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Review

Improving Information Sharing in Offsite Construction (OSC): A Systematic Literature Review

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Abstract: Recently, the adoption of offsite construction (OSC) has been gaining prominence in the building industry due to its unmatched efficiency, quality, and eco-friendliness. Despite its numerous advantages, OSC faces significant hurdles, notably the challenge of inadequate information sharing among stakeholders, which compounds other issues. While acknowledging its importance and challenges, researchers have predominantly focused on different aspects of OSC. Therefore, this study aims to systematically explore key aspects of information sharing in OSC, identify barriers, and propose strategies for improvement. By analyzing 53 articles published between 2013 and 2024, we found that most studies originated from developed countries, and almost 83% were published in the last 5 years. A thematic analysis revealed various information needs across project stages, from market analysis to safety protocols. Moreover, it uncovered factors hindering stakeholder communication and collaboration, including fragmented supply chains, inconsistent standards, and communication barriers. This paper discusses strategies to improve information sharing and proposes a conceptual framework to guide stakeholders in improving information sharing within OSC projects.

Keywords: offsite construction (OSC); information sharing; stakeholders; barriers to information sharing

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1. Introduction

The global construction industry is undergoing a significant transformation fueled by rapid technological advancements, urbanization, and the growing demand for sustainable building practices. OSC has emerged as a progressive approach involving designing and producing components in a factory and then installing them in their final positions on construction sites [1]. OSC is used to build affordable housing, and infrastructure projects like tunnels, bridges, and modular public facilities, addressing social needs for affordable housing and accessible public spaces [2]. Its precise manufacturing reduces waste, enhances safety, and improves sustainability, offering cost savings over traditional methods through automation and energy efficiency [3].

Unlike traditional construction practices, OSC demands greater integration and information exchange among stakeholders, encompassing manufacturers, designers, suppliers, transporters, and assembly teams [4]. Additionally, the decentralized nature of OSC workflows underscores the importance of effective communication and collaboration to ensure projects are delivered on time, within budget, and in accordance with the specified

requirements [5]. Information sharing acts as the backbone of OSC projects, enabling synchronized decision-making, streamlined operations, and reduced risks associated with miscommunication.

Previous studies on OSC in the construction industry have focused on areas like digital technology applications, such as building information modeling (BIM) [6–8], supply chain management [9–11], and OSC research methodologies [12]. However, most research treats information sharing as secondary, focusing instead on trends, benefits, and challenges, with limited systematic reviews of stakeholders' information needs. Consequently, a conspicuous gap exists in our understanding of information sharing within OSC among stakeholders. To address this gap, this study systematically reviews the existing literature, exploring information sharing needs, sources, barriers, and strategies for improvement across various stages of the OSC process. Within this context, the following review questions (RQs) are put forward:

RQ-1: *What are the key aspects of information sharing in OSC?*

RQ-2: *What factors hinder information sharing in OSC?*

RQ-3: *What are the potential strategies to improve information sharing in the OSC industry?*

As a result, this paper has two main objectives: (i) to investigate various aspects of information sharing in OSC, including the factors that hinder its effectiveness and potential ways to improve it; and (ii) to pinpoint future research directions within this field. Consequently, this systematic literature review (SLR) consolidates existing knowledge on information sharing in OSC, laying the foundation for a conceptual framework and offering recommendations for further research. The subsequent sections are organized as follows: Section 2 provides the background, while Section 3 details the methodology. Following this, Section 4 presents the results of descriptive and qualitative analyses. This study's discussion is covered in Section 5, the limitations and future directions are discussed in Section 6, and conclusions are drawn in Section 7.

2. Background

2.1. Information Sharing in Construction Supply Chains

Information sharing involves exchanging data among various organizations during transactions or collaborations [13]. It is crucial for supply chain stability and efficiency [14]. To optimize information sharing, four questions must be addressed: what information to share, who should receive it, how to share it, and when to share it [15,16].

Research highlights the benefits of information sharing in supply chains. For example, it can reduce manufacturers' costs [17] and inventory costs by 5% to 35%, with no loss in service levels [18]. However, challenges remain, including confidentiality concerns, incentive alignment, IT reliability and cost, regulatory constraints, and the need for skills to use shared data effectively [18]. Understanding these benefits and challenges within construction supply chains sets the stage for examining information sharing in specific areas like OSC, which will be discussed next.

2.2. Information Sharing in OSC

Like any supply chain, information sharing is highly significant for the smooth functioning of OSC. However, the industry's fragmentation, where geographically dispersed participants work towards a common goal, leads to challenges such as inconsistent data communication and accountability issues in sharing project-related information [19]. Therefore, the development of a robust information sharing platform becomes imperative to facilitate smooth communication without errors and confusion [20].

