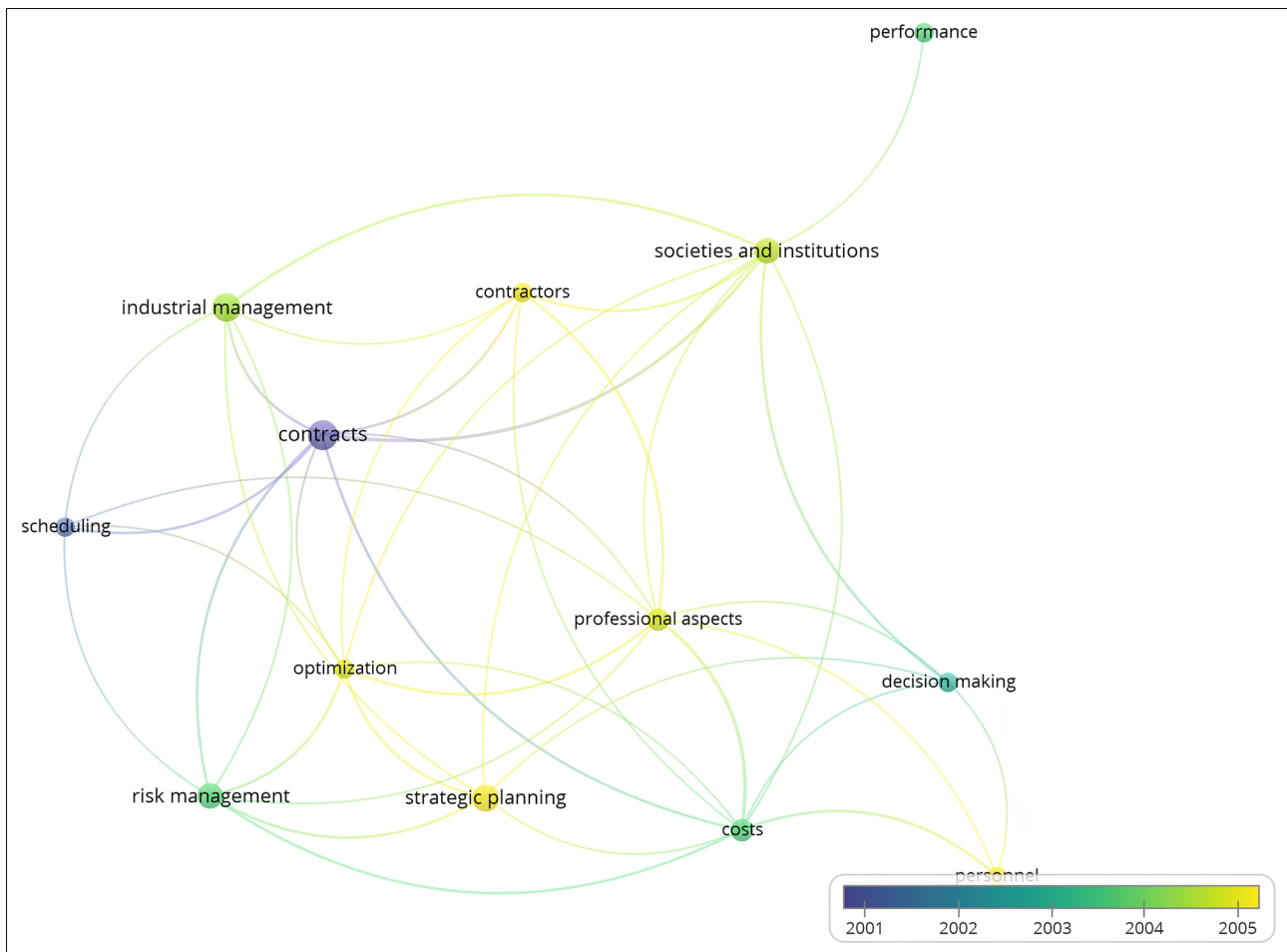- Knowledge management (total link strength is 34) was

Figure 7. Keyword occurrences depending on time variation for Period I.

discussed with smart technologies (Ngo and Hwang, 2022), health and safety (Deepak and Mahesh, 2019), key stakeholder expectations (Staykova and Underwood, 2017).

- Covid-19 (total link strength is 24) was related to value management (Bennett and Mayouf, 2021), health and safety (Araya and Sierra, 2021), project performance (Tekin, 2022), delays and cost overrun (Abubakar et al., 2022).

