Zhang, B., Prado, G., Rischmoller, L., & Fischer, M. (2025). Towards A Supply Chain Integration Theory in Offsite Construction: Insights from Industry Practices. In O. Seppänen, L. Koskela, & K. Murata (Eds.), *Proceedings of the 33rd Annual Conference of the International Group for Lean Construction* (IGLC33) (pp. 645-656). https://doi.org/10.24928/2025/0214

TOWARDS A SUPPLY CHAIN INTEGRATION THEORY IN OFFSITE CONSTRUCTION: INSIGHTS FROM INDUSTRY PRACTICES

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ABSTRACT

The construction industry has long grappled with managing the supply chain, particularly in offsite projects. The supply chain management (SCM) concept flourished in manufacturing and plays an important role in increasing transparency and alignment of the supply chain. In the construction industry, not only building parts and materials manufactured in factories offsite but the aggregation of these parts and materials into building components assembled in offsite facilities (i.e., offsite construction of prefabricated and modular elements) adds complexity to the application of SCM. This paper, which is theoretical in nature, reports on the observation of two supply chain integration approaches implemented by two California construction companies using foundational perspectives of SCM. The results include a summary of the observed advantages and disadvantages using the following six perspectives: (1) target project type, (2) contract type, (3) business strategy, (4) production management methods, (5) supply chain management practices, and (6) organizational culture. An outline of what might become a supply chain integration and management theory to guide construction companies in developing appropriate strategies to realize the potential of offsite construction projects is presented. The proposed theory outline will need to be tested through future experimentation.

KEYWORDS

supply chain management, modular and off-site construction, lean theory, case study analysis.

INTRODUCTION

Manufacturing provides the elements from which buildings, bridges, highways, and factories are constructed (Ballard & Arbulu, 2004). Building parts and materials have been traditionally manufactured in offsite facilities and then supplied to the construction site, where they are transformed into different construction project components, which are then transformed into a finalized construction project. The quality of a main contractor-supplier relationship affects the main contractors' ability to perform on projects (Broft & Koskela, 2018) and has been a research topic for the past decade under the SCM umbrella.

The goal of applying SCM to construction projects involves the improvement of coordinating materials, information, and financial flows (Stadtler, 2000) and the integration of actors to enable the sharing of knowledge and information (Christopher, 2005; Martinsuo & Ahola, 2010). However, in construction supply chains, the relationships required to deliver the constructed product among main contractors and suppliers are often weak and difficult to

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manage (King & Pitt, 2009). Green et al. (2005) pointed out that the implementation of SCM in construction is relatively slow, mainly due to the fragmented nature of the industry and the inability to understand the context of SCM within each organization in the supply chain. Therefore, without an effective SCM strategy, the traditional construction supply chain often ends up with decisions that are locally optimized and myopic (Vrijhoef & Koskela, 2000).

Considering not only building parts and materials manufactured in facilities offsite but also aggregating these parts and materials into building components assembled in offsite facilities (i.e., offsite construction of prefabricated and modular elements) adds complexity to the SCM. As a result, new business strategies such as vertical integration have been observed to enable the offsite construction firms to coordinate design, manufacturing, transport, and assembly from an integrated and industrialized perspective (Hall et al., 2022). However, limited practices to evaluate the performance of the supply chain integration strategy have hindered the wide adoption of these strategies in construction projects (Razkenari et al., 2020).

This paper, which is theoretical in nature, examines six foundational perspectives of SCM: (1) target project type, (2) contract type, (3) business strategy, (4) production management methods, (5) supply chain management practices, and (6) organizational culture. The paper reports on two California construction companies' approaches to utilizing offsite prefabricated elements and modular products. These companies leverage offsite fabrication facilities in various types of projects across the United States. Based on our observations, the paper presents a supply chain integration theory outline to inform future research efforts in developing comprehensive SCM strategies to realize the full potential of offsite construction projects.

