buildings

MDPI

Review

Stakeholder Relationship in Construction Projects: A Mixed Methods Review

Yingnan Yang [1], Ziyi Wei [1,2] and Zhicheng Zhang [1,*]

[1] College of Civil Engineering and Architecture, Zhejiang University, Hangzhou 310058, China
[2] Center for Balance Architecture, Zhejiang University, Hangzhou 310028, China
* Correspondence: jszzc@zju.edu.cn

Abstract: Relationship management among different stakeholder groups plays an increasingly important role in construction innovation, which could explain the growing interest in stakeholder relationship studies of construction projects (SRCP) over the last two decades. However, most of the recent literature review studies have focused on stakeholder management, and there are very few studies systematically describing what types of relationships actually exist in construction projects. To fill the gap, a mixed-methods review is conducted to explore the state-of-the-art work on SRCP. 312 relevant peer-reviewed journal articles published between 2000 and 2022 were examined and analyzed using data from the Scopus and Web of Science databases. A follow-up systematic review of the identified literature was conducted with three main objectives: identifying the main research category, summarizing the main research topics, and proposing future research directions. It was found that over the past 20 years, SRCP has been extended to a greater variety of research topics, such as information technology, which needs to take into account the multi-dimensional research agendas. Overall, this study contributes to the research field in the SRCP domain by offering insightful information on the current state of SRCP and proposing potential future directions for research.

Keywords: stakeholder relationship; construction projects; scientometric analysis; systematic review; research trends

Citation: Yang, Y.; Wei, Z.; Zhang, Z. Stakeholder Relationship in Construction Projects: A Mixed Methods Review. *Buildings* **2023**, *13*, 3122. https://doi.org/10.3390/buildings13123122

Academic Editor: Jorge Lopes

Received: 24 October 2023
Revised: 3 December 2023
Accepted: 11 December 2023
Published: 15 December 2023

1. Introduction

The construction industry is characterized by its deep fragmentation, with various stakeholders and disciplines brought together as virtual teams in many instances for one-off projects [1]. Hence, the success of a construction project depends on a few conflicts and effective collaboration among the multiple stakeholders during various project phases [2]. This is especially important in complex projects where more stakeholders are involved and the goals are more ambitious regarding information and data integration. Construction projects are dynamic entities co-created through different interactions between multiple stakeholders, both internal (i.e., employees) and external (i.e., government, consumers, users, etc.) [3]. It appears that the complex, fragmented, and dynamic nature of construction projects requires effective relationship management for successful project delivery and meeting multiple and conflicting stakeholder expectations (e.g., Mok et al. [4]; Oppong et al. [5]; Georgiadou [6]). Organizations involved in the design and construction of buildings and infrastructure are being linked through various relationships. Relationship management among different stakeholder groups plays an increasingly important role in the preplanning, design, and construction of buildings and infrastructure, which could explain why there has been a growing interest in stakeholder relationship studies in construction projects (SRCP) over the last two decades.

A systematic examination of existing studies, state-of-the-art advancements, and emergent trends is regarded as an effective approach to gaining an in-depth understanding of a research area [7]. Several literature reviews have emerged over the past two decades (e.g., Mok, Shen, and Yang [4]; Oppong, Chan, and Dansoh [5]; Yang and Shen [8];

Wuni and Shen [9]), but the research focus is on stakeholder management in construction projects. Despite the importance of critical review, almost no such work has yet been conducted regarding stakeholder relations in the construction project. One reason for this may be that the relationship itself is an obscure, complex, and multidimensional concept encompassing various behaviors among stakeholders. There is no universally accepted definition for stakeholder relations, which makes literature reviews of stakeholder relations somewhat weak. In addition, as stated by Mainardes, Alves, and Raposo [10], there are very few studies systematically describing what types of relationships actually exist in construction projects and how to manage these relationships [10]. Therefore, conducting systematic review studies of SRCP to spot gaps and address different types of relationships becomes highly relevant. This study aims to provide a systematic review of state-of-the-art work on SRCP. The main research questions are as follows:

- What causes of the different types of relationship?
- How to evaluate the relationships among stakeholders?
- What actions can be taken for bad relationships?
- What are the impacts of the different types of relationship on the project?

To address the above issue, this study conducted a mixed-methods review that encompassed both scientometric analysis and a systematic review of SRCP from 2000 to 2022. The scientometric analysis allows a quantitative study of the hotspot distribution structure, quantitative relationships, and change patterns of SRCP. A follow-up qualitative discussion was conducted with three main objectives: identifying the main research category, summarizing the main research topics, and proposing future research directions. The remainder of the paper is structured as follows: The methodology of this study is elaborated on in Section 2. The results of the scientometric analysis are presented in Section 3. Section 4 encompasses a systematic review analysis of the identified literature. Section 5 provides a discussion, and Section 6 concludes the study.

2. Methodology

Academic publications relevant to SRCP can be retrieved from the online dataset to fulfill this review study's objectives. However, due to the conceptual ambiguity of stakeholder relationships, a manual review might be biased and prone to subjective judgments and omissions. This necessitates the use of a mixed-methods review, as termed by Oraee et al. [11], to clarify, deepen, and synthesize the SRCP. A mixed-methods review combines quantitative and qualitative methods to search, integrate, and analyze the available literature on SRCP. The quantitative analysis was performed using the science mapping approach, including bibliometric search, manual review, and scientometric analysis. Following the scientometric analysis, a qualitative discussion was used to analyze the existing literature, identify research gaps, and provide new insights. Figure 1 illustrates the research process for this study.

2.1. Paper Retrieval

The process of obtaining target articles is carried out in the following two steps: firstly, a preliminary screening was conducted based on specific keywords and published years, yielding an initial list as the outcome of the first stage. In the second screening process, articles that did not meet the criteria according to the filtering standards were further removed. The paper retrieval process is illustrated in Figure 2.

To avoid subjectivity and omissions of target papers, it is necessary to determine the search rules before using scientometric analysis [12]. From the initial literature survey, the search rule was determined as "(stakeholders OR team OR partners OR participants OR actors) AND (relation OR relationship OR conflict OR communication OR cooperation OR partnership OR collaboration OR integration OR coordination) AND (construction)". The core collection database of Scopus and Web of Science (WoS) was searched for relevant publications that were published from 2000 to 2022. According to the first criterion, a total of 444,578 papers were retrieved. Secondly, papers not written in English, book reviews,

editorials, and conference papers were eliminated, and a total of 351,748 journal articles were reviewed. To ensure the authority and quality of selected articles, only papers in peer-reviewed English journals were included for the review considering their impact on construction research in terms of SCImago Journal Rank (SJR) and H-index in the third stage. The SJR serves as a metric for gauging the scientific influence of journals, taking into consideration not only the quantity of citations received by a journal but also the significance and prestige of the journals from which these citations originate. Moreover, a journal's h-index is employed to quantify the scientific productivity and impact of the journal, enhancing the representativeness of the selected articles for bibliometric analysis [13]. As shown in Table 1, 18 journals were selected in this process. These journals have published at least one paper that fits the first criterion and are highly ranked by construction management researchers (e.g., Mok, Shen, and Yang [4]; Oppong, Chan, and Dansoh [5]; Jin, Zou, Piroozfar, Wood, Yang, Yan, and Han [14]). Based on this criteria, 1615 papers were retrieved. The fourth step involves screening the merged database by removing duplicate and out-of-scope studies. In this regard, the irrelevant studies were determined by reviewing their titles and abstracts. To decrease potential bias during the selection of target papers, the contents of each paper were screened by different authors to identify the ones suitable for the analysis. The fifth step encompasses complementing forward with backward snowball search methods to track missing publications pertinent to the scope of this study. After the above process, a total of 312 documents were retained for review.

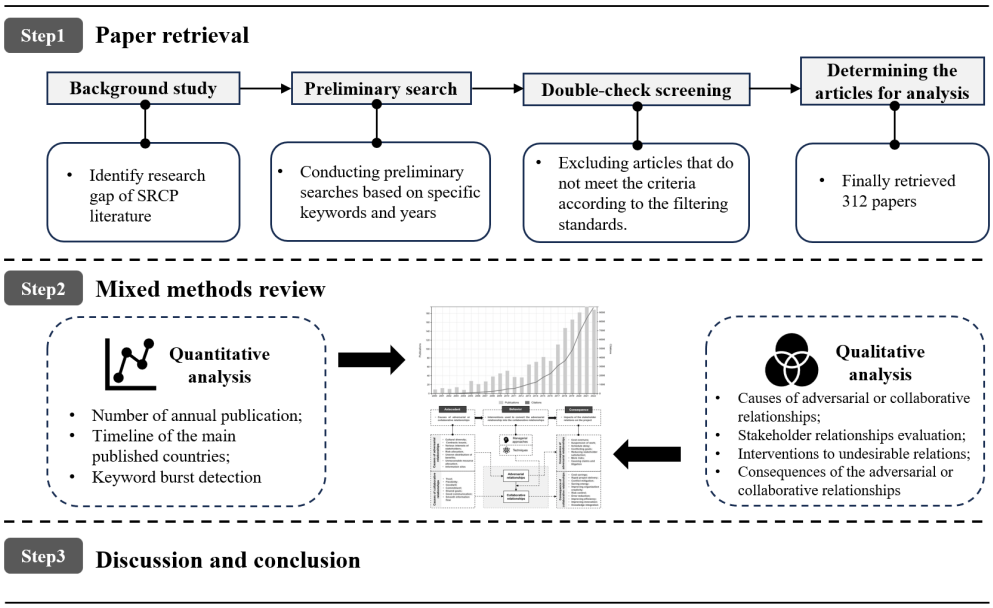

Figure 1. Research process.