- Blockchain (total link strength is 16) was researched with BIM (Lee et al., 2021), smart contract (Ameyaw et al., 2023), supply chain management (Kiu et al., 2022), modular integrated construction (Jiang et al., 2023).

Along with the contractor, other stakeholders (construction companies, external stakeholders, and the public sector) were also taken into consideration and their relation to project was discussed. Different types of projects, environmental and health conditions, were the new research fields for stakeholder management in construction projects.

The new keywords, waste management and knowledge management, have begun to evaluation.

In this period, advanced research models (i.e., game theory, numerical model, reliability analysis) were used to determine and analyze topics as well as building models in stakeholder management within the construction management literature.

DISCUSSION

In bibliometric analysis, not only the central themes were determined in the field of stakeholder management in construction projects but also the interaction between these core topics and their evolution over the years. Bibliometric analysis enables to understand and grasp the relevant features, and directions of stakeholder management in construction projects. In this type of study, the literature is analyzed in regard to the research status and facilitates discussion on important aspects of research associated with the literature. Bibliometric analysis provides guidance on future developments and research trends on a subject.

Based on the bibliometric analysis, a knowledge map of stakeholder management was analyzed using three scientometric analysis (Figure 10). The knowledge structure
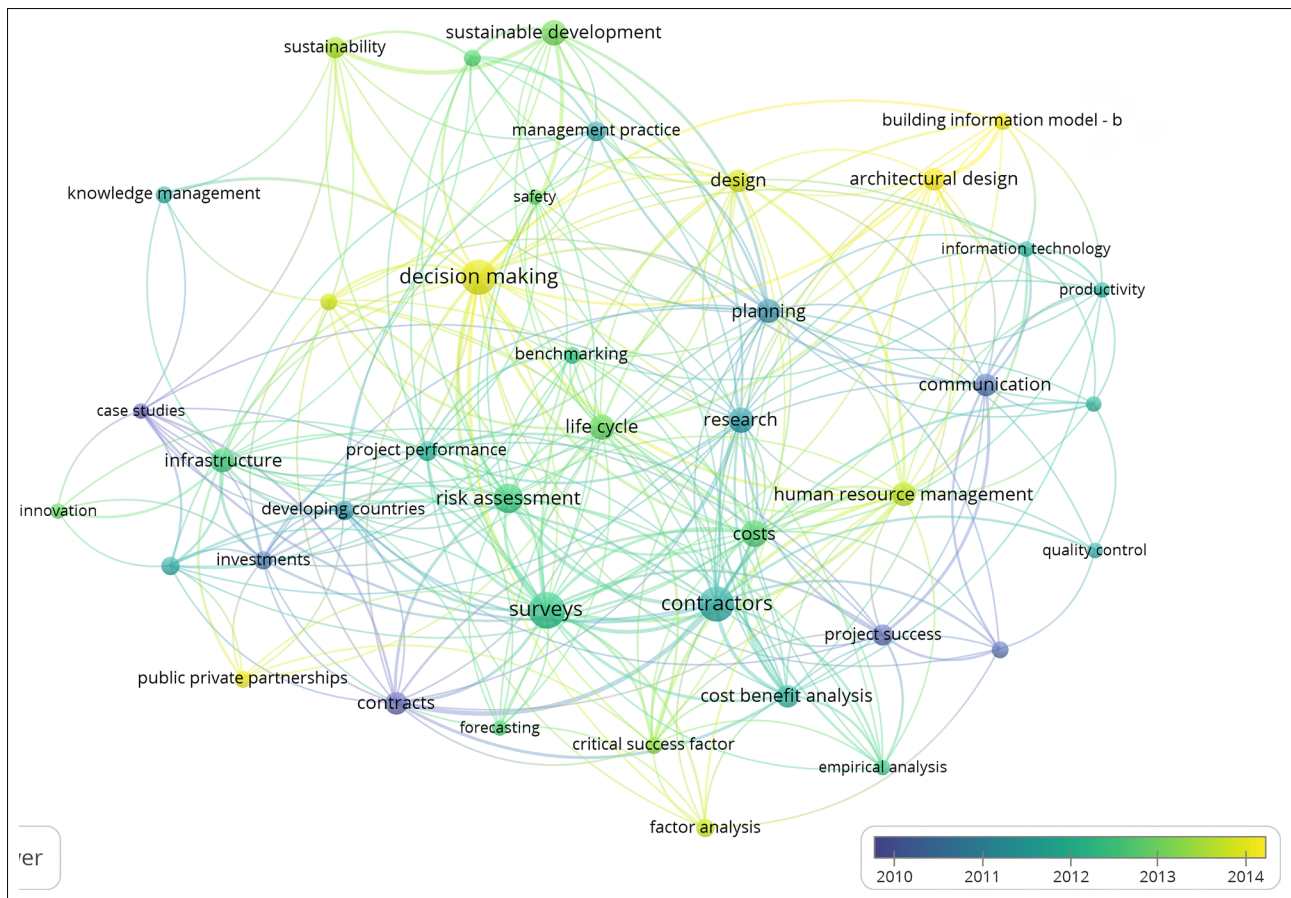
Figure 8. Keyword occurrences depending on time variation for Period II.