SUPPLY CHAIN MANAGEMENT IN CONSTRUCTION

SCM in construction is a concept with more than two decades of development and closer study among construction researchers and practitioners. Christopher (2005) defines a supply chain as a network of organizations involved in the different processes and activities that produce value in the form of products and services for the end-user. Based on Vrijhoef and Koskela (2000), SCM is a concept that has flourished in manufacturing, originating from just-in-time (JIT) production and logistics first developed within the Toyota Motor Company as part of its Toyota production system (TPS). Proposals to embrace the JIT philosophy in the construction industry have mainly focused on providing the right materials in the right quantities and quality when they are needed in order to reduce waste and provide maximum value (Abbasi et al., 2020; Tommelein & Li, 1999), and better management of uncertainty eliminating the causes of workflow variation (Ballard & Howell, 1998; Lindhard, 2014).

Construction supply chains are still full of waste and problems caused by myopic control. The focal company of the JIT application to construction has traditionally been the General Contractor (GC) or Project Management (PM) company in charge of leading the transformation of building parts and materials into a finished project. Unlike Toyota (Toyota being the focal company in the manufacturing application of JIT) who integrated its first-tier suppliers into the JIT concept and propagated the philosophy into its entire supply chain (Choi et al., 2023), inventory of construction building parts and materials (i.e., waste) have traditionally been pushed back to supplier factories expected to supply their product just-in-time to the construction job site (Xie & Palani, 2018).

SCM in construction is considered an emerging field of research and practice that aims to improve coordination, reduce costs, and increase the reliability of the project execution (Azambuja & O'Brien, 2009). To better understand construction SCM, Vrijhoef and Koskela (2000) defined 4 roles that SCM plays in construction: (1) focus on the interface between the supply chain and the construction site, (2) focus on the entire supply chain, (3) focus on transferring activities from the construction site to the supply chain, and (4) focus on the integrated management of the supply chain and the construction site. Moreover, the authors stated that no solution fits all the scenarios in construction, but rather, each of the options has limitations (both subjective and objective), and the decision as to which role to use might depend on the context of the project and the context of its organization. Additionally, each role can interact with other industry tools, such as the Last Planner System (Ballard & Howell, 1998).

OFFSITE CONSTRUCTION SUPPLY CHAIN

Offsite construction (OSC) is a modern method of construction (MMC) that involves a unique mix of construction procedures integrated into a production flow line (Slaughter,1998). OSC involves creating elements of the built environment constructed offsite in a controlled environment to provide value-adding services to the construction process (Ayinla, Cheung, & Tawil, 2019). Despite its long history in urban development, OSC continues to face persistent supply chain inefficiencies (Masood, Lim, & Gonzalez, 2021). Using an example from the modular construction industry (a specific type of offsite construction), companies have been focusing only on automation and quality improvements, overlooking the importance of creating an efficient and integrated supply chain (Jeong et al., 2006); thus, the modular construction supply chain is getting longer, increasingly complex, and more fragmented. Additionally, research showed that the project-based nature of the industry and reliance on local subcontractors hinder achieving the full potential of OSC (Fulford & Standing, 2014).

To address these inefficiencies, researchers have explored supply chain integration strategies, particularly lean methodologies. Value Stream Mapping (VSM) has been shown to enhance JIT delivery for concrete components, improving supply chain predictability based on demand fluctuations (Tommelein & Li, 1999). Similarly, transitioning facade delivery from onsite to offsite through JIT lean techniques has demonstrated significant time and cost savings, though resistance from stakeholders remains a challenge (Cossio & Cossio, 2012). These findings highlight the critical role of supply chain coordination in OSC, where integration strategies between production, logistics, and onsite assembly can drive efficiency gains.

SUPPLY CHAIN INTEGRATION FOR OFFSITE CONSTRUCTION

Supply chain integration aligns objectives and resources within a company to enhance value (Hall et al., 2018). Vertical integration, a key business strategy, consolidates upstream and downstream processes within a single firm, reducing reliance on external suppliers. By bringing in-house design, construction, and manufacturing, offsite construction firms redefine operational boundaries (Eldamnhoury & Hanna, 2020).

Emerging concepts and technology development further drive supply chain integration in OSC. Incorporating Design for Manufacturing and Assembly (DfMA) and Building Information Modelling (BIM) in the design process enhances horizontal and vertical integration by embedding manufacturing and assembly data early into designs (Li et al., 2022). Relational contracts foster collaboration, reducing adversarial dynamics in traditional subcontracting. Industrialized Construction (IC) provides a holistic approach, integrating vertical and horizontal supply chains to improve efficiency (Lessing & Brege, 2018). Digital twins (Lee, Kim, Khanzode, & Fischer, 2021), blockchain (Hamledari & Fischer, 2021), and optimization algorithms (Chang & Han, 2021) are examples of digital technologies that have demonstrated the potential to improve SC visibility, streamline logistics, and lower carbon footprints in construction projects. Effective SCM is crucial for OSC's seamless logistics and production coordination.

