

## **Logistics Strategy for Industrialised House Building**

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### **ABSTRACT**

Construction Logistics has recently emerged as an important consideration for Industrialized House Building (IHB). Previous research has demonstrated that construction logistics improves IHB through: the clarification of interfaces along the supply chain; increased supply chain efficiency; more productive construction sites; the transfer of value-adding activities from site to the supply chain; and the integration of site and supply chain.

IHB research has commonly focused on buildings as *product*, their technical design and production, as well as the *process* of these activities. IHB companies seek the integration of these two aspects. However, there is growing realization of the value of integrating the supply chain through a focus on logistics. This paper argues that in order to achieve a tripartite integration of product, process, and logistics, that first an overarching company-level logistics strategy is required. A strategic perspective enables a separation of high-level logistics decisions from those that are operational in nature, in the same way that product platforms have assisted IHB. This separation is critical in overcoming the peculiarities of construction. This authors identify design-thinking as a powerful tool to assist in the future implementation of logistics strategy in order to drive the creation of contextually specific logistics solutions.

Two company case studies from Sweden reveal two distinct forms of logistics strategy. These case studies, through comparative analysis, show how logistics strategies for IHB might emerge as design-led 'logistics platforms' that utilize the principles of standardization, modularity, and re-usability in order to achieve the flexibility demanded by construction.

This paper proposes that a focus on IHB logistics strategy as a platform be implemented to allow effective integration of construction's supply chain. The result of this approach is a re-usable, continually improving platform for construction logistics that can co-ordinate differing product and process approaches.

### **KEYWORDS**

Supply Chain Management; Logistics; Design; Platform; Industrialised House Building

## FOREWORD

This paper has emerged from a joint research project involving the Innovation in Applied Design Lab at the University of Sydney, the Future Building Initiative at Monash University, Linköping University, and Lendlease acting as an industry research partner.

Lendlease's objective is to improve construction's supply chain through increased focus on construction logistics. To achieve this the company is implementing an over-arching logistics strategy to co-ordinate and test advances between projects. In response to this business decision, the academic research team has sought to understand the implications of generating a logistics strategy in construction, especially one that is suited to industrialised house building, specifically prefabricated timber multi-residential construction.

## INTRODUCTION

Construction is a fundamentally complex industry due to the large number of participants and interactions (Winch 2010). Recent research has demonstrated that the principles of supply chain management, particularly when focused on logistics, offer a potential means of overcoming this complexity and improving productivity (Vrijhoef & Koskela 2000), yet achieving this in practice is far from straightforward. Traditional construction, in which logistics and supply chain management are used as a late project stage 'back-end' task to manage procurement, supplier selection, issues of material handling, and site deliveries, lacks the desired integration and early planning sought by approaches such as 3D Concurrent Engineering (3DCE) (Fine 1998) that unite product, process, and supply chain. Concepts such as 3DCE are now being considered by companies that are seeking to industrialize construction. Industrialized house building (IHB), a term that incorporates all levels of prefabrication from component assemblies to modular house building, but that extends the concept to introduce a strong process-focus has lacked an historic clearly definition. In 2006 Swedish researcher, Jerker Lessing, defined effective IHB as consisting of eight aspects (Lessing 2006). Of these eight, the fifth was identified as "logistics integrated in the construction process". Lessing highlights the importance of incorporating a logistics focus in order to achieve the successful industrialization of construction, yet in practice logistics still remains at the 'back end' of projects with its integration a major difficulty.

Supply Chain Management is a relatively new concept, emerging in the early-1980s from business consultants Keith Oliver and Michael Webber, however in the decades that followed there was a lack of clarity and consistency in its definition (Harland 1996). This lack of clarity persists with the terms 'Supply Chain Management' and 'Logistics' often used interchangeably (Mentzer et al. 2008). The Council of Supply Chain Management Professionals considers logistics to ultimately be a part of supply chain management, and that rather than having a back-end focus, supply chain management should undertake a role that targets the "linking [of] major business functions and business processes within and across companies into a cohesive and high-performing business model" (Anon, n.d.). Specific to construction, a focus on logistics means, "...supplying the right materials to the correct customer and construction site to meet customers' requirements" (Janné 2018). Yet in the complexity of construction this approach is challenging. While some progress has been made, the nature of the industry and the scale of relationships involved cause barriers to progress (Meng 2013). This indicates the need for a 'big picture' view of construction logistics and supply chain management, one that is more strategic than operational in nature, focused on

integrating the whole supply chain from the outset. This approach has the capacity to guide the fundamental decisions of construction company on a strategic level, rather than them operating on a project-to-project basis.