2.2. Quantitative Analysis

Scholars (e.g., He, Wang, Luo, Shi, Xie, and Meng [7]) have identified that the manual review is prone to being biased and limited in terms of subjective interpretation. Therefore, the current study provides a quantitative analysis of the SRCP using a scientometric technique, a research method that refers to knowledge domain visualization or mapping [15]. The scientometric analysis generates network models to visualize the intellectual view of a specific knowledge area that can assist researchers in perceiving the overall research patterns and discovering the research trend [16]. CiteSpace software (version 6.2) is used for network analysis and visualization based on the terms that the authors have used to describe their publications and is capable of visualizing different layouts of networks, the detection of clusters, and emerging trends in the scientific literature [7].

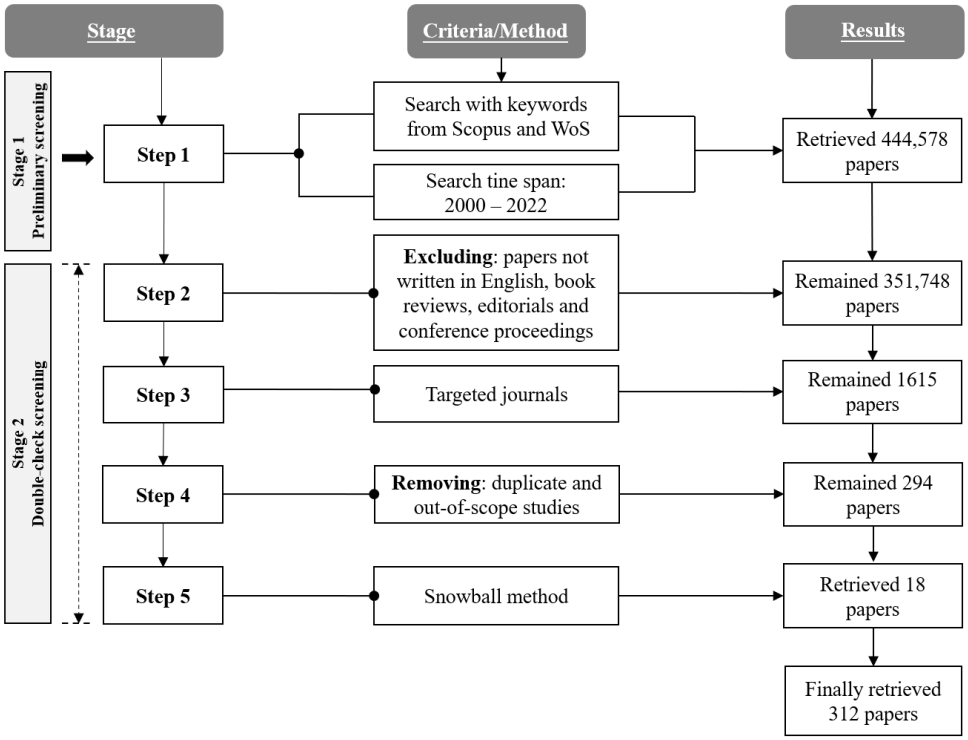

Figure 2. Paper retrieval process.

Table 1. Distribution of selected publications from 2000 to 2022.

Journal Name	Number of Retrieved Papers from Wos	Number of Selected Papers for This Study
Journal of Construction Engineering and Management	215	67
International Journal of Project Management	255	47
Automation in Construction	134	34
Journal of Management in Engineering	192	34
Engineering, Construction and Architectural Management	144	28
Construction Management and Economics	61	20
International Journal of Construction Management	80	16
Built Environment Project and Asset Management	53	11
Building research and information	93	10
Project Management Journal	95	8
Journal of Civil Engineering and Management	26	8
KSCE Journal of Civil Engineering	29	6
Architectural Engineering and Design Management	37	6
Journal of Cleaner Production	28	5
Construction Innovation	25	4
Scandinavian Journal of management	51	4
Habitat International	94	2
Journal of Architectural Engineering	3	2
Total	1615	312

2.3. Qualitative Discussion

Based on the scientometric analysis, the qualitative discussion aims to provide an in-depth and systematic review of the main research categories, the current research topics, as well as the future recommended directions. The analysis followed the objectives suggested by Harden and Thomas [17] for the qualitative phase of a mixed-methods review, which is performed without creating new theories and will identify the main topics of different studies and their respective gaps. In order to narrow down the dataset and identify the

studies directly related to the SRCP, 312 identified papers were thoroughly examined by the research team.

3. Scientometric Analysis

This section renders the results of the scientometric analysis of related research publications in the SRCP domain.

3.1. Article Publishing Trend

Figure 3 displays the yearly publication count in this area from 2000 to 2022. Between 2000 and 2012, the number of publications remained low, indicating that the topic needed to receive more attention during that period. However, after 2012, there was a significant surge in published articles, indicating that the topic is now a thriving academic area. The exponential increase in annual citations also reflects the growing attention from an expanding community of scholars towards the research topic, indirectly indicating its academic significance and influence.

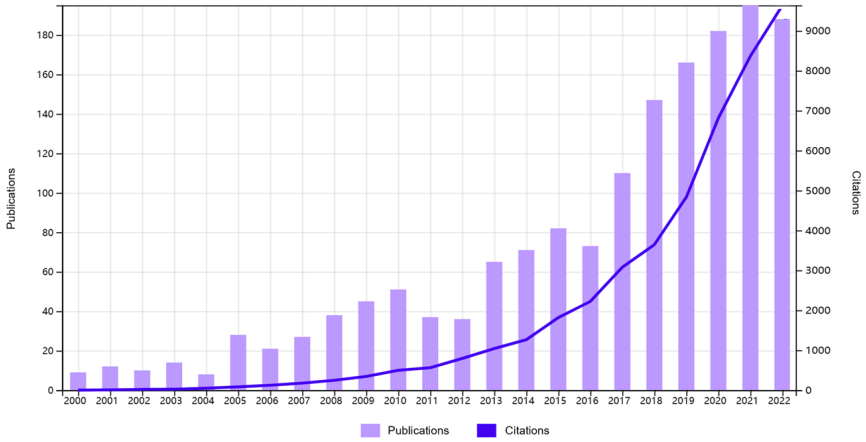

Figure 3. The number of annual publications.

The network map of countries, generated using CiteSpace and illustrated in Figure 4, comprised 78 country nodes connected by 287 collaborative links. Node size is proportional to the volume of articles originating from each country, with larger nodes indicating higher publication output. Figure 4 further presents a graphical representation of trends in primary contributing countries based on the literature data. An extensive statistical analysis of stakeholder relationship literature spanning the past twenty-three years has identified the top ten countries by paper count. These leading contributors include China (417 papers), the USA (319), Australia (262), England (202), Canada (77), the Netherlands (72), Sweden (58), South Korea (53), Finland (43) and Germany (41).

3.2. The Keyword Co-Occurrence Network

Keywords and abstracts considered as clear and concise descriptions of the research contents, which necessitate using such terms as units of analysis to identify prominent groupings that affect the structure of SRCP. The selected 312 papers were analyzed in terms of keywords and abstracts to retain the opinions of the authors as much as possible. Keyword co-occurrence network analysis was performed using CiteSpace. The overall network depicts the development of SRCP over time, showing the most important footprints of this field. Nodes in the network represent individual keywords used to generalize the essence of each paper. Edges connecting the nodes are co-occurrence links, where two different keywords are used together in the same article [7]. Similar words were combined in order to avoid potential misunderstandings; for example, the words "BIM", "building information modelling", and "building information model" were combined under the label "BIM". Figure 5 shows the most frequently occurring keywords, which have excluded the general

words (e.g., management, project management, and construction projects). Node size represents the frequency with which a keyword occurs in the data set.

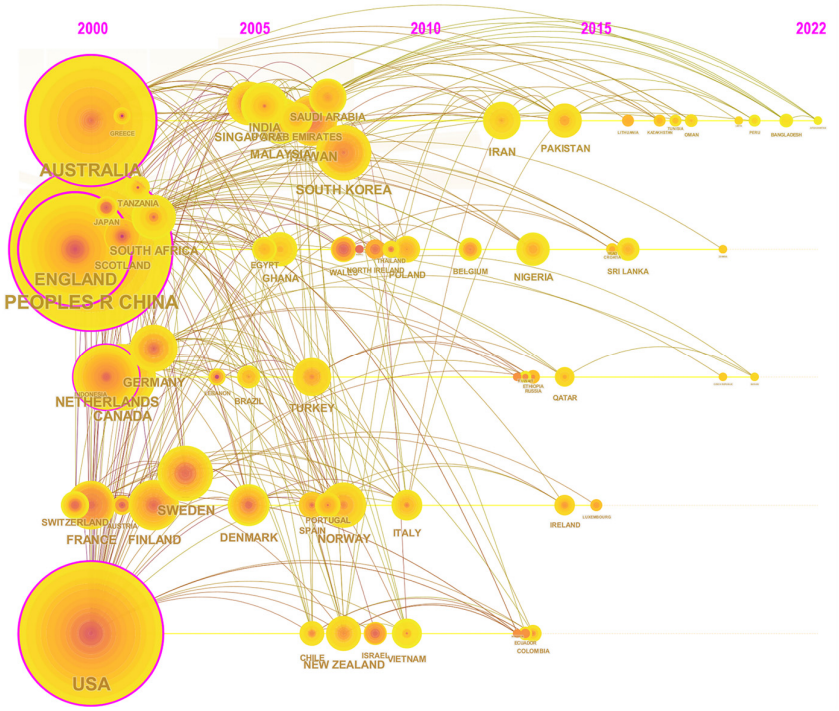

Figure 4. Timeline mapping of the main published countries.

Figure 5. Keyword co-occurrence network: 2000–2022.