Recent research underscores the role of Operations Management (OM) and Operations Science (OS) in quantitatively supporting supply chain integration. Prado (2022) introduced an OM-based integration framework for OSC, focusing on JIT delivery and interconnected production systems. Prado and Tommelein (2023) examined an offsite-manufactured facade installation in a California healthcare project, linking production metrics (work-in-progress, throughput, cycle time) to project cost and schedule. Zhang and Fischer (2024) optimized inventory levels by integrating fabrication and installation planning through OS.

In summary, the current literature review proposed many research avenues to explore, focusing on OSC projects at an operational level. These can dictate avenues for future research and how offsite construction projects' operational aspects and SCM ultimately relate to overall company-level results. Notably, there is a lack of empirical studies on how different companies integrate their supply chains for offsite construction. This gap underscores the urgent need for a robust supply chain integration theoretical framework to help construction firms fully leverage the potential of offsite construction.

METHOD

This study follows an inductive, case-based approach (Eisenhardt, 1989) as the initial step toward developing a supply chain integration theory for offsite construction. Given the limited number of documented supply chain practices in the literature, this research leverages the authors' professional experience as a point of departure for theory exploration. The study also directly examines two California-based construction companies implementing distinct approaches to integrate supply chains.

The study employs the Observation-Participation Method that researchers actively participate in the daily activities of the studied scope, enabling context-rich insights that support theory development (Rischmoller, 2005). Data collection included direct observation, participation in supply chain integration processes, and informal interviews with project management teams. The authors possess multiple years of experience in construction management and have established working relationships with the observed companies.

The supply chain management practices are summarized into six perspectives and the takeaways by comparing the supply chain integration. These takeaways from the six perspectives of SCM form the theory outline and are presented as a potential point of departure for supply chain integration theory in offsite construction. The authors would like to use this theory outline to inform future research efforts in developing comprehensive supply chain integration strategies to realize the full potential of offsite construction projects.

Additionally, integration experiences regarding project team reactions, values and waste reduction consequences, and relationships among supply chain members are also presented to support the development of the theory. Given that the paper's main purpose is to establish the point of departure and inform future research, the genesis of this paper comes from empirical practices, leveraging experiences and knowledge from authors and company experts. Future work will be needed to formalize research questions and methods to develop a comprehensive supply chain integration theoretical framework.

RESULTS

COMPARISON

Company A implements a “One Company Policy” to leverage partnerships with portfolio companies. Company B employs an internal vertical integration business model, centralizing organizational control by integrating internal departments to optimize efficiency. Figure 1 visualizes their respective supply chain structures, including key stakeholders, contractual relationships, and integration scopes. Table 1 presents the comparative analysis results of Company A and Company B across six key perspectives of supply chain integration, outlining their respective operational strategies and decision-making structures.

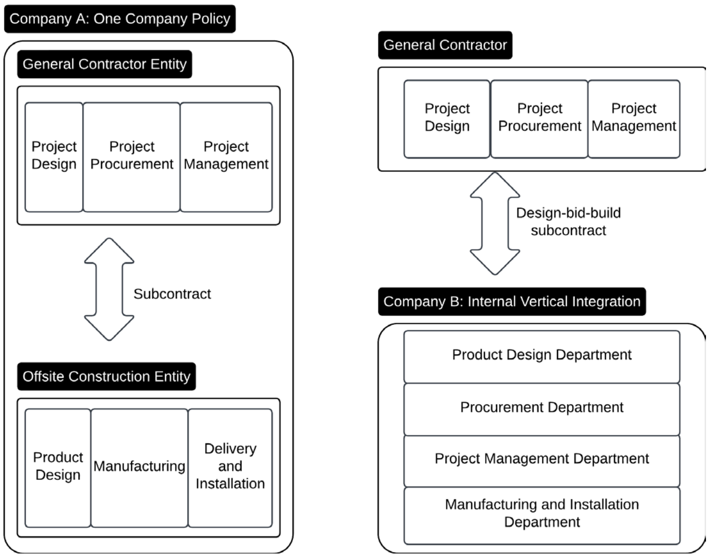

Figure 1: Illustration of Company A's and Company B's supply chain configurations.