This paper argues that because design-thinking is effective at tackling ‘wicked problems’ (Buchanan 1992), it holds the potential to engage with construction’s peculiarities and in doing so frame a new way of considering logistics strategies for construction. Design is often considered a front-end, conceptually-based engagement in a ‘soft’ sense (distinct from its ‘harder’ nature of detailed technical design) that stands in contrast to the common perceptions of logistics. Design is not just a physical, production task but can be considered a way of thinking (Simon 1969). Design-thinking, frames design as an organizational resource to be used for innovation (Rowe 1987), offers new possibilities for investigating construction logistics. Rowe established a framework for design thinking that articulated how designers engage with problems based on gut feelings not just facts, and that the process became part of the solution. This strand of research was developed over two decades later by Tim Brown (2008) who framed design thinking as a strategic business activity to generate ideas, test and prototype solutions, and ultimately implement and monitor improvements for future gains. This process was centered around a three-part investigation of the ‘desirability-feasibility-viability’ of solutions and sows the seeds for a new way of engaging with the formulation of a construction logistics strategy, distinct from the hard, mathematical models based on efficiency that dominate existing solutions.

## **METHODOLOGY**

Both applied and fundamental research approaches have been used in the work that informs this paper. As part of a broad 3-year applied research project, the researchers of this paper have been working with an Australian multi-national Lendlease that is undertaking IHB projects in Australia and elsewhere. This applied aspect of the research has acted as a vehicle to understand the existing commercial state of play, and the challenges faced by an IHB company that is seeking to implement a logistics strategy. In order to understand progress that is being made in similar situations, a more fundamental approach has also been used to develop case studies that present some ‘Lessons from Sweden’. These lessons have emerged from an ongoing research relationship developed since 2016 of the Innovation in Applied Design Lab at the University of Sydney, the Future Building Initiative at Monash University and the Construction Logistics research team of Linköping University,. The case study research drawn from correspondence and interviews from developed industry-research partnerships, and presented later in the paper as companies A and B, reveal the advances that have been achieved by two companies in Sweden that have taken a strategic view of logistics. The results show two contrasting logistics strategies for differing project-types and business models. The case studies deliver findings from qualitative, comparative analysis and provide valuable learnings that are readily transportable (Yin 2013).

## **CONSTRUCTION LOGISTICS STRATEGY**

Vrijhoef and Koskela found there to be four roles for supply chain management in construction: the interface between supply chain and construction site; a focus on the supply chain; the transfer of activities from construction site to the supply chain; and the integration of supply chain and construction site (Vrijhoef & Koskela 2000). An additional “focus on the construction site”, was

recently identified as a 5th role (Ekeskär & Rudberg 2016). These five roles of supply chain management in construction seek operational improvement through the consideration of specific moments in the supply chain in order to improve construction activities in that moment. There has been little research into an holistic view, one that is *strategic* and provides a guiding approach to inform and define logistics and supply chain management from first principles.

In order to understand how this strategic approach to logistics may be pursued and proposed, it is important to identify and consider the context that the supply chain and a project's logistical response must respond to (Janné 2018), a factor to which this paper will return in the discussion. Segerstedt and Olofsson (2010) discussed the type of supply chain involved in construction, noting the importance of matching the type of designed 'product' (single-dwelling or multi-residential building, for example), construction method (whether traditional or pursuing industrialized house building), and company's business model. Like the integration proposed by 3DCE, this integrated view added the dimension of business model. Key to this business model consideration, their work noted the emergence of product platforms in IHB in Sweden and briefly considered the supply chain implications of this platform approach. From the case studies, this paper contends that this avenue of research, concerning the use of a platform approach, holds significant potential in helping to defining a logistics strategy that can respond to design and production requirements through the principles of product platforms that will be returned to in the discussion. The case studies show how logistics strategies are emerging in companies that are industrializing (pursuing some of Lessing's (2006) 8 criteria) but not pursuing IHB explicitly or holistically. Through a focus on logistics strategy for construction, it is proposed that a new starting point for the pursuit of this integration may be established. This new approach, rather than beginning with the product design as in the cases of integration mentioned above, would begin with an holistic view of the supply chain as its guiding force.