of academic research was explored through cluster analysis of the co-citation network of articles, country co-authorship, and keyword co-occurrence. The analysis results were integrated to explore the knowledge map of stakeholder management in construction projects. The key research topics of stakeholder management in construction projects showed significant differences across three periods.

The *initial exploration stage* (Period I) conveyed the critical success factors and project's success indicators of stakeholder management in construction projects. Consequently, stakeholders in construction projects were considered as an essential engagement to improve the possibility of project success by prioritizing stakeholder concerns. In this period, the majority of the publications on stakeholder management were authored from developing countries such as Australia, the United Kingdom, Canada, and Hong Kong. Their influence in this field may be related to the advancements of the industry and companies. This condition lasted till the third period; since 2017, stakeholder management has become a common research area globally.

Keywords were evaluated according to total link strength. In period 1, stakeholder management was related to the body of project management (link strength 68.60%), which was followed by determining the types of stakeholders

(link strength 25.65%). Majority of research was carried out for contractors. As this period was determined as *initial exploration stage*, most of the studies were focused on descriptive aspects, nevertheless, the most common research model was "decision making" with a rate of 5.75%.

In the second period, the studies were advanced stakeholder relationships, risk management, and stakeholder model, which constitute the main research topic. Period II was defined as a steady *development stage*. Analysis of the keywords used in this period was a good starting point for assessing their evolution in this field. Keywords characterized