Table 1: Comparison of the two companies' supply chain integration approaches from six perspectives with takeaways

Perspective	Company A	Company B	Takeaway
Target Project	Projects with repetitive scopes (e.g., bathrooms)	Private projects with reliable agreements (e.g., facades, parking structures)	Balance customization with scalability by creating synergy between product design and project demands
Contractual Type	Design-build contract with clients; subcontract with offsite factory	Hard-bid contracts with early design integration	Adopt flexible, collaborative contracts to encourage integration and transparency
Business Strategy	Project-centric: engineer-to-order, accelerate schedule by concurrent engineering	Product-centric: configure-to-order, standardized process for efficiency	Combine project-centric flexibility with product-centric efficiency for a hybrid business strategy
Production Management	Traditional project management offsite and onsite; apply lean concepts in project	Traditional project management; operations management at manufacturing level	Integrate lean practices with operations management consistently across site operations and manufacturing
Supply Chain Management	Contractor-subcontractor relationship under "one company policy"	Vertically integrated: controls design, procurement, fabrication, and installation	Enhance transparency by real-time information exchange to minimize buffer stock and improve responsiveness
Organizational Culture	Onsite PM teams can override manufacturing decision	Engineering teams and PM teams can override manufacturing decision	Foster a collaborative culture and cross-departmental engagement to balance decision-making

The table highlights differences in target project types, contractual approaches, business strategies, production management methods, supply chain practices, and organizational cultures. The takeaways suggest that Company A prioritizes project adaptability, leveraging portfolio company partnerships and design-build contracts to improve project outcomes. Company B emphasizes product driven standardization, maintaining greater control over its supply chain through vertical integrated departments within the company.

PROJECT TEAMS REACTIONS

Company A

The offsite factory was acquired as the main contractor's portfolio company. Nevertheless, the relationship between the project team and the factory team primarily follows a traditional contractor-subcontractor relationship in projects. Both teams operate as two separate profit centers, with each team assessed independently against minimal profit targets. Typically, the contractor team engages in a design-build contract with the owner and a lump sum contract with the factory, reinforcing their financial and operational separation.

Despite this separation, supply chain integration is encouraged through the "One Company Policy," which promotes collaboration within Company A. In practice, main contractor teams act as brokers, bringing the factory as a subcontractor during the proposal phase to projects. The factory could provide early design input to inform decision-making during the proposal and planning stages. Additionally, collaboration between the project team and the factory occurs through BIM coordination during the preconstruction phase.

While the "One Company Policy" fosters alignment, it also introduces challenges. The factory team, as a subsidiary, is inclined to prioritize the project team's requests, often without sufficient production oversight. The traditional subcontract does not emphasize that the project team should work with the factory team and have visibility into production processes. Due to minimal communication during manufacturing, project teams frequently introduce late changes to safeguard project profitability, leading to disruptions in factory operations.

From a SCM perspective, the factory team primarily focuses on material procurement within the factory. The installation process remains loosely coordinated, and the factory team assumes high uncertainty in site demand, often relying on large material buffers to mitigate risks. This lack of synchronized planning between site operations and manufacturing contributes to inefficiencies and increased material waste.

Company B

Fragmentation among Company B's departments exists, considering the nature of the hard-bid jobs, as each department contains a specific budget value and is trying to "save" as much as possible. However, the engineering and project management teams have the "power" to propose fluctuations in the manufacturing and engineering budget to provide "solutions" to the client. This situation can lead to reducing repeatability during manufacturing (the most expensive phase), therefore, reduce the profit of the job compared to most manufacturing-wise production.

Company B prefers a JIT delivery of the prefabricated components from the plant to the project site as it allows to avoid any issue with these components within the job site and also reduces the time spent on the job site, which helps to have a more profitable project execution. Meanwhile, and considering the delta between the manufacturing and erection rates, each job might decide to have a percentage of completed units before starting erection in order to have the two processes ending at the same time, considering a buffer of an average of X days between processes. This approach also helps to plan the transportation for each prefabricated component, as the company team considers a buffer to maintain the job site intake constantly during the erection sequence of the job.