There are surprisingly few clear definitions of what a logistics 'strategy' is, even outside of construction in its more traditional domain of manufacturing. According to the Financial Times Lexicon, a logistics strategy is "the set of guiding principles, driving forces and ingrained attitudes that help to coordinate goals, plans and policies between partners across a given supply chain." (Financial Times Lexicon, n.d.)

Bowersox and Daugherty (1987) established the first logistics strategy classification. They found three distinct bases for logistics development: process-based (that are internally-focused), market-based (externally-focused logistics packages with defined and limited activities), and information-based (involving inter-firm co-ordination). McGinnis and Kohn similarly investigated forms of logistics strategies (McGinnis & Kohn 1990). Throughout this strand of research into logistics strategy has been a continual questioning of the detail of what such a proposition contains (Clinton & Closs 1997). However, for the purpose of this initial paper the authors accept that a strategic view of logistics exists regardless of the detail of how such a logistics strategy emerges, particularly for construction, which will be addressed by this research project's future outputs.

Working to categorize logistics strategies, Autry et al. (2008) defined a them as "...directives formulated at the corporate level ... used to guide more efficient and effective logistics activities at the operational level of the organization". This highlights the important separation of logistics as a strategic activity at the company-level, compared to its implementation at an operational, or

in construction's case, project-level. In construction, logistics is often considered to be a 'nuts and bolts' activity, strongly defined by issues of procurement, supplier selection, and site deliveries. This separation of company and project echoes research of the 1990s defining product platforms and opens new possibilities for thinking about logistics within construction.

Product platforms emerged to co-ordinate the design and manufacture of consumer products, notably personal electronics and cars (Lehnerd & Meyer 1997). These platforms were developed to define common and re-usable 'assets' consisting of physical components, processes, knowledge and relationships (Robertson & Ulrich 1998). These assets form a shared platform that sits distinct from the individual product. The authors propose that this method of working, a platform approach, can be applied to logistics strategy so as to propose logistics assets that can be developed and re-used to respond to changing project types. This process of developing, re-using, and responding, we argue is assisted by design-thinking a tool that helps develop understanding of context and deriving a solution. This platform-based approach to logistics emerges from findings in two Swedish construction firms, that the authors have anonymized as companies A and B.

## **CASE STUDIES: LESSONS FROM SWEDEN**

### **Company A**

Although not operating as in IHB, company A, a commercial construction company demonstrates clearly a construction logistics 'strategy' that is focused upon a narrow 'product-type', defined as commercial office buildings in dense, urban areas of Sweden (such a similarly narrow, defined product-type is found in IHB). Their projects are typically new-builds, with some renovations, and are valued up to 500m SEK (US\$55m at January 2019). Utilising traditional construction methods, the company only undertakes a handful of projects at one time. Company A's logistics strategy is highly standardised in order to meet the pre-defined demands of these projects.

Company A demonstrates that a clearly defined logistics strategy can be put in place that responds to a fixed 'product' through a pre-defined, standardised logistics approach at the project-level. The areas of focus of this strategy are:

- Long-term strategic suppliers and sub-contractors — development of relationships for continual improvement
- Use of a Construction Consolidation Centre (CCC) — a centralised distribution centre to help manage material flows
- Integrated Planning Process — clear and related production and delivery planning
- Planning Roles — dedicated organizational management roles for: transport co-ordination, in-bound co-ordination, and IT co-ordination
- Dedicated IT System (Cloud-based) — All project participants must use this system (contractors, suppliers, transport companies etc.)
- On-site Materials Handling Team — Dedicated and specialised team for efficient materials movement and task planning

### **Company B**

Company B, a larger Swedish construction company than A, undertakes projects all over Sweden in urban and sub-urban locations. The projects that they have developed a logistics strategy for are

residential in nature and almost exclusively new-builds (again these are largely not ‘industrialised’ in their construction method, however their logistics strategy would be transportable to an industrialised setting). The structures are built using a mix of traditional and prefabricated methods, with a typical cost between 50m-300m SEK (US\$5.5m-\$33m at January 2019). Being a large company there a large number of projects running concurrently around the country.