The keywords shown in Figure 5 have been more frequently used in the literature sample, including "performance (76)", "trust (50)", "collaboration (44)", "innovation (39)", "communication (35)", etc. The numbers in parentheses represent the frequency of occurrence of the keywords. The selected literature sample is generally concerned with the effects of relationships on project performance; the frequency of "performance" is thus the highest, with a frequency of 76 in the network. Karlsen et al. [18] have identified that trust (50) has a positive impact on collaboration (44) and communication (35) in stakeholder relations. From the keyword co-occurrence network, the hot research topics can also be identified. As a major breakthrough in information technology during the past two decades, BIM technology (22) facilitates communication (35) and collaboration (44) among participants while triggering a paradigm shift in project management [7]. Combined with other information and communication technologies (ICTs) [19], BIM technology (22) improves the integration (28) of knowledge (41) and innovation (39) across sectors [20].

The keyword co-occurrence network shows a static scene that does not take into account the dynamic changes over time. CiteSpace provides a timeline view to show the trends of these keywords. In this view, each keyword is arranged according to its mean year of occurrence. The size of the node indicates the occurrence frequency of the keyword, i.e., the larger the node, the more frequently it appears [21]. As shown in Figure 6, the evolution of the high-frequency keywords can be observed from 2000 to 2022, which has excluded the general words (e.g., management, construction, and construction project). From 2001, the keywords tend to focus on project management issues such as "performance", "conflict", and "communication". From 2006, the keywords such as "integration", "culture", "critical success factors", "team", "collaboration", and "organization" became prevalent. A large number of studies on PPP began to proliferate during this period. As suggested by Zou, Kumaraswamy, Chung, and Wong [7], the critical success factors of effective relationship management in PPP include the integration of the divisions of the organization, enhanced project culture, and integrated teamwork. In 2010, with the advent of information technology, research began to focus on "BIM", "information", "knowledge", "governance", and "systems integration". The business processes of construction projects are becoming more complex, and the use of information technology is becoming more prevalent, increasing the difficulty of project governance. Both contractual and relational governance affect BIM collaboration and implementation [22]. In addition, information technology has given rise to new roles (e.g., BIM managers) and relationships, and it is important to facilitate collaboration and information sharing among them. From 2018, more and more studies are focusing on "collaborative networks", "social network analysis (SNA)", and "megaprojects". This indicates that the complexity of megaprojects has increased, and stakeholder relationships have shifted from a linear form to a network one. Network thinking becomes the new logical paradigm for analysis, preferring a relational, contextual, and systematic understanding [23].

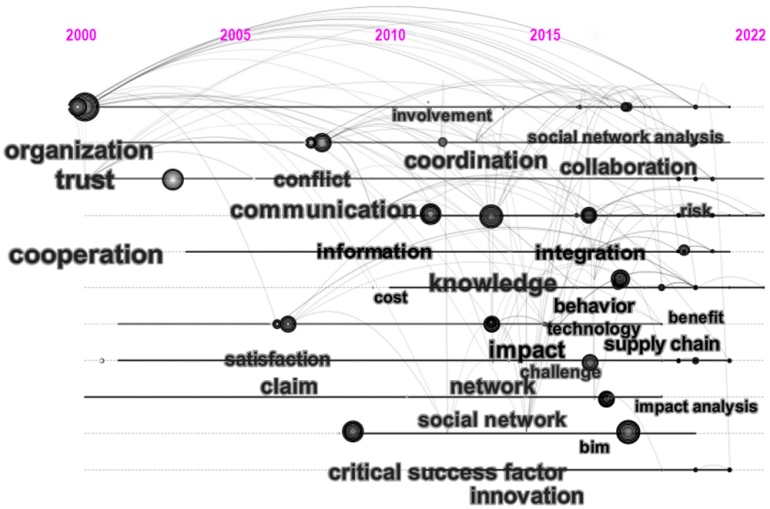

Figure 6. A timeline view of keyword co-occurrence network: 2000–2022.

4. Systematic Review Analysis

Despite numerous SRCPs, the available studies have not been subjected to a thorough and quantitative study. Therefore, based on the foregoing scientometric review, a systematic review analysis of SRCP is proposed. This section delineates the results of a qualitative discussion of the identified literature.

As identified by Bourne and Walker [24], stakeholder relations are a double-edged sword that may have a positive or negative impact on the project. To explore the underlying relationship typology, the identified literature will be reviewed. According to Kim and Choi [25], the prevailing relationship typology focuses on the adversarial-collaborative relationship dichotomy. SRCP can be divided into two categories, i.e., adversarial rela-

tionships and collaborative relationships. For example, conflict, claims, disputes, etc. are often used interchangeably in academic literature to describe adversarial or confrontational relationships, which can produce tension and confrontation and thus distract team members from performing the task [26,27]. In construction projects, conflict can be defined as a disagreement between project teams due to different views on project objectives (e.g., quality, time, cost, and safety). Examples of conflict include disputes over task scheduling, inconsistencies in team goals, etc. [28]. Furthermore, contracts of construction projects are inherently incomplete, which is a crucial factor that leads to conflicts and claims. Collaborative relationships occur when a group of stakeholders in a problem domain engage in an interactive process, using shared rules, norms, and organizational structures, to act on issues related to that domain, while adversarial relationships have been equated to arms-length relationships [25].

4.1. Main Research Topics

The Antecedent-Behavior-Consequence (hereafter referred to as "ABC") model suggested by Ray et al. [29] was used to guide the qualitative discussion of the main research topics. The ABC model explains scenario recognition process in an orderly way by dividing it into three sequential stages, i.e., antecedent input, behavior design, and consequence analysis [30], which is very consistent with the research topics of SRCP. In the ABC model, (A) the antecedent is something that comes before the behavior and may trigger the behavior; (B) the behaviors indicate the focused decisions (e.g., the approaches and techniques used to sustain a good relationship in SRCP); and (C) the consequences of the behaviors are presented to facilitate the decision-making. Guided by the ABC model, the research topics of SRCP can be summarized as (as shown in Figure 7): (1) what causes adversarial or collaborative relationships in construction projects; (2) how to evaluate the stakeholder relationships; (3) what interventions can be used to convert adversarial relationships into collaborative relationships; and (4) what are the impacts of the stakeholder relations on the project.

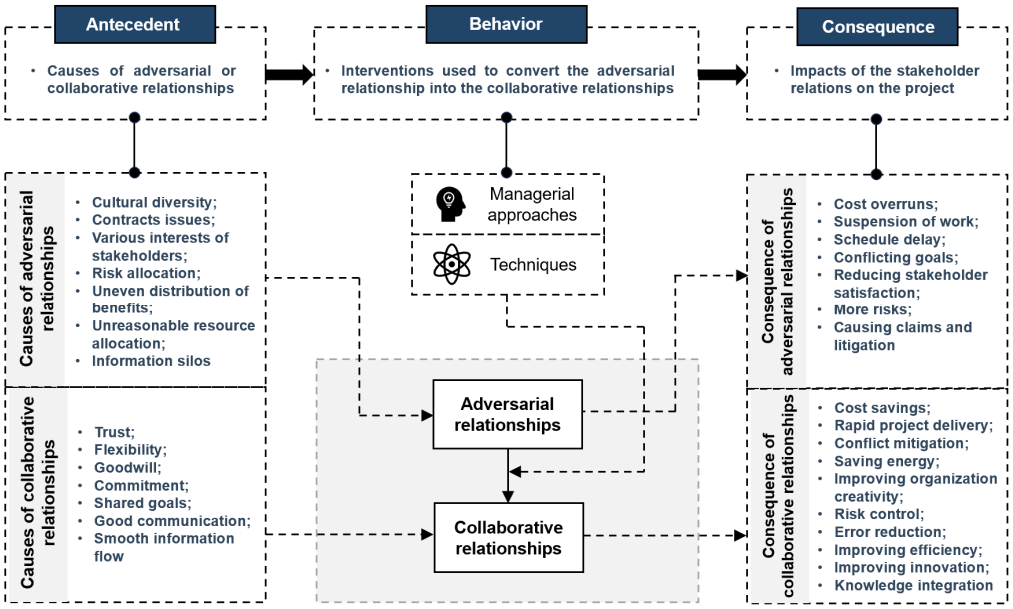

Figure 7. Research topics guided by the ABC model.

4.1.1. Antecedents of Adversarial or Collaborative Relationships

In recent years, keywords such as "knowledge", "strategy", and "integration" appeared in the selected literature sample (as shown in Figure 6), which are important for a good cooperation atmosphere. Based on the scientometric analysis, the qualitative analysis aims to provide an in-depth evaluation to explore the factors that influence stakeholder

relations. Ng et al. [31] identified that trust, commitment, and shared goals are often key factors in a good partnership between project owners and main contractors. For international projects, Vu and Carmichael [32] considered cultural differences to be a potential source of conflict in relationships. Burke and Demirag [33] identified that trust, flexibility, and goodwill may contribute to the quality of stakeholder relationships in PPPs (Public-Private Partnerships). Jelodar, Yiu, and Wilkinson [27] found that trust and commitment are crucial attributes for building a quality relationship. Other factors, such as team/joint work, risk allocation, and problem solving, were also reported to play important roles in improving the relationships between main contractors, suppliers, and/or subcontractors [34]. Moreover, Pal et al. [35] summarized the potential factors (e.g., trust, supply delivery reliability, supply service, etc.) that impact stakeholder relations and project success. Table 2 summarizes some causes of adversarial or collaborative relationships in construction projects.

Table 2. Antecedents of adversarial or collaborative relationships in construction projects.

