

Industrialised Building System (IBS) Construction Supply-Chain Strategies of Malaysian Contractors

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Abstract

Industrialised Building System (IBS) is the term coined by the industry and government in Malaysia to represent the adoption of construction industrialisation and the use of prefabrication of components in building construction. Despite acknowledging its benefits, the construction industry is still not rapidly embracing IBS. Fragmented and disconnected construction supply chains are the leading causes of low construction performance and limited uptake to IBS construction. The purpose of the paper is to identify supply chain strategy of contractors involves in IBS construction. The paper uses case study as research methodology and the analysis is based primarily on cross-case investigation and pattern matching. The main part of this paper is presentation and discussion of case studies with contractors in Malaysia. The case studies show that the IBS supply chain requires close control of materials and resource management to ensure continuity and timely delivery of construction components at site. The case companies involve heavily in the production of IBS components and practices closed supply chain. The supply chain is managed in a manner that allows the contractors full control of the process with the intention to improve efficiencies and competitiveness. As the way forward, this paper suggesting contractors to adopt partnering initiatives, and embrace open collaborative environment to be competitive. In addition, Information Technology (IT) tools such as Building Information Modeling (BIM) can be useful to support collaborative supply chain.

Keywords

Industrialised Building System (IBS), supply chain, strategy, Malaysia, contractors

1. Introduction

Industrialised Building System (IBS) is the term coined by the industry and government in Malaysia to represent the adoption of construction industrialisation and the use of prefabrication of components in building construction. IBS is defined as a construction technique in which components are manufactured in a controlled environment (on or off site), transported, positioned and assembled into a structure with minimal additional site work (Hamid *et al.*, 2008; CIDB, 2007; CIDB, 2005 and CIDB, 2003). It consists of precast component systems, fabricated steel structures, innovative mould systems, modular block systems and prefabricated timber structures as construction components (CIDB, 2003). Parts of the building that are repetitive but difficult – and too time consuming and labour intensive to be casted onsite – are designed and detailed as standardised components at the factory and are then brought to the site to be assembled (CIDB, 2003). The onsite casting activities in IBS utilise innovative and clean mould technologies (CIDB, 2007; CIDB, 2005 and CIDB, 2003). The construction industry has started to embrace IBS as a method of attaining better construction quality and productivity, reducing risks related to occupational safety and health, alleviating issues for skilled workers and dependency on manual foreign labour, and achieving the ultimate goal of reducing the overall cost of construction. Apart from this, it offers minimal wastage, fewer site materials, a cleaner and neater environment, controlled quality, and lower total construction costs (Pan *et al.* 2008, Hamid *et al.* 2008 and Pan *et al.* 2007).

2. Problem statement

Despite acknowledging its benefits, the construction industry is still not rapidly embracing IBS. The construction industry is an established industry with many deep-seated and culturally-embedded practices, so the introduction of anything perceived as new or different faces barriers. Fragmented and disconnected IBS construction supply chain is one of the leading causes of the limited uptake to IBS (Hamid *et al.* 2008). The current state of the supply chain is fragmented and underpinned by poor communication, adverse relationships and lack of trust and commitment (Hong-Minh *et al.* 2001) and the relationship between parties has been driven by the cost agenda (Wood and Ellis, 2005). These issues are attributed to the industry's involvement in a variety of separate and interdependent parties in the entire process. It is well known by the adopters that the IBS procurement process is slightly different from conventional methods which include purchasing of materials in advance before the actual site progresses (Whelan, 2008 and BSRIA, 1998). In addition, the design of IBS construction project might requires designers to consider the ease to fabricate and to install the components but the common practice shows that contractors and manufacture of IBS components is involved only after the tender stage of the value chain. This lack of integration among relevant players in the design stage has resulted in a need for redesign and additional costs to be incurred if IBS is adopted (Hussein, 2007 and Hamid *et al.* 2008). The adopters are also in need to integrate the key business processes in the supply chain from the end user as a result of high demands on logistical activities in IBS construction (Hong-Minh *et al.* 2001; Venables *et al.* (2004) and Goodier and Gibb, 2004) and solve the problem related to complex interfacing between systems and ensure efficient process sequences (Pan *et al.* 2007; Na, 2007; Na and Liska, 2008; Haas and Fangerlund, 2002). Therefore, there is a desperate need of a new approach in supply chain to improve IBS construction delivery system.

3. Literature Reviews

To date there has been no one commonly-accepted or agreed approach or strategy for contractors to manage IBS construction supply chain. However, there are a few recommendations have been highlighted by researchers who studied into this area previously were found through literature. Malik (2006) suggested that the supply chain in IBS construction needs to be managed in a manner that allows the constructors full control of the process with the intention to improve efficiencies and competitiveness. It consists of planning and management of all activities including procurement, conversion, logistics and coordination between contractors, suppliers, intermediaries and third party solution providers within and

across the company structure (Malik, 2006). BSRIA (1998) recommended that the supply chain effort includes attention to detail management of all stages, enabling correct and timely information to be available. It should extend beyond the simple exchange of materials or services (commodity supplier) and instead act as a strategic partner to integrate the design, distribution, marketing and knowledge exchange (BSRIA, 1998). The strategic alliance and partnering on the supply chain providers need to be adopted to address the fragmented supply chain in the construction industry (Pan *et al.* 2007). With this approach, all the key suppliers and contractors are employed by clients or developers for a number of years, and for several projects (Kamar *et al.* 2009; Pan *et al.* 2008; Pan *et al.* 2007 and Gibb, 1999). Partnering with suppliers and manufacturers from the early stages was significant to ensure efficient and timely delivery of components at site (BSRIA, 1998; SCRI, 2003 and Sanderson, 2003). It enables early involvement from contractors, specialist subcontractors and manufacturers to achieve the agreed objective through a team effort (BSRIA, 1998).