VALUES AND WASTE REDUCTION CONSEQUENCES

Company A

In company A, both the project team and the factory highlight that the primary value of offsite construction lies in the supply chain integration. This integration enables acceleration of the project schedule through concurrent engineering and streamlined onsite installation based on their experience. It enhances coordination across design, manufacturing, and construction phases, reducing delays and inefficiencies. This integration results in fewer requests for information and change orders, reduced reliance on general contractor staff. Additionally, streamlined logistics reduce onsite manpower, overtime, rework, cleanup, and waste. The improved offsite production environment lowers exposure to weather-related delays and other external risks while reducing onsite labor hours, which in turn minimizes safety incidents and labor shortages. While these supply chain efficiencies may not be immediately reflected in bid proposals, their value becomes evident throughout the project lifecycle.

Company B

In company B, the value of vertical integration comes from the intention to increase repeatability and reduce changes during the manufacturing process and include more time thinking about the design, creating different alternatives, and coordinating more intensively between engineering and manufacturing to mitigate any deviation from the original (manufacturing-driven) casting sequence. When this optimal proposal is not possible (due to either internal or external factors, such as the owner changing the design or the engineering and the production teams not finding the right supplier for a specific component), the engineering and manufacturing teams try to convey on a “partial” solution, which consists on having a percentage of pours being made following a manufacturing-driven process, and the remaining percentage of pours following an erection-driven process.

RELATIONSHIP AMONG CLIENT, GC, AND SUBCONTRACTORS

Company A

Company A forms a portfolio of companies through acquisition. These portfolio companies usually act as strategic partners in projects, sharing long-term client resources from the GC. Under the "One Company Policy," the GC's project team assesses each project's potential for integrating offsite construction products. GC collaborates closely with its manufacturing factory during the proposal phase to advocate using offsite-manufactured products. Once the project is awarded, the factory team provides design input early in the design phase to support critical decision-making. The GC's onsite project team facilitates design coordination between the offsite manufacturing team and other trades through BIM coordination sessions.

However, the offsite factory operates with independent profit objectives and prefers lump sum contracts to safeguard its profit margins. The factory team keeps its production processes distinct and autonomous to maximize efficiency. This subcontracting structure causes the client and GC project team to focus primarily on product delivery deadlines, often overlooking inefficiencies at the interface of the onsite-offsite. As a result, both the client and the GC have limited visibility into the offsite production process during manufacturing, which can hinder collaboration and process integration.

Company B

The client of the project (not always GC) usually does not realize the production management portion of the job that company B does. The client mostly focuses on delivering the project on time and within the expected budget. If company B obtains any gains in terms of money, the client does not realize it as the job was bid with a hard-bid offer. Additionally, having the panels ready way in advance provides a less risky approach to delivering the panels on time, leading to a happier customer.

Company B usually prefers to have less impact from other suppliers and GC as much as possible. The offsite construction approach has a minimal impact and takes less time on the job site, generating several benefits for the client, the GC, and other suppliers. Additionally, since company B begins with the design of their scope of work in a project, company B coordinates with the other companies involved in order to obtain their feedback and deliver supplier-friendly prefabricated elements to the job site. Unfortunately, when there are issues from other parties that input data into Company B's scope of work (external designers), company B takes responsibility for these issues, and this sometimes generates less profitable results.

DISCUSSION

The comparative analysis of two distinct supply chain integration approaches in offsite construction projects reveals critical insights into how supply chain strategies influence project and operational performance. Company A's approach, characterized by acquiring a modular fabrication factory, promotes a project-centric business model that accelerates project schedules while maintaining a customizable product. This model benefits from early design input, DfMA, and BIM integration, aligning with findings from Lessing (2017) on the importance of front-end design coordination in industrialized construction. However, challenges arise from the organizational and financial separation between the factory and projects, leading to misaligned incentives, insufficient information flow, and inefficiencies at supply chain interfaces consistent with the fragmentation challenges identified by previous research (Vrijhoef & Koskela, 2000; Zhang & Fischer, 2024).