The Type of Relationship	Antecedents
Adversarial relationship	cultural diversity; contracts issues; various interests of stakeholders; risk allocation; uneven distribution of benefits; unreasonable resource allocation; information silos
Collaborative relationship	trust; flexibility; goodwill; commitment; shared goals; good communication; smooth information flow

4.1.2. Evaluation of Stakeholder Relationships

Relationship assessment plays a crucial role in relationship management, as it facilitates stakeholders in making relevant strategies to improve relationships [36]. Table 3 reviewed and summarized the relationship dynamics between different stakeholders in construction projects. For example, Deep et al. [37] applied buyer-supplier relationship theory and power-dependence theory to develop a reliable and validated scale for analyzing the relationship between subcontractors and general contractors in the construction industry.

Table 3. Relationship dynamics between different stakeholders in construction projects.

Researchers	Stakeholders	Scales	Relationship Type	Impact on Project
Deep, Gajendran, Jefferies, and Jha Kumar [37]	Subcontractor–general contractor	Power: clarity of procurement decisions; market structure; market competition Dependence: commercial importance; market reputation	Both	More effective collaboration; enhanced trust; improved overall project outcomes
Nasir Muhammad and Hadikusumo Bonaventura [38]	Owner-contractor	Risk; work quality; monitoring and supervision; cooperation; conflicts; communication	Both	Time and resource savings; conflict reduction; improved collaboration
Wu, et al. [39]	Owner-contractor	-	Adversarial relationships	Conflict reduction; cost savings
Beach, et al. [40]	Client, main contractor, subcontractor, and supplier	Commitment; processes; tools; outcomes	Collaborative relationships	Reduction in capital cost, construction time, accident reduction, and defects; improved predictability, productivity, etc.
Meng [41]	Client-supplier	Procurement; objectives; trust; collaboration; communication; problem solving; risk allocation; and continuous improvement	Both	Relationship improvement
Frödell [42]	Client-contractor	Trust, coordination, and interdependence; communication behavior; conflict resolution, etc.	Both	Higher quality; lower total cost, etc.

Table 3. *Cont.*

Researchers	Stakeholders	Scales	Relationship Type	Impact on Project
Ujene and Edike [43]	Professional, client, and contractor	Communication; information sharing; commitment from top management; clearly defined project scope, etc.	Collaborative relationships	Improved relationships and project performance
Oppong et al. [44]	Contractor; client, et al.	Involving stakeholders and ensuring mutual trust; effective communication with stakeholders, etc.	Collaborative relationships	Conflict reduction; project success improvement

From the above research, it is clear that SRCP needs to figure out what types of relationships actually exist in construction projects and what impacts on the project, which is consistent with the research questions proposed in this paper. Also, the assessment of the relationship stands as a crucial component in SRCP. The development of the measurement scale is thus crucial for assessing the particular relationships [45]. Two types of relationships mentioned in this paper (i.e., adversarial relationships and collaborative relationships) can be evaluated with the two key variables: *power and dependence*. The term 'power' refers to the balance of power between parties [46], whereas 'dependence' refers to the extent to which stakeholders rely on each other for resources, information sharing, and support [47,48]. A new matrix model, modified from [25,47], expands into four types of relationships: deep, sticky, transient, and gracious (see Figure 8). Categorizing stakeholders' relationships in a power/dependence matrix is a very popular tool for responding to different levels of power and dependence. By considering the influence of power and dependence in each category, project managers can make strategic decisions on what interventions can be used.

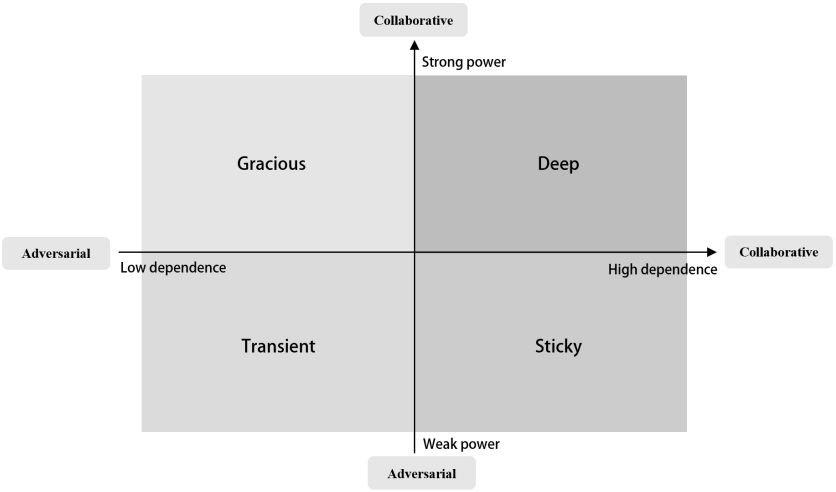

Figure 8. The matrix model for categorizing two types of relationships.

4.1.3. Interventions in Adversarial Relationships

Based on the assessment of the relationship, interventions in adversarial relationships will be considered. Many scholars have endeavored to explore management methods and techniques to prevent and reduce confrontation and even convert it into a partnership [49]. Table 4 summarizes the interventions for undesirable relationships.

As shown in Figure 6, different methods and techniques emerge at different points in the timeline. For example, with the development of information technology, the selected literature sample began to discuss how to use ICTs to improve communication. The managerial approach is primarily focused on changing the project's contracting or delivery mode. Different project structures and delivery systems determine the different stakeholder relationships [50]. Therefore, many scholars hope to improve stakeholder relationships by introducing new contracting modes or project delivery models. Tradi-

tional contract design may affect the formation of a collaborative relationship [51], and traditional construction procurement methods should be improved to form a coordinated relationship [52]. Ling et al. [53] identified that the joint contracting mode is beneficial to the formation of a good relationship. Xue et al. [54] found that partnering management may contribute to converting the adversarial relationship among the participants into a relationship with common benefits. New project delivery practices, such as Integrated Project Delivery (IPD) and PPP, have also been recognized to facilitate collaboration from an organizational perspective [55]. El Asmar et al. [56] believed that IPD could bring improvements to the communication relationship. In addition, partnering has attracted much attention recently. This approach requires neglecting organizational boundaries to form a shared organizational culture. Partnership is not a specific way of project delivery, but it can be combined with other delivery modes to promote teamwork [57]. Therefore, Chan et al. [58] believed that partnerships can promote teamwork and improve the relationship between government and contractors [59] and even the relationship between all project stakeholders [60].

Table 4. The interventions for undesirable relationships.

Type of Intervention	Approaches and Techniques Used to Sustain a Good Relationship
Managerial approaches	joint contracting mode; effective communication routines; new project delivery (e.g., IPD)
Techniques	web-based or network-based technology (e.g., ICT; PDA; call center; Internet of Things); model-based technologies (e.g., BIM)

Butt et al. [61] identified that effective communication tools could help to maintain trust and prevent conflict. Web-based or network-based technology for communication and information exchange was one of those [62,63]. Stakeholder relations can be improved by ICT-based tools and applications [64,65]. A web-based portal system was established by Thomas-Alvarez and Mandjoubi [66] to help stakeholders obtain up-to-date building information and regulations. Network-based technologies can be used to improve communication and information exchange [62,63]. Vaughan, Leming, Liu, and Jaselskis [64] believed that the information exchange relationship could be improved by applying an information management system combined with network technology. Considering the information exchange between government departments and project organizations, Thomas-Alvarez and Mandjoubi [66] believed that web-based portals could help project participants obtain information and specifications in a timely manner. Another emerging project management tool, interface management, is mainly used in complex, large-scale projects [67]. Considering the lack of information on interface management during the construction phase, Lin [68] proposed a network-based interface management tool. Also, managers need to exchange quality inspection and defect management information based on the construction site. For example, Kim et al. [69] proposed a quality inspection and defect management system using Personal Digital Assistant (PDA) and wireless network technology to significantly improve communication efficiency. Nuntasunti and Bernold [70] proposed to use wireless network technology to build an integrated wireless website to collect construction site information in real time. The call center can be used in many projects because it helps to improve trust and cooperation [71].

BIM, as a model-based technology, needs to integrate all kinds of construction project information to establish 3D building models. The reduction of information requests has proved the impact of BIM on the information exchange relationship. BIM is thus recognized as being able to support effective collaboration between stakeholders [72]. BIM contains embedded links to virtual information that cannot be contained in non-model documents, which is the main reason why BIM can improve information exchange [73]. Simultaneously, BIM serves as a digital platform for stakeholders to share information [74] and the hub of information communication among design teams [75]. As a communication platform [74], BIM also serves for information exchange between design teams [75].

4.1.4. Consequences of Adversarial or Collaborative Relationships

As identified in Figure 5, "project performance" has been a topic of high frequency and long-standing interest in the selected literature sample. According to the effects on project performance, the relationship can be classified as adversarial or cooperative (e.g., Bourne and Walker [24]; Clark [76]; Eweje et al. [77]; Mazur et al. [78]). Iyer and Jha [79] demonstrated the impact of a conflicting relationship on program performance. At the same time, a collaborative relationship is important for the improvement of project performance [80]. Mollaoglu, Sparkling, and Thomas [57] concluded that project performance can be improved by collaborative relationships. More importantly, conflict and dispute reduction have been identified as performance indicators for large public projects [81]. An adversarial relationship is likely to result in construction delays, project claims, cost overruns, and litigation [82]. Ibrahim et al. [83] indicated that successful project delivery and good performance depend, to a large extent, on how the information and experiences of team members can be brought together through a collaborative relationship. Table 5 summarizes the impact of stakeholder relations on project performance.

Table 5. Consequences of adversarial or collaborative relationships.