Existing studies have identified various stages in the OSC process, with variations in the number and naming of phases. Alfieri et al. 2020 [21] proposed a comprehensive six-stage framework, which includes project brief, concept design, detailed design, pre-construction, construction, and post-construction. In contrast, Chen et al. 2021 [22] presented a four-phase model, encompassing design, scheduling, production, and transportation. Sooriyamudalige et al. 2020 [3] identified six stages: idea generation, design and planning, procurement, manufacturing, transportation, and onsite assembly. For this research, a five-stage framework for OSC will be utilized, based on insights from Jung and Yu 2022 [23]; it includes design, manufacturing, logistics/transportation, onsite assembly, and handover/completion. This selection provides a clear and structured approach to understanding the OSC process, capturing the sequential flow from design initiation to project handover. These stages reflect a comprehensive view of the OSC lifecycle, highlighting the key interactions among various stakeholders throughout the process [24,25]. Categorizing OSC into these five phases aligns with the broader literature and addresses the need for effective information sharing to improve coordination, collaboration, quality assurance, and logistical efficiency in offsite construction projects [26].

The stakeholders include designers, who specialize in design for manufacture and assembly and who plan and design the offsite components based on the structural and functionality specifications; manufacturers, responsible for producing the building components to be used offsite; transporters, who move the prefabricated components to the construction site; contractors, responsible for the onsite assembly and construction process; and onsite installers, who assemble and install the prefabricated materials [27]. Each of these stakeholders has unique needs and requirements, including the need to have adequate information needed to perform their tasks. Therefore, there should be efficient collaboration among them to address these needs and ensure the successful completion of the OSC project on time and within budget [5]. For instance, as manufacturers transport building components to multiple locations, it is essential to coordinate the production process and logistics with the schedules of the construction sites [28]. Bäckstrand and Fredriksson 2020 [29] argue that inadequate information sharing can lead to incorrect deliveries, untimely deliveries, material wastage, and the need for rework, all of which can significantly impact construction projects. Luo et al. 2019 [30] identified issues in OSC due to insufficient information sharing, notably design changes occurring without consulting manufacturers and the main contractor. This results in the production of components based on outdated designs, causing delays [31]. Exploring diverse information sharing approaches is crucial to addressing this challenge.

2.3. Research Gap

Despite the evident importance of information sharing in OSC, there exists a notable gap in the existing body of research. Previous studies have explored the benefits of OSC but have not delved comprehensively into the nuances of information sharing among stakeholders during the various stages of the OSC process. This research endeavors to bridge this gap by conducting an in-depth examination of information sharing practices among stakeholders. By elucidating the current state of information flow, identifying potential challenges, and proposing effective strategies, this study aims to contribute valuable insights that can inform both academia and industry practitioners.

3. Methodology

This paper conducts an SLR on the OSC and information sharing domain using a typical three-step research methodology. The first step is data collection, which involves identifying keywords and screening articles. The second stage entails descriptive analysis,

while the third step involves qualitative discussion and providing recommendations in response to the research questions. This is conducted as per the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology, a widely accepted standard operating procedure for conducting SLRs. The PRISMA methodology involves the following key steps: formulating RQs, selecting relevant databases for article searches, defining inclusion and exclusion criteria, analyzing and synthesizing the selected studies, and presenting the results and discussion [32]. The RQs are established in Section 1, while this section outlines the subsequent steps. The final stages, including the results and discussion, are detailed in Sections 4 and 5. Adhering to the PRISMA guidelines ensures accuracy and completeness and minimizes bias in the research process.

3.1. Data Collection

The systematic search starts with the selection of search engines and keywords to find articles. This study used Scopus and Web of Science to search articles relevant to this study. These databases were selected due to their extensive coverage of journals and their inclusion of more recent publications [33]. Many other studies [11,34,35] have also recommended Scopus and Web of Science in the construction and project management fields. Then, a comprehensive list of relevant and alternative keywords related to OSC and information sharing is used to extract bibliometric data. The research keywords were chosen based on a comprehensive review of prior relevant papers [10,12,25,36] concerning the definition and concepts of OSC and information sharing. A set of terminology items for OSC and information sharing that are frequently interchanged was identified as the list of keywords. Thus, the following keywords were used in the title, keywords, and abstract search: ((“off-site construction” OR “offsite construction” OR “prefabri*” OR “industriali*ed building” OR “paneli*ed construction” OR “modular construction” OR “tilt up construction” OR “precast” OR “offsite construction” OR “precast construction” OR “tilt-up construction” OR “off-site manufactur*” OR “off site manufactur*” OR “offsite manufactur*”) AND (“information shar*” OR “data shar*” OR “flow of information” OR “information flow*”)).

As of November 2024, the initial search resulted in 228 articles. Table 1 illustrates the data collection process for the SLR. The next step in this study involves the establishment of inclusion and exclusion criteria to refine the articles obtained and select the relevant ones for analysis. Publications from the preceding decade were considered. This led to the exclusion of 50 articles; thus, the remaining 178 articles were considered for further analysis. Only research from the past decade was considered, as 10 years is commonly used as a standard timeframe for reviewing recent studies [25,37]. Moreover, only articles published in the English language were retained. The rationale for choosing studies published in English is based on its dominance in scientific communication and high visibility in the research field [38]. This led to the exclusion of an additional four articles. Subsequently, strict adherence to peer-reviewed publications was maintained. These studies were chosen for their high credibility, having been reviewed by competent professionals to make them methodologically sound and relevant [39]. This resulted in the exclusion of 38 papers and a final count of 136 articles.