the focus of project management, research model, project life cycle, and type of stakeholder provided general ideas concerning research trends. Risk management, human resource management, cost management, contract, management practice, safety, and quality control are the most used keywords under project management at a rate of 36.8%. Unlike Period I, a variety of stakeholder models has been asserted, such as factor analysis, BIM, and empirical analysis with a rate of 29%. Project environment, sustainability, project performance, and communication came into prominence. These are defined as project life cycle with a rate of 26.80% for the successful completion of the project. Contractor, one of the stakeholder types,
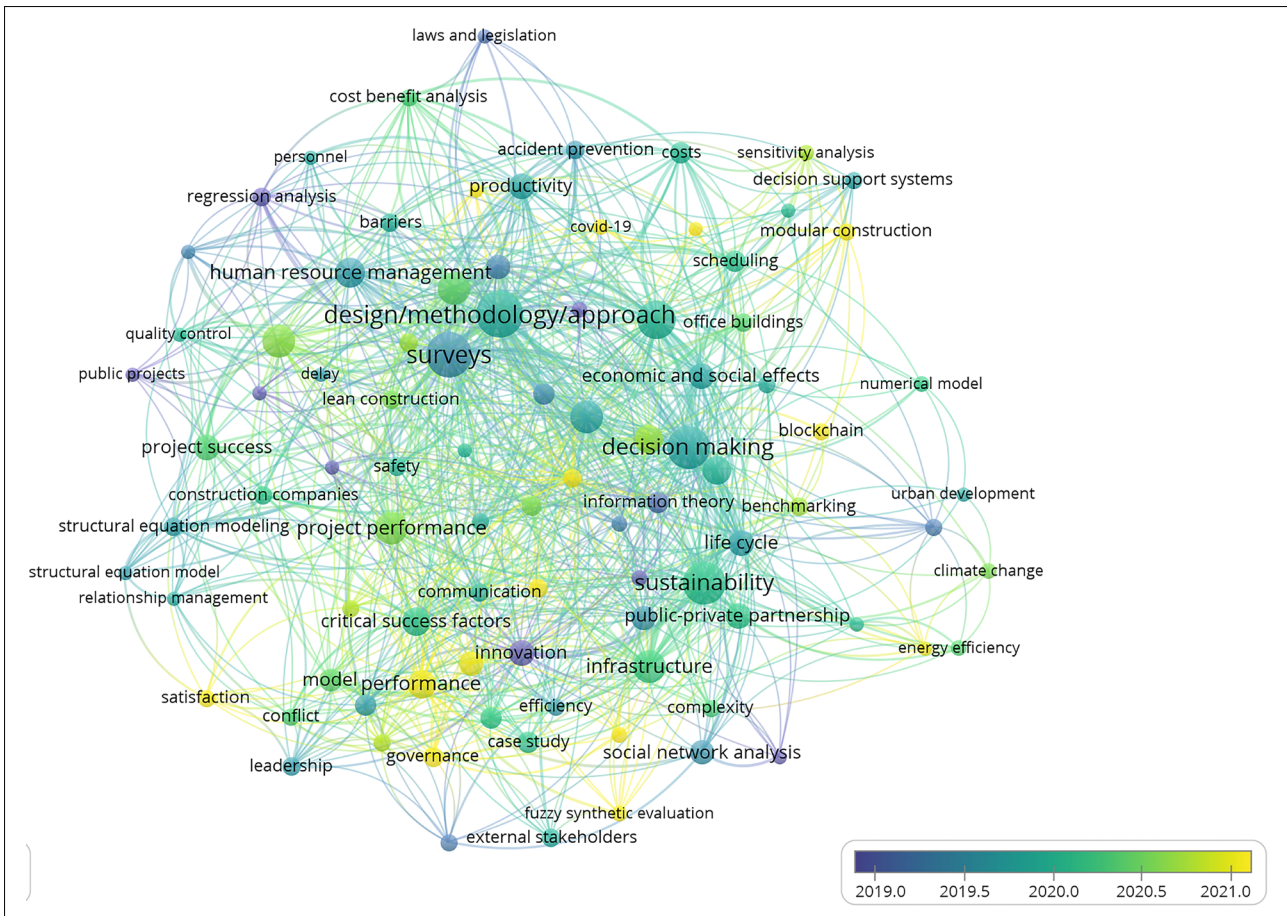
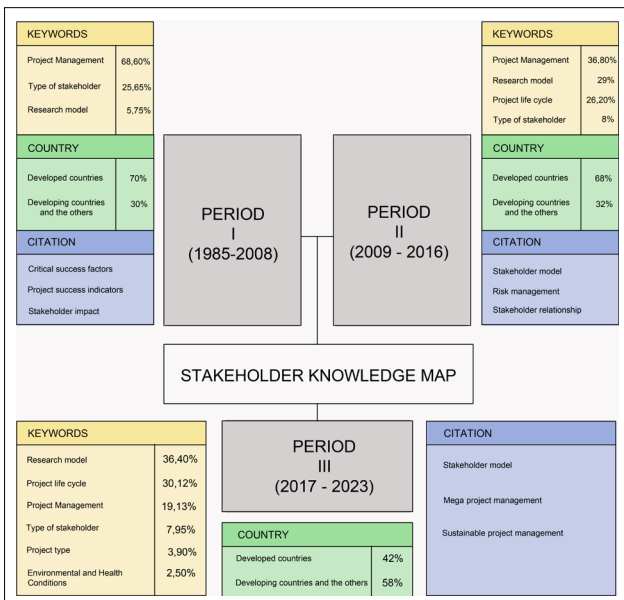**Figure 9**. Keyword occurrences depending on time variation for Period III.

Figure 10. Knowledge map of stakeholder management in construction projects.

took an active part in this period as well at the rate of 8%. Nevertheless, there is no study focusing on stakeholders such as suppliers, consultants, architect, etc. except

contractor. In other words, the importance of stakeholder management was still depending on the contractor.

Compared to the *initial exploration* (Period I) and *steady development stages* (Period II), stakeholder management in construction projects studies has been systematically increased at the *booming growth stage*. This stage is named as Period III. It has been determined that model development articles were produced instead of stakeholder conceptual frameworks. In addition, project types and sustainability have gained importance in this period. The number of publications and the variety of topics about stakeholder management in construction projects have increased, as well as the number of countries. The studies carried out in this field are not only limited to developed countries but also have begun to spread throughout the world.