The Type of Relationship	Impact of the Stakeholder Relations on the Project
Adversarial relationship	cost overruns; suspension of work; schedule delay; conflicting goals; reducing stakeholder satisfaction; more risks; causing claims and litigation
Collaborative relationship	cost savings; rapid project delivery; conflict mitigation; saving energy; improving organization creativity; risk control; error reduction; improving efficiency; improving innovation; knowledge integration

As shown in Figure 6, words such as "conflict", "cost", and "risk" are consistently high-frequency terms in the selected literature sample, which are the key indicators of project performance. Firstly, stakeholder relations can have an impact on project schedules. Conflicts encountered in a project can lead to a schedule delay or even suspension of work [84]. Anderson et al. [85] have identified that a collaborative environment is one of the fundamentals that can facilitate project delivery. Also, Mahalingam, Yadav, and Varaprasad [74] raised a collaboration issue among stakeholders in multinational construction projects that may lead to conflicts and delays in the project. Secondly, stakeholder relations are important to project cost. Polat [86] revealed that 93% of the contractors achieved cost savings due to collaboration. Xue, Zhang, Su, Wu, and Yang [54] found that collaborative relationships positively affect project costs. Brockman [87] indicated that the presence of conflicts is an important factor that affects project costs. In addition to this, improving communication relationships helps to reduce the probability of errors [88], thus saving project costs. Thirdly, stakeholder relations may affect risk management. Partnering relationships have been found to be helpful for risk management. Good collaboration between customers and contractors is the key to risk management, which is highly dependent on the strategic management of collaboration [89]. Also, Liao et al. [90] noted that a good communication climate is essential for improving safety performance in the construction industry. Fourthly, organization creativity, working efficiency, innovation, and stakeholder satisfaction are also considered to be related to stakeholder relations [51,91,92]. For example, an adversarial relationship reduces participants' satisfaction with project outcomes and can negatively impact an organization's viability [78]; Xue, Zhang, Wang, Fan, Yang, and Dai [93] highlighted that collaboration among project members is beneficial to improving efficiency and innovation; Li et al. [94] suggested that decision-makers should maintain effective communication with project groups to avoid project failure.

4.2. Research Trends

Helin et al. [95] criticized that general stakeholder management often ignored relationship issues. Ujene and Edike [43] emphasized that previous works had not shed light on

the types and levels of stakeholder relations. SRCP thus needs to receive more attention in the future than general stakeholder management research, which has received too much attention in the past. Visualizing and reviewing the entire SRCP provides an opportunity to acquire a global perspective on research patterns and trends in this field. As shown in Figure 6, SRCP has been extended to a wider variety of research topics, such as BIM, system integration, etc. Articles related to the application of BIM in SRCP have recently received a high average normalized citation.

Table 6 summarizes a few potential directions for SRCP in the future study. Some studies have pointed out that failure to address the different concerns of project participants is one of the key reasons for adversarial relationships [96,97]. Wei, Liu, Skibniewski, and Balali [97] suggested that more research could be conducted to reveal the particular needs and concerns of different stakeholder groups for better understanding the stakeholders' perceptions and the discrepancies. Therefore, an in-depth analysis of the different concerns of stakeholders could be one of the future directions. Moreover, conducting dynamic conflict simulation aids in the quantitative analysis of conflict research and provides a better understanding of the dynamic relationships among stakeholders [39]. For the evaluation of stakeholder relationships in construction projects, measurement scales have been developed in previous research, such as the general contractor-subcontractor relationship scale, which was developed by Deep, Gajendran, Jefferies, and Jha Kumar [37]. In the future, there is potential for applying these scales to validate their effectiveness through real-world scenarios, and more measurement scales involving other stakeholders are needed to be developed. Moreover, Leung, Yu, and Liang [98] recommended that project management consider different types of stakeholders' power and interests, manage conflicts in a constructive manner, and thus improve ultimate satisfaction. After the assessment of relationships, it is imperative to implement appropriate measures to transform adversarial relationships among stakeholders into collaborative ones. Recent studies suggest that information technologies, especially BIM, can be used to improve stakeholder relations. For example, Badi and Diamantidou [99] suggested that BIM would enable stronger ties between actors to reduce adversarial relationships. Moreover, new technology/mode to improve information exchange and prevent adversarial relationships should gain the attention of the academic community.

Table 6. The potential directions of SRCP in the future study.

	Research Topics	Potential Directions in the Future Study
(1)	what causes adversarial or collaborative relationships in construction projects	• identify the significant factors that affects stakeholder relations • analyze the interactions between the factors • analyze the impact of the factors on different types of relationship
(2)	how to evaluate stakeholder relationships	• develop measurement scales for the latent construct of the key variables (e.g., power and dependence) • validate the measurement scales with empirical analysis
(3)	what measures can be used to transform adversarial relationships into collaborative relationships	• analyze the impact of new technology/measurement on the stakeholder relations
(4)	what is the impact of stakeholder relations on the project	• undertake empirical studies to analyze the practical implications of different types of relationship

Digital transformation and sustainable development of the construction industry require innovation, and innovation needs to be supported by collaborative relationships [100]. The diffusion and application of new technologies require a multi-stage, cross-organizational

collaborative innovation system, which may be one of the future research directions [101]. In addition, Abdirad [102] pointed out that the multiplicity of BIM tools and their inadequate interoperability hinder efficient information exchange. Therefore, how to promote technological innovation to improve information exchange and knowledge integration can be one of the future directions of SRCP. For example, Redmond, et al. [103] suggested to develop 'Cloud BIM', in conjunction with standard deliverables, as information can be easily exchanged on a cloud platform; Das, et al. [104] suggested Open BIM standards such as IFC can be explored to facilitate interoperability and data consistency in the AEC industry, and BIM platform can be developed to facilitate information exchange among project partners; He, Wang, Luo, Shi, Xie and Meng [7] pointed out that the BIM implementation needs to fully consider and effectively balance the interests of the participants and their respective concerns; Oraee, Hosseini, Papadonikolaki, Palliyaguru, and Arashpour [11] proposed that the envisaged potential of BIM remains untapped in the absence of effective collaboration. In addition, more stakeholders and more complex environments spawned by information technology have also made collaborative governance significant [105]. Moreover, relationships in construction projects are often multi-layered and even form multiple networks. Xue, Zhang, Wang, Fan, Yang, and Dai [79] thus suggested that collaborative relationships can be explored from a network perspective to shed light on the internal mechanisms of innovation.

In a multi-participant and multi-disciplinary working environment, BIM aims to facilitate information exchange and communication among stakeholders over the project lifecycle. The introduction of BIM technology changes the structure of stakeholder relationships from peer-to-peer to networking (as shown in Figure 9). In the future, more tools for studying networking and ecology can be introduced to explore the changes in stakeholder relationships. For example, social network analysis has been used as a potential method to analyze structured relationships [106].

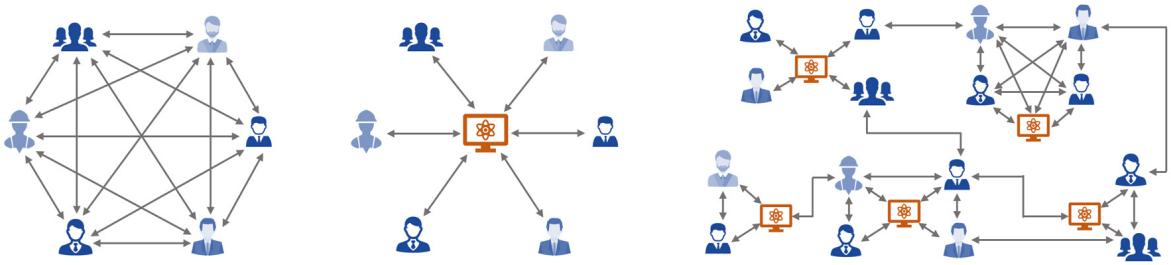

Figure 9. Changes in the structure of stakeholder relationships with the introduction of BIM.

5. Discussion

Relationship management among different stakeholder groups plays an increasingly important role in construction innovation, which could explain why there has been a growing interest in SRCP over the last two decades. However, the relationship itself is an obscure, complex, and multi-dimensional concept encompassing various behaviors among stakeholders, as stressed by Tatham and Spens [107], resulting in a lack of a common understanding of the vocabulary used to describe stakeholder relationships and their meanings. Therefore, it is necessary to systematically review the SRCP along with a deeper understanding of stakeholder relationships in construction projects.

It was discovered that there are a wide variety of relationships due to the multiplicity of behaviors, flexibility of the project organization, and multiple stakeholders involved in construction projects. For example, Cross and Parker [108] identified that two types of relationships exist among stakeholders: formal and informal relationships. Formal relationships include contracts and the hierarchy in organizations and projects; informal relationships can refer to many interactions, such as information exchange and communication; Li et al. [109] suggested that trust is an important part of inter-organizational relationships; Liu et al. [110] identified that collaboration between designers and contractors affects not only operational outcomes but also their relationships; Xue, Zhang, Wang,

Fan, Yang, and Dai [93] found that there are many kinds of relationships in AEC projects, such as cooperation, exchange, and confrontation. Also, stakeholder relationships may change accordingly when an organization undergoes different circumstances [111]. For example, the application of digital technologies (e.g., BIM) has triggered new stakeholders, generated new sources of information, and might lead to dynamic changes in stakeholder relationships [112]. This means that the research hotspots and methods of SRCP are also in flux. Also, researchers have criticized the current SRCP for a lack of attention to the dynamic nature of stakeholder relationships [8]. The study reviewed and summarized the relationship dynamics between different stakeholders in construction projects. Based on this, the scales for assessing the different type of relationships can be developed. By considering the influence of the scales in these relationships, project managers can make strategic decisions on what interventions can be used.