Within this subset, 51 publications were identified as duplicates and consequently removed. As a result, out of the remaining 85 articles, 2 publications were unretrievable, culminating in a final tally of 83 articles for scrutiny. These articles were further scrutinized, focusing on their abstracts and findings, resulting in 51 papers for comprehensive analysis. Additionally, two articles were included in the sample for full-document review after being identified as relevant to this study through cross-referencing. Accordingly, 53 articles were selected for this study based on the inclusion and exclusion criteria.

Table 1. Data collection process for SLR.

Step	Description	No of Articles
1	Initial search (Scopus: 154; Web of Science: 74)	228
2	Limiting search to last 10 years (2013 to 2024)	178
3	Limiting search to articles written in English	174
4	Limiting search to peer-reviewed articles	136
5	Limiting search after excluding duplicates	85
6	Limiting search by removing inaccessible articles	83
7	Limiting search after reading titles, abstracts, and findings	51
8	Final papers for the analysis after including cross-referencing	53

3.2. Descriptive Analysis

In this stage, the bibliographic statistics of the selected literature were tabulated. It consists of the yearly distribution of publications, article sources, and study locations. This will map the research landscape on this topic, show trends and gaps in the research, and establish the geographical spread of this study.

3.3. Qualitative Analysis

While descriptive analysis offers valuable insights, its capacity for providing an in-depth understanding of the collected data is limited. To gain a more profound comprehension of the data, a qualitative analysis was undertaken to answer the research questions, pinpoint potential research gaps, and ascertain future research requirements. Thematic analysis was used to analyze the publications. Thematic analysis is a way to find patterns and themes in data, helping us understand things better and discover new insights [40]. Inductive thematic analysis was employed, as this approach is exploratory; it allows the researcher to remain open to new ideas and themes that may emerge from the data [41].

4. Results

4.1. Results of Descriptive Analysis

Table 2 presents the breakdown of articles based on publication sources. The majority came from journals (92%), with a smaller portion from conference proceedings (8%). Notable journals included *Automation in Construction* (eight articles), *Engineering, Construction and Architectural Management* (five articles), and *Journal of Cleaner Production* (five articles), reflecting a diverse range of perspectives. Additionally, articles were sourced from 22 different journals, highlighting the comprehensive nature of this study. Furthermore, four conference articles were from Proceedings of the Institution of Civil Engineers—Civil Engineering, Management Procurement and Law, International Conference on Computer Supported Cooperative Work in Design, and IOP Conference Series: Earth and Environmental Science. The esteemed reputation of the publication sources instills confidence in the overall quality and credibility of this SLR.

Figure 1 illustrates the trend of articles published between 2013 and 2024, displaying the yearly distribution of publications. The graph demonstrates a steady increase in the number of articles over time, reaching a peak of 13 articles in the year 2022. This indicates a rising interest among researchers in information sharing in OSC, highlighting its growing importance as a research focus. Additionally, the data reveal that 83% (44) of the papers were published within the last 5 years, underscoring the recent surge in scholarly attention to this topic.

Table 2. Number of articles published in journals and conferences.

Source Name	Number of Articles
Automation in Construction	8
Engineering, Construction, and Architectural Management	5
Journal of Cleaner Production	5
Buildings	4
Conference Papers	4
Construction Innovation	3
Journal of Construction Engineering and Management	3
Architectural Engineering and Design Management	2
Built Environment Project and Asset Management	2
Computers in Industry	2
International Journal of Construction Management	2
Journal of Management in Engineering	2
Concurrent Engineering	1
Construction Management and Economics	1
Habitat International	1
International Journal of Construction Supply Chain Management	1
Journal of Building Engineering	1
Journal of Engineering Project and Production Management	1
Sustainability	1
Smart and Sustainable Built Environment	1
Safety Science	1
Sensors and Materials	1
Management Science Letters	1
Total	53

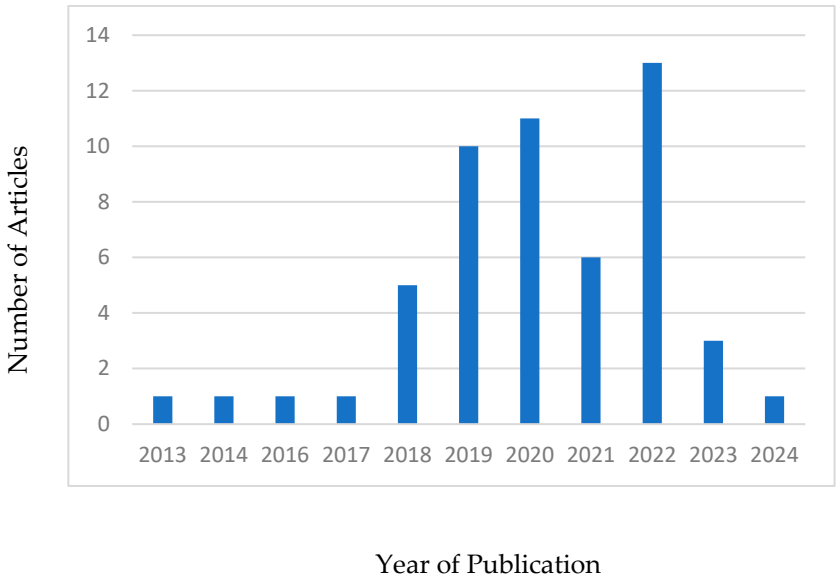


Figure 1. Annual distribution of articles.