In contrast, Company B demonstrates strength in operational control and cost efficiency through a highly integrated structure that streamlines design, fabrication, transportation, and installation. Their use of configure-to-order strategies and JIT delivery practices reflects mass customization principles discussed by Prado (2022) and supports lean operations and inventory control as emphasized by Ballard (2004). Standardization and streamlined processes within Company B optimize production flow and minimize site disruption. However, internal fragmentation between design and production departments, along with the use of hard-bid contracts, introduces challenges in maintaining consistent production strategies and adapting to project-specific design changes. These observations mirror the tensions between standardization and project-level flexibility discussed in industrialized construction context (Vásquez-Hernández et al., 2023).

Examining the six SCM perspectives, target project type, contract type, business strategy, production management methods, supply chain management practices, and organizational culture, highlight key strengths and limitations in both approaches. Company A's approach excels in project adaptability and stakeholder engagement, particularly benefiting from project acquisition, early design inputs and BIM coordination. However, its traditional subcontracting and project management approach results in separated profit centers between the contractor and the factory, creating potential misalignments in decision-making and limiting production information transparency. Conversely, Company B's model, while excelling in internal standardization and operational efficiency, encounters difficulties in cross-departmental coordination and responsiveness to design changes in complex, multi-trade projects. These findings reinforce the argument by Lessing and Brege (2018) that achieving high performance in offsite construction requires both internal integration and external supply chain collaboration.

Ultimately, this comparative study demonstrates that while internal integration and configure-to-order production strategies improve cost control and predictability, they must be balanced with mechanisms that enable design adaptability, external coordination, and shared incentives. Future research should focus on developing hybrid integration models that simultaneously support operational efficiency and cross-organizational collaboration to fully realize the potential of offsite construction.

OFFSITE CONSTRUCTION SUPPLY CHAIN INTEGRATION THEORY OUTLINE

The takeaways derived from observing the integration approaches of two leading offsite construction companies provide a foundational outline for a supply chain integration theory tailored to the offsite construction industry. The proposed theory outline is built upon three key insights that may evolve into general principles, ultimately forming the backbone for enhancing operational efficiency, alignment, and project performance across the offsite supply chain.

The first insight (Figure 2) of our proposed theory involves integrating project-centric adaptability with product-centric standardization through a hybrid business strategy. This approach aligns modular product designs with diverse project requirements, optimizing production efficiency while preserving design flexibility. Integrated delivery approaches such as early stakeholder engagement and incentive-driven alignment further mitigate inefficiencies associated with fragmented project delivery. Balancing customization and scalability enhance project delivery speed and improves cost efficiency in offsite fabrication.

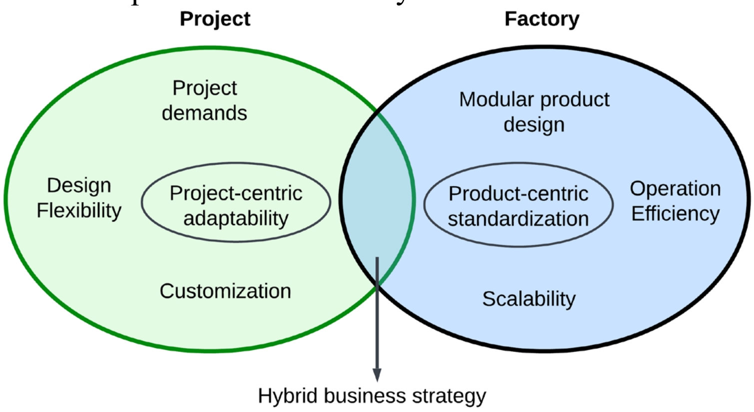

Figure 2: Proposed supply chain integration theory outline for offsite construction projects

The second insight of our proposed theory focuses on integrating lean production practices applied in offsite construction factories with lean construction processes implemented at project sites (Figure 3 left). Effective coordination between offsite and onsite workflows minimizes waste, optimizes production processes, and enables seamless integration across the supply chain. Achieving a transparent and responsive supply chain enhances decision-making at critical interfaces, reducing inventory costs and improving procurement efficiency.