Behavior Modification theory states that all behavior is governed by extrinsic reinforcing and punishing stimuli [29]. This theory gives rise to the more recent use of the ABC model along with qualitative research. Antecedent strategies focus on conditions that precede desirable or undesirable behavior in an environment. Information can thus be collected on the environmental events that lead to those undesirable relationships, and then interventions (e.g., managerial approaches and techniques) can be introduced to the antecedent analysis to mitigate the undesirable relationship. These research topics can be used as a guide for the study on how to eliminate adversarial relationships in construction projects as well as encourage and enhance collaborative relationships.

Standing on the knowledge frontier, future SRCP are encouraged to focus on the challenges of construction project management in the aspects of innovation, information technology, and sustainability. Moreover, the increasing demand for knowledge integration and collaborative innovation requires an in-depth study of information technologies. It could be further indicated that SRCP is a constantly updated research topic. The proposed directions for future work could benefit both academic communities and industry practitioners by enhancing collaborative innovation and system integration.

6. Conclusions

Relationship management among different stakeholder groups plays an increasingly important role in the preplanning, design, and construction of buildings and infrastructure, and SRCP has received sufficient attention from scholars and practitioners. This study adopted a science mapping approach followed by an in-depth qualitative discussion to review over 312 journal articles published between 2000 and 2022 in the domain of SRCP. It was found that over the past two decades, there have been significant increases in publications in SRCP. The increasing number of bibliographic records over time that pertain to SRCP indicates that increasing attention is being directed toward this research field. This scientometric analysis of SRCP is significant and invaluable in allowing bibliometric data to provide a highly accurate representation of previous research efforts, as well as in illustrating a future research roadmap for SRCP. A follow-up systematic review of the identified literature was conducted to address the four research questions. SRCP can be divided into two categories, i.e., adversarial relationships and collaborative relationships. Guided by the proposed ABC model, the research topics of SRCP can be summarized as: (1) what causes adversarial or collaborative relationships in construction projects; (2) how to evaluate the stakeholder relationships; (3) what interventions can be used to convert adversarial relationships into collaborative relationships; and (4) what are the impacts of the stakeholder relations on the project. The stakeholder relationships can be evaluated using two key variables: power and dependence. By considering the influence of power and dependence in each type of relationship, project managers can make strategic decisions on what interventions can be used. Finally, a few potential directions for SRCP in the future study are proposed.

It was found that over the past 20 years, SRCP has been extended to a variety of research topics, such as information technology. The social incorporation of BIM enables

full collaboration across multiple disciplines and stakeholders, which may open a unique multilayered dimension for SRCP. Overall, this research contributes to the research field of SRCP-domain by offering insightful information on the current state of SRCP and proposing potential future directions for research.

The limitations of the research are acknowledged as follows: First, it should be pointed out that the scientometric analysis is limited to the selected literature sample, using particular keywords to describe SRCP that may have been omitted or neglected from relevant studies. It is possible that it excludes some relevant studies. Second, while the use of peer-reviewed articles ensures high quality, the exclusion of conference papers and books, as well as articles in languages other than English, may provide more valuable insights. Third, this research has specifically focused on stakeholder interaction in construction projects, but further understanding of potential factors affecting stakeholder relations requires attention and should be assessed in the future. Lastly, this review deliberately focused on the review and analysis of the SRCP, a systematic and generic framework reference for the practice of relationship management in construction projects that needs to be further developed in the future.

Author Contributions: Conceptualization, Y.Y.; methodology, Y.Y.; formal analysis, Y.Y.; writing—original draft preparation, Y.Y. and Z.W.; writing—review and editing, Y.Y. and Z.W.; project administration, Z.Z.; funding acquisition, Z.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by the National Natural Science Foundation of China (Grant Nos. 71673240, 42271179, and 71772163), and funded by the Center for Balance Architecture at Zhejiang University.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships.

References

1. Underwood, J.; Khosrowshahi, F. Academe-industry collaboration through the experience of a construction it membership-based network. *Ind. High. Educ.* **2005**, *19*, 375–383. [CrossRef]
2. Fellows, R.; Liu, A.M.M. Managing organizational interfaces in engineering construction projects: Addressing fragmentation and boundary issues across multiple interfaces. *Constr. Manag. Econ.* **2012**, *30*, 653–671. [CrossRef]
3. Mato-Santiso, V.; Rey-García, M.; Sanzo-Pérez, M.J. Managing multi-stakeholder relationships in nonprofit organizations through multiple channels: A systematic review and research agenda for enhancing stakeholder relationship marketing. *Public Relat. Rev.* **2021**, *47*, 102074. [CrossRef]
4. Mok, K.Y.; Shen, G.Q.; Yang, J. Stakeholder management studies in mega construction projects: A review and future directions. *Int. J. Proj. Manag.* **2015**, *33*, 446–457. [CrossRef]
5. Oppong, G.D.; Chan, A.P.C.; Dansoh, A. A review of stakeholder management performance attributes in construction projects. *Int. J. Proj. Manag.* **2017**, *35*, 1037–1051. [CrossRef]
6. Georgiadou, M.C. An overview of benefits and challenges of building information modelling (BIM) adoption in UK residential projects. *Constr. Innov.* **2019**, *19*, 298–320. [CrossRef]
7. Zou, W.; Kumaraswamy, M.; Chung, J.; Wong, J. Identifying the critical success factors for relationship management in ppp projects. *Int. J. Proj. Manag.* **2014**, *32*, 265–274. [CrossRef]
8. Yang, R.J.; Shen, G.Q. Framework for Stakeholder Management in Construction Projects. *J. Manag. Eng.* **2015**, *31*, 337–348. [CrossRef]
9. Wuni, I.Y.; Shen, G.Q. Stakeholder management in prefabricated prefinished volumetric construction projects: Benchmarking the key result areas. *Built. Environ. Proj. Asset Manag.* **2020**, *10*, 407–421. [CrossRef]
10. Mainardes, E.W.; Alves, H.; Raposo, M. A model for stakeholder classification and stakeholder relationships. *Manag. Decis.* **2012**, *50*, 1861–1879. [CrossRef]
11. Oraee, M.; Hosseini, M.R.; Papadonikolaki, E.; Palliyaguru, R.; Arashpour, M. Collaboration in BIM-based construction networks: A bibliometric-qualitative literature review. *Int. J. Proj. Manag.* **2017**, *35*, 1288–1301. [CrossRef]
12. Chen, K.; Lu, W.; Peng, Y.; Rowlinson, S.; Huang, G. Bridging BIM and building: From a literature review to an integrated conceptual framework. *Int. J. Proj. Manag.* **2015**, *33*, 1405–1416. [CrossRef]

13. Kurian, N.; Gandhi, N.; Daniel, A.Y.; Varghese, K.G.; Dhawan, K.; Mathew, J.E.; Kaur, P. A 10-year (2010 to 2019) scientometric analysis of prosthodontic journals based on SCImago Journal and Country Rank indicators. *J. Prosthet. Dent.* **2023**, *129*, 913–919. [CrossRef]
14. Jin, R.; Zou, X.W.; Piroozfar, P.; Wood, H.; Yang, Y.; Yan, L.; Han, Y. A science mapping approach based review of construction safety research. *Saf. Sci.* **2019**, *113*, 285–297. [CrossRef]
15. Pollack, J.; Adler, D. Emergent trends and passing fads in project management research: A scientometric analysis of changes in the field. *Int. J. Proj. Manag.* **2015**, *33*, 236–248. [CrossRef]
16. Alhajlah, H.H.; Abdullah, A.A.B.; Kassem, M.A.; Al-Sharafi, M.A. A Scientometric Analysis and Systematic Literature Review for Construction Project Complexity. *Buildings* **2022**, *12*, 482.
17. Harden, A.; Thomas, J. *Sage Handbook of Mixed Methods in Social & Behavioral Research*; Tashakkori, A., Teddlie, C., Eds.; Sage: Thousand Oaks, CA, USA, 2010.
18. Karlsen, J.T.; Graee, K.; Massaoud, M.J. The role of trust in project-stakeholder relationships: A study of a construction project. *Int. J. Proj. Organ. Manag.* **2008**, *1*, 105–118. [CrossRef]
19. Kameli, M.; Hosseinalipour, M.; Sardroud, J.M.; Ahmed, S.M.; Behruyan, M. Improving maintenance performance by developing an IFC BIM/RFID-based computer system. *J. Ambient. Intell. Humaniz. Comput.* **2021**, *12*, 3055–3074. [CrossRef]
20. Garcia-Muniz, A.S.; Vicente, M.R. ICT technologies in europe: A study of technological diffusion and economic growth under network theory. *Telecommun. Policy* **2014**, *38*, 360–370. [CrossRef]
21. Wang, G.; Wu, P.; Wu, X.; Zhang, H.; Cai, Y. Mapping global research on sustainability of megaproject management: A scientometric review. *J. Clean. Prod.* **2020**, *259*, 120831. [CrossRef]
22. Liu, T.; Chong, H.Y.; Zhang, W.; Lee, C.Y.; Tang, X. Effects of contractual and relational governances on bim collaboration and implementation for project performance improvement. *J. Constr. Eng. Manag.* **2022**, *148*, 04022029. [CrossRef]
23. Lu, Y.; Li, Y.; Da, P.; Zhang, Y. Organizational network evolution and governance strategies in megaprojects. *Constr. Econ. Build.* **2015**, *15*, 19–33. [CrossRef]
24. Bourne, L.; Walker, D.H.T. Project relationship management and the stakeholder circle™. *Int. J. Manag. Proj. Bus.* **2008**, *1*, 125–130. [CrossRef]
25. Kim, Y.; Choi, T.Y. Deep, sticky, transient, and gracious: An expanded buyer–supplier relationship typology. *J. Supply Chain. Manag.* **2015**, *51*, 61–86. [CrossRef]
26. Jaffar, N.; Tharim, A.H.A.; Shuib, M.N. Factors of conflict in construction industry: A literature review. *Procedia Eng.* **2011**, *20*, 193–202. [CrossRef]
27. Jelodar, M.B.; Yiu, T.W.; Wilkinson, S. Assessing contractual relationship quality: Study of judgment trends among construction industry participants. *J. Manag. Eng.* **2017**, *33*, 04016028. [CrossRef]
28. Wu, G.; Liu, C.; Zhao, X. Investigating the relationship between communication-conflict interaction and project success among construction project teams. *Int. J. Proj. Manag.* **2017**, *35*, 1466–1482. [CrossRef]
29. Ray, M.; Onifade, E.; Davis, C. Using 'happy' or 'sad' face in a decision-making grid to motivate students to improve academic success. *Int. Rev. Econ. Educ.* **2019**, *30*, 100131. [CrossRef]
30. Liu, Z.G.; Li, X.Y.; Zhu, X.H. Scenario modeling for government big data governance decision-making: Chinese experience with public safety services. *Inf. Manag.* **2022**, *59*, 103622. [CrossRef]
31. Ng, S.T.; Rose, T.M.; Mak, M.; Chen, S.E. Problematic issues associated with project partnering—The contractor perspective. *Int. J. Proj. Manag.* **2002**, *20*, 437–449. [CrossRef]
32. Vu, A.T.; Carmichael, D.G. Cultural difference and conflict management—A vietnamese-australian and construction industry case study. *Int. J. Constr. Manag.* **2009**, *9*, 1–19. [CrossRef]
33. Burke, R.; Demirag, I. Risk transfer and stakeholder relationships in public private partnerships. *Account. Forum* **2016**, *41*, 28–43. [CrossRef]
34. Meng, X. The effect of relationship management on project performance in construction. *Int. J. Proj. Manag.* **2012**, *30*, 188–198. [CrossRef]
35. Pal, R.; Wang, P.; Liang, X. The critical factors in managing relationships in international engineering, procurement, and construction (IEPC) projects of Chinese organizations. *Int. J. Proj. Manag.* **2017**, *35*, 1225–1237. [CrossRef]
36. Brinkerhoff, J.M. Assessing and improving partnership relationships and outcomes: A proposed framework. *Eval. Program Plan.* **2002**, *25*, 215–231. [CrossRef]
37. Deep, S.; Gajendran, T.; Jefferies, M.; Jha Kumar, N. Developing Subcontractor–General Contractor Relationships in the Construction Industry: Constructs and Scales for Analytical Decision Making. *J. Constr. Eng. Manag.* **2023**, *149*, 04023136. [CrossRef]
38. Nasir Muhammad, K.; Hadikusumo Bonaventura, H.W. System Dynamics Model of Contractual Relationships between Owner and Contractor in Construction Projects. *J. Manag. Eng.* **2019**, *35*, 04018052. [CrossRef]
39. Wu, G.; Wang, H.; Chang, R. A decision model assessing the owner and contractor's conflict behaviors in construction projects. *Adv. Civ. Eng.* **2018**, *2018*, 1347914. [CrossRef]
40. Beach, R.; Webster, M.; Campbell, K.M. An evaluation of partnership development in the construction industry. *Int. J. Proj. Manag.* **2005**, *23*, 611–621. [CrossRef]
41. Meng, X. Assessment framework for construction supply chain relationships: Development and evaluation. *Int. J. Proj. Manag.* **2010**, *28*, 695–707. [CrossRef]