Table 3 provides insight into the geographical distribution of the analyzed articles according to their study locations. The data reveal that most articles originate from China (28%), followed by the UK (23%) and the US (11%). Interestingly, most of the publications are from developed countries such as the US, Australia, and the UK. Notably, China contributes the most articles (15), highlighting its substantial presence in the research despite being a developing nation.

Table 3. Distribution of selected articles based on the location of study.

Location of Study	Number of Articles	Percentage (%)
China	15	28%
UK	13	25%
US	6	11%
Australia	5	9%
Canada	2	4%
Hong Kong	2	4%
New Zealand	2	4%
Germany	1	2%
Italy	1	2%
South Korea	1	2%
South Africa	1	2%
Spain	1	2%
Sweden	1	2%
Switzerland	1	2%
UAE	1	2%
	53	

4.2. Results of Qualitative Analysis

The selected articles were analyzed using inductive thematic analysis. The process started by reading the selected articles to understand their context to our research on information sharing among the stakeholders in the OSC during different stages. After that, initial codes for sections of the articles that covered key ideas related to the research questions were created. Finally, the themes were reviewed, finalized, and arranged into clear categories representing the different stages of information sharing in the OSC process.

4.2.1. Need for Information Sharing in OSC

OSC presents unique challenges in coordinating dispersed activities and remote stakeholders, which underscores the importance of effective information sharing. Information sharing bridges gaps that arise from conducting these activities at different locations and times, reducing the risk of misalignments, errors, and costly delays [42,43]. Unlike traditional construction, where real-time collaboration occurs onsite, OSC demands that remote teams maintain coordination through robust information systems [4,44].

Five key reasons justify the need for information sharing in OSC. Firstly, it promotes collaboration and coordination among contractors, designers, and manufacturers, allowing them to streamline processes and work toward shared project goals even from different locations [6]. Secondly, sharing information acts as a risk mitigation strategy, minimizing errors during crucial stages such as transportation and assembly by ensuring that all stakeholders are aligned [9]. Thirdly, it facilitates innovation by spreading best practices, emerging technologies, and lessons learned, thus building a foundation for more efficient and effective project execution [45]. Moreover, optimizing supply chain operations through shared information about lead times, material availability, and logistics enhances resource management and ensures timely deliveries [9]. Lastly, consistency in information flow supports standardization across design and production phases, leading to higher quality outcomes and adherence to original project specifications [46].

Effective information sharing throughout the OSC stages ensures that all participants remain fully informed, which is crucial for project coordination and quality assurance. The following section will further explore the specific information needs and sources at each stage of the OSC process.

4.2.2. Information Needs and Its Sources

In OSC, stakeholders need information from various sources to perform effectively. Designers and architects require assembly guidelines, design specifications, and material compatibility [24]. Builders and contractors need information on project timelines, safety protocols, and construction methods [47]. Manufacturers require quality standards, production schedules, and component fabrications while suppliers require lead time, pricing, and material availability [48]. This information is needed at various phases of the project. This section will discuss the information needs and sources within the five stages of OSC projects.

Information Needed and Its Sources During the Design Stage

The design phase in OSC demands precise and well-coordinated plans to support efficient offsite manufacturing and assembly [23]. The early involvement of key stakeholders is essential to ensure that design decisions align with construction site realities. Study [4] highlights that earlier involvement fosters a collaborative environment, enabling a smoother flow of critical project information between designers, manufacturers, and contractors. Also, establishing a fixed design blueprint early on is essential to prevent disruptions during the manufacturing process. This stage requires a strong focus on modular coordination to ensure that all components integrate seamlessly, addressing issues such as dimensional compatibility and the alignment of load-bearing structures [49]. The integration of Mechanical, Electrical, and Plumbing (MEP) systems further demands detailed information on structural specifications, making it necessary for architects and engineers to exchange information on dimensions, load capacities, and modular unit alignment to avoid assembly errors [50]. The client's input on functional and aesthetic requirements also plays a significant role, helping to refine the design to align with the project's intended outcomes while minimizing potential rework [35,51]. This lays the foundation for the entire construction workflow, with technical drawings and shop drawings serving as essential guides for planning and execution [3,52]. Moreover, various information sources—including design software, environmental consultant reports, and supplier catalogs—play a significant role in ensuring the accuracy and accessibility of critical data, which influences material selection, sustainability strategies, and human resource management [53,54].

Information Needed and Its Sources During the Manufacturing Stage

The manufacturing stage in OSC is pivotal, translating carefully designed plans into tangible modular components. Conducted within controlled factory settings, this phase employs advanced machinery and skilled labor to produce prefabricated modules that meet precise specifications [23]. The controlled environment eliminates variables such as weather, ensuring consistent quality and adherence to project requirements [55]. To maintain high standards and streamline workflows, this phase relies heavily on quality assurance measures and thorough testing. Each module must meet industry standards, safety requirements, and specific project criteria before approval for transportation to the construction site [56]. Information sharing during this phase is critical to maintaining quality standards and efficient workflows, supported by accurate documentation and robust communication channels.