Company B’s logistics strategy has put in place a ‘modular’ approach, meaning that a range of areas of focus are defined and then a range of solutions within these focus areas are defined for selection based upon the nature of the specific project’s context. The modules focus on:

- Understanding the detailed design requirements of a project from a logistics perspective
- Site logistics planning solutions
- Marking and labelling of goods
- Delivery planning and scheduling
- The use of CCCs or Distribution Terminals
- Planning of transport and distribution activities
- Long-term relationships with suppliers and development of these relationships

Overlaps with company A appear in the content of these strategies. However, rather than focusing on the content (that is specific to each company’s business model), instead the two approaches reveal distinct ways of approaching a logistics strategy and its implementation at the project-level.

## **DISCUSSION: A DESIGN-LED PLATFORM FOR LOGISTICS**

The case studies reveal two contrasting, yet related approaches to construction logistics. Related in the detail of their focus, they contrast in how these strategies are formulated at the company-level for implementation between projects. Company A pursues a standardized approach that is crafted to respond to a defined project-type, Company B’s ‘modular’ strategy defines a broader range of solutions that can be selected or excluded based on the specific nature of individual projects. These approaches suggest that not only is it possible to create a ‘designed’ logistics strategy that either responds traditionally to a static brief of requirements (Company A), but that there lies the potential for a logistics strategy to be formed that responds in a manner that is analogous to how product platforms have been defined to manage design and production interactions. This integrative pursuit is particularly critical as companies, such as the authors’ industry partner, pursue a comprehensive approach to IHB.

Product platforms for IHB, initially proposed by Lessing (2006), have subsequently been pursued by a number of Swedish IHB companies. The principles of the concept were assessed and adjusted for implementation within IHB by Jansson (2013), who assessed the specific design requirements of construction and how standardization and variability could be handled, distinct from traditional manufacturing platform approaches. The authors consider that a means of achieving the integration of logistics into IHB lies with the principles of these product platforms that are currently managing design (product) and production (process) for IHB companies. A focus on logistics would add an additional dimension to these IHB platforms, in line with the concept of 3DCE.

Case studies A and B show how construction logistics strategies emerge in response to specific contextual factors. This context extends beyond the physical construction site and includes factors that are related to the specific business models of the companies themselves, responding to their technical platform (construction method), their product offering (type of building), and target market (customer profile or budget), in line with Brege et al.'s (2014) definition of IHB business models. However, the primary challenge in developing a platform-based logistics strategy lies in how to generate re-usable modular solutions, such as those demonstrated by company B. These modules must respond to the context of a business model, as well as be flexible so as to be able to respond to each project's context. Design has been shown to drive increased value from such contextual interaction. This contextual value comes from projects' response to social and cultural concerns, as well as the environment and economic drivers (CABE & Macmillan 2006).

The authors contend that construction logistics strategies benefit from design-thinking in order to understand the complex range of issues at play in construction's business and project context. This view, sees design not as a physical task but simply a way of thinking (Simon 1969). Design-thinking is effective at responding to problems that are considered 'wicked, or stubborn and complex in their nature (Buchanan 1992). Fundamentally, design-thinking is founded upon an empathetic engagement with a problem, collaborative and integrative working processes that not only analyze situations but understand them holistically, so that ideas can be tested, prototyped, and improved (Brown 2008).

## **CONCLUSION**

Case Studies A and B reveal the possibilities of a strategic approach to construction logistics. These approaches establish a spectrum that at one end responds in a standardised manner to a pre-determined design solution (as in A) and at the other uses a re-configurable modular approach (as B shows). Existing IHB platform approaches, similarly exist along a spectrum of standardisation and variability, and so these logistics approaches show an opportunity to mesh with these existing IHB platforms to create logistics-focused platform assets. The generative process that is required for this next step will benefit from design-thinking. Design not only helps to understand and respond to the context of a specific project but can also be used strategically to evaluate the context of a business' operations. In seeking to define a logistics strategy for IHB, the authors contend that design-thinking can help to understand and document business and project contexts in order to map their respective interfaces. In doing so, this understanding can then be documented and organised into modular solutions that define a logistics platform approach. Such an approach for IHB would result in an integrated, re-usable, and flexible logistics strategy that can adapt to the changing nature of construction, and that would importantly be focused on continual improvement.

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