42. Frödell, M. Criteria for achieving efficient contractor-supplier relations. *Eng. Constr. Archit. Manag.* **2011**, *18*, 381–393. [CrossRef]
43. Ujene, A.O.; Edike, U.E. Relationships among internal stakeholders in construction projects: A cognitive evaluation for sustainable team integration in Nigeria. *Int. J. Constr. Manag.* **2015**, *15*, 71–81. [CrossRef]
44. Oppong, G.D.; Chan, A.P.C.; Ameyaw, E.E.; Frimpong, S.; Dansoh, A. Fuzzy Evaluation of the Factors Contributing to the Success of External Stakeholder Management in Construction. *J. Constr. Eng. Manag.* **2021**, *147*, 04021142. [CrossRef]
45. Mazur, A.K.; Pisarski, A. Major project managers' internal and external stakeholder relationships: The development and validation of measurement scales. *Int. J. Proj. Manag.* **2015**, *33*, 1680–1691. [CrossRef]
46. Yang, J.; Shen, G.Q.; Ho, M.F.; Drew, D.S.; Chan, A.P.C. Exploring critical success factors for stakeholder management in construction projects. *J. Civ. Eng. Manag.* **2009**, *15*, 337–348. [CrossRef]
47. Lin, X.; Ho, M.F.; Shen, G.Q. For the balance of stakeholders' power and responsibility. *Manag. Decis.* **2018**, *56*, 550–569. [CrossRef]
48. Acharya, C.; Rechberg, I.; Dong, X.D. Race to learn: Knowledge characteristics and resource structure. *J. Knowl. Manag.* **2020**, *24*, 1059–1078. [CrossRef]
49. Qian, X.A.; Papadonikolaki, E. Shifting trust in construction supply chains through blockchain technology. *Eng. Constr. Archit. Manag.* **2021**, *28*, 584–602. [CrossRef]
50. Pena-mora, F.; Tamaki, T. Effect of delivery systems on collaborative negotiations for large-scale infrastructure projects. *J. Manag. Eng.* **2001**, *17*, 105–121. [CrossRef]
51. Strahorn, S.; Gajendran, T.; Brewer, G. The Influence of Trust in Traditional Contracting: Investigating the "Lived Experience" of Stakeholders. *Constr. Econ. Build.* **2015**, *15*, 81–101. [CrossRef]
52. Eriksson, P.E.; Nilsson, T.B. Partnering the construction of a swedish pharmaceutical plant: Case study. *J. Manag. Eng.* **2008**, *24*, 227–233. [CrossRef]
53. Ling, F.Y.Y.; Ning, Y.; Ke, Y.J.; Kumaraswamy, M.M. Modeling relational transaction and relationship quality among team members in public projects in Hong Kong. *Autom. Constr.* **2013**, *36*, 16–24. [CrossRef]
54. Xue, H.; Zhang, S.; Su, Y.; Wu, Z.; Yang, R.J. Effect of stakeholder collaborative management on off-site construction cost performance. *J. Clean. Prod.* **2018**, *184*, 490–502. [CrossRef]
55. Han, Y.; Li, Y.; Taylor, J.E.; Zhong, J. Characteristics and evolution of innovative collaboration networks in architecture, engineering, and construction: Study of national prize-winning projects in china. *J. Constr. Eng. Manag.* **2018**, *144*, 04018038. [CrossRef]
56. El Asmar, M.; Hanna, A.S.; Loh, W.Y. Evaluating Integrated Project Delivery Using the Project Quarterback Rating. *J. Constr. Eng. Manag.* **2016**, *142*, 04015046. [CrossRef]
57. Mollaoglu, S.; Sparkling, A.; Thomas, S. An Inquiry to Move an Underutilized Best Practice Forward: Barriers to Partnering in the Architecture, Engineering, and Construction Industry. *Proj. Manag. J.* **2015**, *46*, 69–83. [CrossRef]
58. Chan, A.P.C.; Chan, D.W.M.; Kathy, S.K.H. Partnering in construction: Critical study of problems for implementation. *J. Manag. Eng.* **2003**, *19*, 126–135. [CrossRef]
59. Glagola, C.R.; Sheedy, W.M. Partnering on defense contracts. *J. Constr. Eng. Manag. ASCE* **2002**, *128*, 127–138. [CrossRef]
60. Kumaraswamy, M.M.; Matthews, J.D. Improved subcontractor selection employing partnering principles. *J. Manag. Eng.* **2000**, *16*, 47–57. [CrossRef]
61. Butt, A.; Naaranoja, M.; Savolainen, J. Project change stakeholder communication. *Int. J. Proj. Manag.* **2016**, *34*, 1579–1595. [CrossRef]
62. Zaneldin, E.; Hegazy, T.; Grierson, D. Improving design coordination for building projects. II: A collaborative system. *J. Constr. Eng. Manag. ASCE* **2001**, *127*, 330–336. [CrossRef]
63. Osman, H.M.; El-Diraby, T.E. Knowledge-Enabled Decision Support System for Routing Urban Utilities. *J. Constr. Eng. Manag. ASCE* **2011**, *137*, 198–213. [CrossRef]
64. Vaughan, J.L.; Leming, M.L.; Liu, M.; Jaselskis, E. Cost-Benefit Analysis of Construction Information Management System Implementation: Case Study. *J. Constr. Eng. Manag. ASCE* **2013**, *139*, 445–455. [CrossRef]
65. Vishal, S. BIM and systemic ICT innovation in AEC: Perceived needs and actor's degrees of freedom. *Constr. Innov.* **2014**, *14*, 292–306.
66. Thomas-Alvarez, N.; Mandjoubi, L. Testing the effectiveness of a web-based portal system for the building control sector. *Autom. Constr.* **2013**, *29*, 196–204. [CrossRef]
67. Shokri, S.; Ahn, S.; Lee, S.; Haas, C.T.; Haas, R.C.G. Current Status of Interface Management in Construction: Drivers and Effects of Systematic Interface Management. *J. Constr. Eng. Manag.* **2016**, *142*, 04015070. [CrossRef]
68. Lin, Y.C. Construction network-based interface management system. *Autom. Constr.* **2013**, *30*, 228–241. [CrossRef]
69. Kim, Y.S.; Oh, S.W.; Cho, Y.K.; Seo, J.W. A PDA and wireless web-integrated system for quality inspection and defect management of apartment housing projects. *Autom. Constr.* **2008**, *17*, 163–179. [CrossRef]
70. Nuntasunti, S.; Bernold, L.E. Experimental assessment of wireless construction technologies. *J. Constr. Eng. Manag. ASCE* **2006**, *132*, 1009–1018. [CrossRef]
71. Bond-Barnard, T.J.; Steyn, H.; Fabris-Rotelli, I. The impact of a call centre on communication in a programme and its projects. *Int. J. Proj. Manag.* **2013**, *31*, 1006–1016. [CrossRef]
72. Oh, M.; Lee, J.; Hong, S.W.; Jeong, Y. Integrated system for BIM-based collaborative design. *Autom. Constr.* **2015**, *58*, 196–206. [CrossRef]