A foundational document for this stage is the Manufacturing Bill of Materials (MBOM), which details all necessary components, quantities, and material specifications for production. The MBOM guides the manufacturing process, ensuring the correct materials are used, and aligns the production with the original design requirements [57]. It is important to include details on quality control measures, such as testing the structural integrity of modular units, along with documentation regarding material handling practices, includ-

ing storage conditions and protection during the manufacturing process [58]. By using integrated project management software, manufacturers can keep site managers updated on production timelines and any changes in material availability, which ensures that all parties are prepared for the next stages. Furthermore, insights from site workers regarding any site-specific adaptations can help optimize the installation of manufactured units. For effective results, it is important that workers are well-oriented with OSC technology and trained to handle advanced machinery commonly used in factory settings [56].

Information Needed and Its Sources During the Logistics/Transportation Stage

During this stage, stakeholders require specific information to ensure the safe and efficient movement of prefabricated components or modules from the manufacturing facility to the construction site. Logistics details are of utmost importance in coordinating the proper delivery of materials and equipment to the construction site at the right time [59].

Key information required during this stage includes transportation schedules and load-handling specifications, such as the dimensions of modular units, weight limits, and any site-specific challenges like access roads or crane placement [9,60]. Real-time data sharing through GPS tracking and shared scheduling platforms can facilitate coordination between manufacturers and site managers, reducing downtime by ensuring that the components arrive in the correct sequence and are installation-ready [5,60]. Any deviations from the delivery schedule due to factors like weather or traffic must be promptly updated to allow onsite teams to adjust their plans accordingly [61]. Additionally, site information, including the availability of space and access constraints, should be provided to adjust the logistics plans effectively [62]. Proper handling of transportation logistics is vital for maintaining the overall project timeline, as any disruption can significantly impact subsequent construction activities.

Information Needed and Its Sources During the Onsite Assembly Stage

The onsite assembly phase in OSC focuses heavily on the physical integration of prefabricated components, where precise coordination and adherence to quality standards are crucial [63,64]. Detailed sequencing instructions and connection specifications help ensure modules are correctly aligned and integrated with surrounding units [23,24]. This includes detailed module placement, alignment, and connection integrity tolerances to minimize potential deviations [65]. Essential information at this stage includes comprehensive construction plans, quality control measures, safety protocols, and real-time progress tracking, which collectively guide activity sequencing and resource allocation to ensure timely completion and optimal resource use [24,63].

Implementing safety protocols is critical to minimizing health risks and potential hazards, with safety management systems acting as foundational elements in risk mitigation and accident prevention [66,67]. Real-time progress updates via digital platforms empower stakeholders by providing direct access to current construction schedules, enabling timely decision-making and efficient resource management [68]. Additionally, robust communication through project management software and mobile applications ensures that stakeholders are engaged and prepared to address challenges, keeping the project aligned with budget and time constraints [69].

Skilled installation crews attach modules to foundations and connect necessary plumbing and electrical systems, while project managers oversee compliance with building codes and occupational safety standards [70]. Engineers and manufacturers often provide technical support to address unexpected issues, ensuring component compatibility and installation reliability [71]. This structured approach within OSC guarantees that the fi-

nal product meets stringent quality and safety requirements, reflecting the reliability and efficiency inherent in OSC methodologies.

Information Needed and Its Sources During the Handover/Completion Stage

The handover/completion phase in OSC focuses on verifying that the completed structure meets all required standards before it is officially transferred to the client. This includes thorough checks by project managers and engineers to ensure onsite assembly was completed to specification and that no damage occurred during transportation or installation [72,73]. A critical component of this stage is ensuring that all relevant documentation is available. Some documents are inspection reports, warranty-related details, operation instructions, and customer feedback gathering [62,74]. Inspection reports form part of the validation process that ensures that the construction standard has been met and regulations have been adhered to [75,76].

It was found that providing operational manuals is integral to ensuring the safety and proper functioning of the facility [77]. Furthermore, these documents detail how to perform maintenance, solve problems, and offer guidelines for foreseeable contingencies [78]. Feedback collection mechanisms help the stakeholders share their ideas and problems, which can also be related to the project's outcome. These comments offer vital information on areas to be improved and areas where unresolved difficulties still require attention before transitioning to the operational phase. Also, quality assurance checklists confirm that all vital steps have been taken and that the required quality standards have been achieved [79]. Training materials play a crucial role in training operators and maintainers in facility operations, thus ensuring skillfulness and knowledge in performing duties [78]. Feedback sessions allow all the stakeholders to express their experiences, likes, and dislikes. Moreover, they encourage an environment where stakeholders provide inputs for improvement [45]. Properly administrating this phase allows for a seamless transition to the operational stage when the structure is ready for occupation and potential concerns are resolved promptly.