The third insight emphasizes the need for an integrated team that facilitates close collaboration between onsite project management teams and offsite manufacturing teams. A well-integrated mechanism promotes holistic decision-making, mitigates risks associated with myopic control mechanisms, and fosters continuous supply chain innovation. Figure 3 (right) illustrates the interconnection between lean production implementation and team collaboration as essential components of the proposed supply chain integration theory.

Key enablers of the proposed theory outlines include collaborative contracting, digital integration, and cooperative organizational culture. Traditional subcontracting models shift risks to subcontractors, often hindering integration. A transparent, collaboration-driven contract framework is essential to aligning stakeholder incentives across the supply chain. Seamless coordination between offsite and onsite operations requires digital technologies to facilitate real-time information exchange, reducing communication delays and enhancing efficiency. Lastly, fostering a collaborative organizational culture promotes globally optimized decision-making, maximizing overall supply chain benefits.

The validation process of this proposed theory outlines will refine them into a comprehensive supply chain integration framework that aligns individual stakeholders' objectives with broader supply chain performance objectives. Effective supply chain integration should prioritize a balanced approach between project-based product customization and operational efficiency, flexible and collaborative contracting, comprehensive lean supply chain management practices, and a culture of collaboration. Furthermore, embedding production and operations management based on OS principles throughout the entire supply chain is essential for fully realizing the benefits of offsite construction.

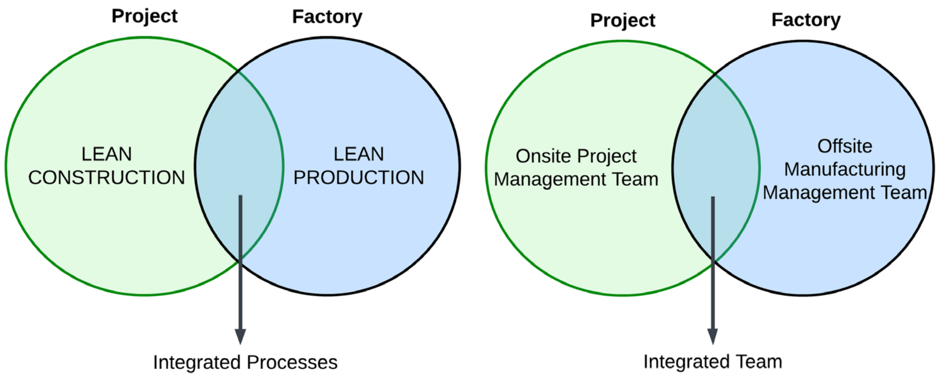

Figure 3: Integrating lean construction with lean production practices in factory (left) and cultivating team collaboration amongst supply chain participants (right).

CONCLUSION

The takeaways from comparing the supply chain integration approaches of two leading offsite construction companies propose a foundational outline for a supply chain integration theory tailored to the offsite construction industry. Further research should develop a comprehensive supply chain integration theoretical framework based on the theory outlined.

In addition, following research studies should empirically validate the proposed supply chain integration theory using quantitative methods, expand the case studies for generalization, and consider how the latest technology and relational contractual relationships can facilitate a more seamless integration. OM, OS, and production simulation methods such as discrete-event simulation are theoretical fundamentals that quantitatively validate supply chain integration theory. Expanding more case studies in the US and international will offer insights into how regulatory, economic, and cultural differences shape supply chain integration practices. Additionally, the latest technology, such as AI-powered predictive analytics and real-time decision-support systems, should be explored to enhance supply chain adaptability. Research on collaborative contract models, such as Integrated Project Delivery and performance-based contracts, can address misalignment issues. Studies on organizational culture and leadership can identify best practices for fostering incentives for supply chain alignment.

From an industry and policy perspective, enhancing project teams' experience, operational efficiency, and supply chain stakeholders' relationships through integration is essential for advancing offsite construction. Companies should invest in advanced technologies such as IoT-enabled tracking, digital twin simulations, and AI-driven analytics integrated with BIM and DfMA to improve supply chain coordination and optimize decision-making. Policymakers should establish policies encouraging data-sharing initiatives and interoperability standards to promote offsite construction supply chain efficiency and collaboration. Furthermore, the increasing adoption of automation and digital supply chain management necessitates workforce development programs integrating OM and OS principles into architectural, engineering, and construction education, driving a more efficient and globally competitive construction industry.

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