73. Ahn, Y.H.; Kwak, Y.H.; Suk, S.J. Contractors' Transformation Strategies for Adopting Building Information Modeling. *J. Manag. Eng.* **2016**, *32*, 05015005. [CrossRef]
74. Mahalingam, A.; Yadav, A.K.; Varaprasad, J. Investigating the Role of Lean Practices in Enabling BIM Adoption: Evidence from Two Indian Cases. *J. Constr. Eng. Manag.* **2015**, *141*, 05015006. [CrossRef]
75. Porwal, A.; Hewage, K.N. Building Information Modeling-Based Analysis to Minimize Waste Rate of Structural Reinforcement. *J. Constr. Eng. Manag. ASCE* **2012**, *138*, 943–954. [CrossRef]
76. Clark, N. Projects are emotional: How project managers' emotional awareness can influence decisions and behaviours in projects. *Int. J. Manag. Proj. Bus.* **2010**, *3*, 604–624. [CrossRef]
77. Eweje, J.; Turner, R.; Müller, R. Maximizing strategic value from megaprojects: The influence of information-feed on decision-making by the project manager. *Int. J. Proj. Manag.* **2012**, *30*, 639–651. [CrossRef]
78. Mazur, A.; Pisarski, A.; Chang, A.; Ashkanasy, N.M. Rating defense mega-project success: The role of personal attributes and stakeholder relationships. *Int. J. Proj. Manag.* **2014**, *32*, 944–957. [CrossRef]
79. Iyer, K.C.; Jha, K.N. Critical factors affecting schedule performance: Evidence from Indian construction projects. *J. Constr. Eng. Manag. ASCE* **2006**, *132*, 871–881. [CrossRef]
80. El-Sawalhi, N.I.; Hammad, S. Factors affecting stakeholder management in construction projects in the Gaza Strip. *Int. J. Constr. Manag.* **2015**, *15*, 157–169. [CrossRef]
81. Toor, S.U.R.; Ogunlana, S.O. Beyond the 'iron triangle': Stakeholder perception of key performance indicators (KPIs) for large-scale public sector development projects. *Int. J. Proj. Manag.* **2010**, *28*, 228–236. [CrossRef]
82. Chan, A.P.C.; Chan, D.W.M.; Fan, L.C.N.; Lam, P.T.I.; Yeung, J.F.Y. Achieving partnering success through an incentive agreement: Lessons learned from an underground railway extension project in Hong Kong. *J. Manag. Eng.* **2008**, *24*, 128–137. [CrossRef]
83. Ibrahim, C.K.I.C.; Costello, S.B.; Wilkinson, S. Key relationship oriented indicators of team integration in construction projects. *Int. J. Innov. Manag. Technol.* **2011**, *2*, 441–446.
84. Mahato, B.; Ogunlana, S. Conflict dynamics in a dam construction project: A case study. *Built. Environ. Proj. Asset Manag.* **2011**, *1*, 176–194. [CrossRef]
85. Anderson, S.; Shane, J.S.; Schexnayder, C. Strategies for Planned Project Acceleration. *J. Constr. Eng. Manag. ASCE* **2011**, *137*, 372–381. [CrossRef]
86. Polat, G. Precast concrete systems in developing vs. industrialized countries. *J. Civ. Eng. Manag.* **2010**, *16*, 85–94. [CrossRef]
87. Brockman, J.L. Interpersonal Conflict in Construction: Cost, Cause, and Consequence. *J. Constr. Eng. Manag.* **2014**, *140*, 04013050. [CrossRef]
88. Love, P.E.D.; Josephson, P.E. Role of error-recovery process in projects. *J. Manag. Eng.* **2004**, *20*, 70–79. [CrossRef]
89. Osipova, E. Establishing Cooperative Relationships and Joint Risk Management in Construction Projects: Agency Theory Perspective. *J. Manag. Eng.* **2015**, *31*, 05014026. [CrossRef]
90. Liao, P.C.; Lei, G.; Fang, D.; Liu, W. The relationship between communication and construction safety climate in china. *KSCE J. Civ. Eng.* **2014**, *18*, 887–897. [CrossRef]
91. Hu, Y.; Chan, A.P.C.; Le, Y. Understanding the Determinants of Program Organization for Construction Megaproject Success: Case Study of the Shanghai Expo Construction. *J. Manag. Eng.* **2015**, *31*, 05014019. [CrossRef]
92. Yun, S.M.; Jung, W.; Han, S.H.; Park, H. Critical organizational success factors for public private partnership projects—A comparison of solicited and unsolicited proposals. *J. Civ. Eng. Manag.* **2015**, *21*, 131–143. [CrossRef]
93. Xue, X.; Zhang, R.; Wang, L.; Fan, H.; Yang, R.J.; Dai, J. Collaborative innovation in construction project: A social network perspective. *KSCE J. Civ. Eng.* **2018**, *22*, 417–427. [CrossRef]
94. Li, H.; Zhang, X.; Thomas Ng, S.; Skitmore, M. Quantifying stakeholder influence in decision/evaluations relating to sustainable construction in China-A Delphi approach. *J. Clean. Prod.* **2018**, *173*, 160–170. [CrossRef]
95. Helin, S.; Jensen, T.; Sandström, J. "Like a battalion of tanks": A critical analysis of stakeholder management. *Scand. J. Manag.* **2013**, *29*, 209–218. [CrossRef]
96. Xie, L.L.; Yang, Y.; Hu, Y.; Chan, A.P.C. Understanding project stakeholders' perceptions of public participation in China's infrastructure and construction projects: Social effects, benefits, forms, and barriers. *Eng. Constr. Archit. Manag.* **2014**, *21*, 224–240. [CrossRef]
97. Wei, H.; Liu, M.; Skibniewski, M.J.; Balali, V. Conflict and consensus in stakeholder attitudes toward sustainable transport projects in china: An empirical investigation. *Habitat Int.* **2016**, *53*, 473–484. [CrossRef]
98. Leung, M.Y.; Yu, J.; Liang, Q. Improving public engagement in construction development projects from a stakeholder's perspective. *J. Constr. Eng. Manag.* **2013**, *139*, 04013019. [CrossRef]
99. Badi, S.; Diamantidou, D. A social network perspective of building information modelling in Greek construction projects. *Archit. Eng. Des. Manag.* **2017**, *13*, 406–422. [CrossRef]
100. Elmualim, A.; Gilder, J. BIM: Innovation in design management, influence and challenges of implementation. *Archit. Eng. Des. Manag.* **2014**, *10*, 183–199. [CrossRef]
101. Abdalla, S.; Nakagawa, K. The interplay of digital transformation and collaborative innovation on supply chain ambidexterity. *Technol. Innov. Manag. Rev.* **2021**, *11*, 45–56. [CrossRef]
102. Abdirad, H. Managing digital integration routines in engineering firms: Cases of disruptive BIM cloud collaboration protocols. *J. Manag. Eng.* **2022**, *38*, 05021012. [CrossRef]

103. Redmond, A.; Hore, A.; Alshawi, M.; West, R. Exploring how information exchanges can be enhanced through cloud BIM. *Autom. Constr.* **2012**, *24*, 175–183. [CrossRef]
104. Das, M.; Cheng, J.C.; Kumar, S.S. Social BIMCloud: A distributed cloud-based bim platform for object-based lifecycle information exchange. *Vis. Eng.* **2015**, *3*, 8. [CrossRef]
105. Zhang, S.; Yi, J.; Chen, G. Research on modeling and framework of building information model cloud platform supporting collaborative governance. *Comput. Eng.* **2016**, *42*, 95–101.
106. Li, J.R.; Jiang, W.P.; Zuo, J. The effects of trust network among project participants on project performance based on SNA approach: A case study in China. *Int. J. Constr. Manag.* **2020**, *20*, 837–847. [CrossRef]
107. Tatham, P.; Spens, K. Cracking the humanitarian logistic coordination challenge: Lessons from the urban search and rescue community. *Disasters* **2016**, *40*, 246–261. [CrossRef] [PubMed]
108. Cross, R.; Parker, A. *The Hidden Power of Social Networks*; Harvard Business School Press: Boston, MA, USA, 2004.
109. Li, Y.; He, N.; Li, H.; Liu, Z.; Qi, J. Influencing factors on inter-organizational trust asymmetry behavior in construction projects evidence from china. *Eng. Constr. Archit. Manag.* **2021**, *28*, 308–331. [CrossRef]
110. Liu, Y.; Nederveen, S.v.; Hertogh, M. Understanding effects of BIM on collaborative design and construction: An empirical study in China. *Int. J. Proj. Manag.* **2017**, *35*, 686–698. [CrossRef]
111. Van der Meer, T.G.L.A.; Verhoeven, P.; Hans, W.; Vliegenthart, R. Communication in times of crisis: The stakeholder relationship under pressure. *Public Relat. Rev.* **2017**, *43*, 426–440. [CrossRef]
112. Antwi-Afari, M.F.; Li, H.; Pärn, E.A.; Edwards, D.J. Critical success factors for implementing building information modelling (BIM): A longitudinal review. *Autom. Constr.* **2018**, *91*, 100–110. [CrossRef]