4.2.3. Factors That Act as Barriers to Information Sharing in OSC

In OSC, effective information sharing is paramount for seamless teamwork among all involved [46]. However, various elements can act as barriers to information sharing making it challenging for stakeholders to share information among them and coordinate multiple processes. Miscommunication is one of the barriers that arise when stakeholders use different types of tools for communication. For example, individuals working on the OSC project come from various cultural and linguistic backgrounds, and this can lead to translation errors or misunderstandings, causing delays further affecting the project's completion in time [68].

Secondly, although standards like Industry Foundation Classes exist to streamline digital information sharing, many stakeholders face challenges in adopting them, often preferring traditional methods, leading to data integration issues [80]. Other barriers include language barriers and cultural disparities. While these barriers may also affect information sharing in onsite construction, their impact is more pronounced in OSC, particularly when working with diverse teams from different geographical locations with varying cultural norms and perceptions of information [7]. Trust issues among the stakeholders are another factor hindering information sharing. Manufacturing firms often rely on informal channels, this can cause contractual mistrust where other stakeholders doubt the intention of others to meet contractual agreements. For example, suppliers may doubt the manager's commitment to honor an agreement to pay for the supplies for the offsite construction [81]. Moreover, when trust is low, various stakeholders may likely hold critical information

that could contribute to the success [74]. Furthermore, OSC involves various stakeholders operating independently utilizing outdated communication methods [3]. This reduces their ability to communicate transparently.

Addressing the above challenges is pivotal for unlocking the full potential of information sharing in OSC projects.

4.2.4. Strategies to Improve Information Sharing

- Adoption of Digital Technologies: The construction industry has generally lagged in adopting digital advancements, critical for improving OSC processes [82]. Technologies like BIM, cloud platforms, and project management software facilitate data flow and collaboration, centralizing project information to improve transparency and accessibility [82–84]. Collaborative contracts further support this by fostering stakeholder trust and encouraging open information sharing [6]. However, high initial costs and limited technical skills among professionals hinder widespread adoption [85].
- Standardization of Processes and Protocols: Establishing standardized procedures, systems, and documentation will synergize various projects and assist in information sharing between different operations [86,87]. This entails developing standard data formats, references, programming protocols, and project management plans. Also, standardization helps present clear and consistent information to the client, reducing the chances of stakeholder mix-ups or misinterpretation [83]. However, one major challenge of the standardization of protocols and processes is the resistance of stakeholders to changes that would affect their normal way of information sharing [88].
- Collaborative Contracting Practices: Collaborative contracts improve teamwork by establishing shared goals, benefits, and transparent communication among stakeholders [89,90]. Despite their advantages, these contracts are not widely adopted, as many stakeholders lack the necessary expertise [91].
- Investment in Training and Education: Offering training and education programs to OSC participants enables them to improve their technical qualifications and communication skills, allowing them to share new information properly [62,92]. The training may include BIM workshops, digital collaboration tools training, and effective teamwork among team members [93,94]. Organizations can plan for the development of their workforce and provide them with tools to leverage digital technologies and communication strategies to maximize information sharing for OSC projects. However, organizational strategies to build the capacity of various stakeholders may be hit by high costs and limited resources [92].
- Promotion of a Culture of Transparency and Trust: Creating an atmosphere of openness and trust is crucial to presenting information and stimulating communication between OSC members. Facilitating interaction can be achieved through frequent communication channels, with clearly assigned roles and responsibilities, and by providing an atmosphere that creates trust [4,95]. Due to trust, stakeholders will not hesitate to exchange information and raise questions whenever necessary [96]. Achieving trust and transparency in a project may be challenging when leaders who are entitled to implement a culture of trust and transparency are not committed to carrying out the change process and continuous improvement [95].

5. Discussion

5.1. Discussions on Descriptive Analysis

By analyzing the studies' publication years, sources, and geographic locations, researchers can identify commonalities, distinctions, and areas for further investigation. The

growing number of publications, particularly in the past five years, signifies the increasing recognition of OSC as a critical solution to modern construction challenges.

Despite this upward trend, significant geographic disparities are evident. Research output remains concentrated in developed regions, such as Europe, North America, and parts of Asia, while contributions from developing economies are notably sparse. This lack of representation may be attributed to the limited adoption of OSC technologies, lack of training, and reduced research funding in these regions [3]. Considering that many emerging economies face pressing infrastructure demands, future research should focus on the unique challenges and opportunities of OSC adoption in these contexts, which could bridge this critical knowledge gap. Furthermore, the diversity of publication sources—spanning construction management, engineering, and supply chain disciplines—reflects a multidisciplinary approach

This study's findings highlight the need for further exploration of OSC in regions with limited research output. Identifying local challenges and tailoring OSC strategies to these regions can ensure a more globalized adoption of OSC practices. Additionally, the growing focus on multidisciplinary research demonstrates the complexity of OSC projects, requiring collaboration across various expertise areas. These insights guide future research to address the unequal geographic representation and foster an inclusive approach to OSC knowledge development.