All topics are associated with each other, but their strengths are different. The research model is in the first at the rate of 36.40%. A wide range of methods ("Social Network Analysis," "Regression Analysis," "Multivariant Analysis," "Sensitivity Analysis," "Game Theory," "Analytical Hierarchy Process," "Numerical Model") was used to develop models. Studies on "Project Life Cycle" and "Project Management" were supported by these models. In this period, the project life cycle was examined more than in period II. In this

context, studies on the complexity of projects, barriers, and uncertainties were related to stakeholders in projects.

In the third period, "Project Type" and "Environmental and Health Conditions" topics with stakeholder management have the highest frequency. Because of their unique structures and production processes, "mega projects" and "public projects" were studied from the stakeholder management perspective in the last period. On the other hand, recent publications have explored the relationship between "environmental and health conditions" and project stakeholders. In this period, studies revealed that "Covid-19," "carbon emission," "energy efficiency," "urban development," and "environmental effect" have impacts on the selection and management of stakeholders.

CONCLUSION

The research findings unveiled a steady rise in the quantity of published works overtime, which mirrors the keen interest of researchers in the field and underscores the significance of this domain. This study's primary contributions encompass an examination of bibliographic connections and the identification of conceptual structures. The former illuminated emerging research patterns and key topics of discourse, while the latter utilized co-citation analyses to ascertain the works closely linked to the latest articles.

This study reviewed the existing literature on stakeholder management in construction projects published from 1985 to 2023 through scientometric analysis. The academic communities, key research topics, and knowledge map of the existing research were quantitatively analyzed and visualized. Based on the results of the quantitative analysis, a knowledge map of stakeholder management in construction projects was constructed and discussed. According to the analysis of 762 retrieved articles from Scopus and WOS, interest in research in this field has been increasing since 2017. This development shows that stakeholder management has gained importance in construction projects in recent years, as outlined below.

- In the Period I defined as "initial exploration," the foundations of stakeholder theory were established. The necessity of stakeholder management in project success was advocated, and the conceptual aspects of stakeholder management were addressed. The model proposals related to stakeholder management in construction projects have remained quite shallow. The emphasis on the importance of stakeholders has mostly been placed on contractors, while other types of stakeholders have not been deeply examined.

- In period 2 characterized by steady developmental stages, stakeholder management has evolved through stakeholder relations and risk management. The presented research model studies have begun, and factor

analysis, BIM, and empirical analysis have been used in the development of the stakeholder model. Studies have been conducted on the feasibility of achieving project life cycle and sustainability through stakeholder management.

- In period 3 described by the booming growth stage, studies on stakeholder management have been undertaken in various project types, such as mega projects, public projects, and public-private partnership projects. New research models have been proposed using regression analysis, analytical hierarchy process, and numerical models. In contrast to other periods, uncertainties and barriers in projects have been examined through stakeholders in this period. Environmental and health conditions have recently begun to be explored.

According to the results of this study, several important issues require more attention in future studies. Limited studies have been done to identity the relations stakeholder management and "blockchain," "Covid-19," "carbon emission," "climate change," "supply chain," "modular construction," "waste management," and "knowledge management." However, in recent times, there is a lack of studies that utilize artificial intelligence analysis actively used in many fields, to make recommendations in this area.

Knowledge mapping represents significant areas that can influence stakeholder management. Future studies will build upon the trends identified here because knowledge mapping serves as a driving force in the development of stakeholder management. The emerging trends identified here open the door to new research opportunities. In conclusion, this study highlights fertile areas that need to be explored, including project types, environmental and health factors, and digital technology that examines stakeholder management in construction projects.

Unlike other studies, this study has considered a significantly larger number of article searches. It is also a more up-to-date study compared to others, including the past 6 years, and is the first study to demonstrate the booming growth stage in which stakeholder management in construction projects has spread to a much broader network. The study not only evaluates the historical development of stakeholder management periodically but also highlights its relationship with other project management disciplines. In addition, it examines the current themes within stakeholder management. The contribution of this study is creating a new knowledge map about the stakeholder management in construction projects to determine the trend of the development of the related literature over the domain and the time. Therefore, the proposed knowledge

map comprehensively indicates the past, current, and future of stakeholder management in construction projects. Furthermore, the knowledge map can be updated regularly with the development of new stakeholder management practices in the construction projects.

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