5.2. Discussions on Qualitative Analysis

Figure 2 presents a conceptual framework designed to improve information sharing in OSC by incorporating critical factors often overlooked in previous studies. For instance, the inclusion of manufacturer and contractor input during the design stage ensures that practical considerations are embedded early, mitigating downstream inefficiencies [4]. Similarly, real-time updates to project schedules during manufacturing and detailed site logistics planning—encompassing laydown areas, access points, and transport routes—address logistical bottlenecks that often hinder OSC projects [5].

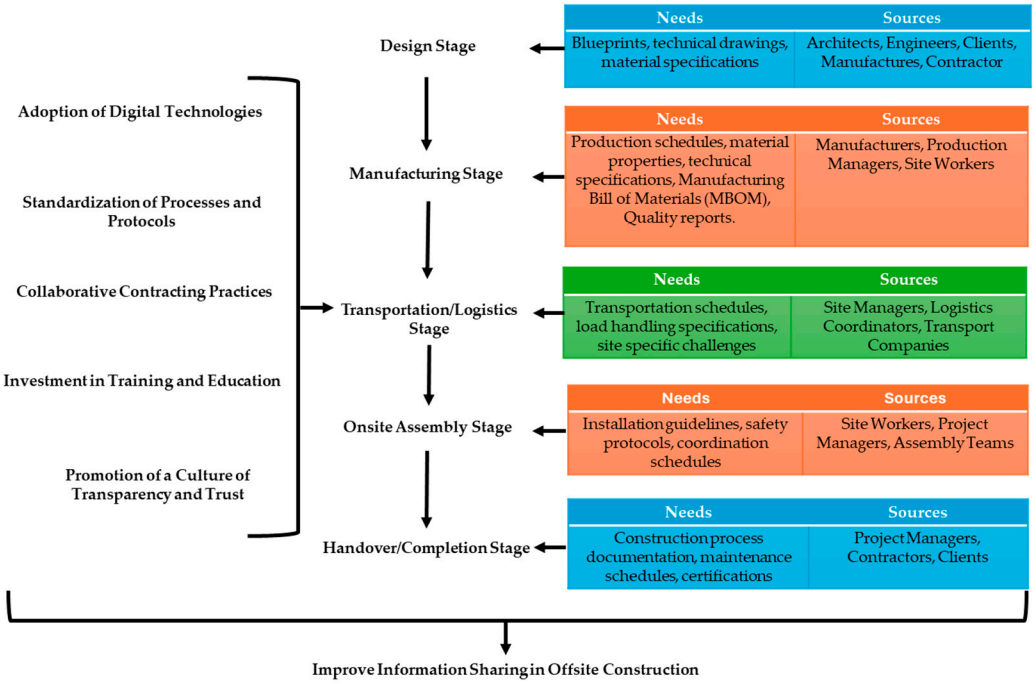


Figure 2. Conceptual framework.

The framework also addresses key factors that can improve the information sharing process. Collaborative contracts, such as alliancing and partnering, are included to help align the goals and interests of all parties involved [97]. Leveraging technology and considering factors like regulatory requirements help to tailor the information sharing process to the needs of the project, making it more efficient and effective [98].

The findings from this study offer a comprehensive understanding of the importance of information sharing in OSC, highlighting both commonalities and distinctions from existing research on the topic. As highlighted in earlier research [42,43], the remote nature of OSC necessitates seamless communication across distributed teams. However, this study goes beyond prior research by identifying specific challenges at each stage of OSC, such as the unique complexities of the logistics and transportation phases. Whereas some studies [4,44] discuss the importance of information flow in broader terms, this study provides a nuanced breakdown of information needs at each stage—design, manufacturing, logistics, onsite assembly, and handover/completion—offering a more granular view of the information requirements at each phase. Like previous studies, this research highlights the importance of early-stage collaboration and information flow among stakeholders, to mitigate inefficiencies and delays [4,5]. However, the proposed framework introduces new insights by incorporating a broader range of information needs across different project stages.

5.2.1. What Information to Share?

RQ-1 (What are the key aspects of information sharing in OSC?) is addressed by identifying the critical stages and information requirements of OSC projects, including technical specifications during design, quality control measures during manufacturing, logistics details during transportation, and real-time updates during assembly. As highlighted by [99], the qualitative analysis further explores the nature of information that should be shared with stakeholders at different project stages, as revealed through thematic analysis. This includes market evaluation, feasibility assessments, construction timetables, and safety guidelines. The findings underscore the multifaceted nature of information sharing in OSC, encompassing technical specifications, regulatory requirements, logistics details, and stakeholder feedback, all of which play a crucial role throughout the project lifecycle.

5.2.2. Why Is Information Not Shared?

For RQ-2 (What factors hinder information sharing in OSC?), this study reveals significant barriers, including fragmented supply chains, cultural and linguistic differences, and resistance to adopting digital tools. Miscommunication stemming from these barriers leads to inefficiencies and project delays. Understanding these impediments provides a foundation for developing targeted strategies to enhance collaboration and information exchange among stakeholders.

5.2.3. How to Improve Information Sharing

RQ-3 (What are the potential strategies to improve information sharing in the OSC industry?) is addressed through the proposed strategies in the framework. Recommendations such as adopting digital technologies, standardizing processes, fostering collaborative contractual practices, and investing in training and education are essential to overcoming the identified barriers. Building a culture of transparency and trust further ensures stakeholders are engaged and willing to share critical information.

The conceptual framework developed in this study provides a practical approach for addressing information sharing challenges in OSC. It supports strategic decision-making by enabling stakeholders to determine appropriate technologies and training to improve collaboration. Additionally, it identifies information sharing gaps at each project stage,

allowing processes to be adapted to meet unique requirements, thereby enhancing efficiency and effectiveness [88]. By offering a structured tool for gap analysis and project-specific adaptations, the framework provides valuable insights to ensure that information sharing becomes integral to achieving successful OSC project outcomes.

6. Limitations and Further Research Directions

While this SLT enabled a comprehensive search to cover a wide range of research on the topic of OSC—specifically, studies aligned with the research questions, providing a critical evaluation of their evidence—there were some limitations. First, the publication language was restricted to English. This excluded non-English-language studies that could have valuable evidence for the SLR process [100]. Secondly, while Scopus and Web of Science contain high-quality journals, restricting the search to these databases could have restricted exposure to other credible papers that cover the topic of study [33]. Lastly, limiting the search to only peer-reviewed studies ensured the quality of the data collected, this could have also limited exposure to real-case scenarios about information sharing in OSC.

While the conceptual framework provides a foundational basis for advancing research and professional practice in this area, it is derived exclusively from the literature reviewed in this study. As such, it serves as an initial step, necessitating further development to enhance its applicability and effectiveness. Future research should incorporate empirical methods, including interviews, surveys, and case studies, to engage professionals and experts in refining and validating the framework. Such efforts will be critical to ensure its practical relevance and robustness in addressing the complex and dynamic challenges encountered in real-world OSC projects.

Various technologies that support information sharing in OSC projects have emerged. BIM is a technology that helps various stakeholders share information [69]. It is also valuable in terms of time and cost estimates, which, in turn, help in schedule management to minimize threats of budget and time overruns [95]. BIM facilitates the efficient production of deliverables, leading to financial gains and enhancing the reputation of construction organizations [64,101]. Despite these benefits, these technologies have not been largely implemented in OSC projects. Further comprehensive studies are needed to understand why it has not been largely implemented. Further studies can delve into factors that facilitate and/or hinder seamless collaboration among OSC stakeholders. Future research should also incorporate empirical studies, case analyses, and industry surveys to comprehensively understand information sharing dynamics in real-world construction projects. Additionally, research is needed to focus on emerging technologies like the Internet of Things (IoT) that can further improve information sharing in OSC [102]. IoT is a network of smart devices that can sense, communicate, and work together [103]. These devices collect and share data, allowing different applications and services to function smoothly. In the context of OSC, IoT can be utilized to monitor manufacturing processes, track logistics, and ensure quality control.

While information sharing improves OSC project success, it remains underutilized. Future research should explore additional factors contributing to OSC success beyond information sharing, incorporating practical studies, case examples, and organizational data for real-world insights. Understanding stakeholder behavior and attitudes toward information sharing, along with monitoring its long-term impact, will be essential for advancing OSC practices.

7. Conclusions

This systemic literature review has shed light on different aspects of information sharing in OSC projects. The findings of this study show information needs and sources at various stages of the OSC project. At the design stage, stakeholders like architects and engineers need information such as initial design concepts and ensuring compliance with regulatory requirements. Industry reports emerge as a major information source that can be used in analyzing the market implications of OSC and help identify opportunities, threats, and avenues for growth. Having this information guides stakeholders in tailoring construction to meet customer needs and comply with sustainability specifications. Information sources include design software, environmental consultant reports, and supplier catalogs. As the project progresses to the transportation/logistics stage, information needs include logistics details for material transportation and delivery, such information can be accessed from logistics companies and transportation databases. This stage add to the acquisition of various materials, and methods that are used in the OSC project. At the onsite assembly stage, stakeholders need detailed construction schedules, detailed construction schedules and task sequencing, quality control standards and inspection reports, safety protocols and hazard identification as well as real-time progress updates and communication channels from various sources including project management software, and quality control documentation and testing records. Such information enhances the coordination of various processes of construction in the OSC project. Lastly, during the handover stage, various stakeholders including project managers and quality assurance teams, suppliers, manufacturers, warranty providers, facility managers, and maintenance personnel require inspection reports for quality assessment, details for materials and equipment, and operational manuals for facility maintenance. This information can be sourced from inspection reports, quality assurance checklists, supplier and manufacturer documentation, operational manuals from equipment vendors, as well as feedback gathered through stakeholder surveys and discussion sessions.

The findings also highlight that effective collaboration among OSC stakeholders ensures smooth workflows, facilitated by sharing accurate information through appropriate channels. Real-time data integration helps detect issues early and respond proactively, fostering innovation in environmentally sustainable OSC practices. However, challenges like supply chain fragmentation, non-standardization, and communication barriers can hinder information flow, causing inefficiencies and delays. Overcoming these requires strategic use of digital technologies, standardization, collaboration, and a culture of transparency and trust. Future research can further explore these aspects of information management in OSC.

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