4. Research Methodology

The paper uses case study as research methodology. The case study is used to present the strategies used by contractors in Malaysia to manage their supply chain in IBS construction projects. The analysis is based primarily on cross-case analysis and pattern matching technique. In the case study, semi-structured interviews were designed and used to obtain detailed, complex answers from the interviewees, to clarify unclear answers. A list of a few open-ended questions were arranged in a reasonably logical order and were emailed to the interviewees a week or so in advance. This would offer them comfort of the pre-planned questions and reasonable time to think of the issues. All of the semi-structured interviews were carried out with selected respondents who are senior managers and site personnel. The rigid selection of cases is the key success of the case study research (Yin, 2003). This is also supported by Eisenhardt (1989), as the cases may be chosen to replicate previous cases or extend emergent theory, to fill theoretical categories and to provide examples of polar types of result. The context and scope of this research is on Malaysian contractors classified under the G7 classification, registered under the Construction Industry Development Board (CIDB)'s registration scheme. Being large, the G7 contractors will most probably take the lead in the domestic construction industry and eventually will influence the overall constituents of the industry to change from conventional to IBS. The G7 contractors sub-contract a large amount of the contract to smaller contractors, thus creating work demand in IBS and influencing further adoptions. The G7 contractors also employ the largest group of professionals, where their perspective towards IBS is worth being measured.

4. Case Study Report

Company A was formed on 18th March 1981 to undertake this task under the management and purview of the state government economic development cooperation. The company has established under joint venture agreement with construction firm from Germany (Praton Haus) to produce pre-fabricated houses on plots of land provided by the government in town centres and surrounding suburbs. The company headquarter is located in Shah Alam, the capital city of Selangor. Based on their smart partnering agreement with Praton Haus, they built and operated a very modern prefabrication yard at Shah Alam using Praton Haus's belt conveyor and semi-automatic precast production from 1981 to 1991. According to the company, the supply chain in IBS construction requires close control of materials and resource delivery. It was observed that the supply chain in this company being managed effectively and the company has produced almost all their building components in closed supply chain approach. On 31st March 1990, the company successfully set up a factory to manufacture roof tiles in Salak Tinggi, Sepang – under the Estee Tiles trademark – for the supply of their housing construction. In 1993, the company established P & M Concrete Sdn Bhd, a joint venture with Mega Pascal Bhd to produce ready-to-use concrete. The establishment of these companies is important in closing the loop in the supply chain. However, the company has to deal with manufactures of doors, windows and other components suppliers which were manufactured in-house. They also managed installers and Mechanical and Electrical (M&E)

specialists. The company has a comprehensive system to pre-qualify its subcontractors and suppliers which determines only experienced and knowledgeable suppliers and sub-contractors to be selected. A feasibility study to determine appropriate suppliers and sub-contractors was conducted. The close and integrated supply chain and careful selection of suppliers and sub-contractors give greater efficiency to the company and lead to more economical construction of buildings.

Company B was incorporated in August 2001 under a holding company and made its first modest business forays in the trading of fertilizer and supplying products to the government and private organisations. The company headquarters is based in Kuala Lumpur and it has a workforce of 80 personnel with an annual turnover of RM 10 million. The company's authorised capital is RM 10 million, of which RM 6.0 million is fully paid up. The holding company has established as a one-stop centre for IBS providing a wide range of products and services from design to installation with the capability of providing turnkey services. According to the company, the supply chain in IBS construction requires close control of materials and resource delivery. It was observed the company practiced close supply chain and used components manufactured by their own subsidiary. However, the company also purchased non-critical components from suppliers. Though the company had not formally set any partnering initiatives at the company level, it did maintain long-term strategic relationships with a number of specialists, suppliers and sub-contractors through partnering and joint venture initiatives at the project level. In 2010, the company set up a joint venture agreement with local construction company in Sarawak to set up prefabrication facility in Kuching. This is a new venture to cater demand of IBS in East Malaysia region. It was also claimed that the company has established a good working condition with suppliers of windows, doors and other building elements which the components were not produced in house. Although the company would not interfere with the supplier's aspiration and creativity, the company would still give them advice in terms of constructability and modularity.

Founded in 1996, Company C has an annual turnover is in excess of RM 10 million. The company headquarters is in Klang, about 70 km west of Kuala Lumpur, near Port Klang, and their prefabrication yard is located at Rasa Industrial Park, 60 km north of Kuala Lumpur. The company has established themselves as a one-stop centre for IBS providing a wide range of products and services from design to installation with the capability of providing turnkey services. In the supply chain, the company strategy is to manage the entire supply chain activities in a close system, including the design, manufacturing activities, installation and manufacturing of the moulds. Nonetheless, the company has to deal with manufactures of doors, windows and other components suppliers which have not been manufactured in-house. The company looks for a corporate model that creates benefits for both parties involved in the supply chain exchange of materials and services. Close collaboration with suppliers and sub-contractors from the earliest project stages can be vital to ensure efficient and timely delivery of components and services. In 2007, the company embarked on a partnership agreement project client to construct 2,000 units of bungalows in Shah Alam over a period of three years. The construction will commence in three phases. This partnership is important to secure sufficient demands and volume to justify their investment in IBS. Ability to discuss options and aspects with client throughout the project is also highly beneficial. This allows the company to plan in advance and optimise their production. The partnership also improves project performance.

6. Analysis and Discussion

It was observed that the supply chain in IBS construction requires close control of materials and resource delivery. The nature of the IBS construction itself requires close integration and cooperation among stakeholders with regard to the upstream and downstream relationship of the project delivery system. Therefore, the case companies as observed are not limiting its role as conventional contractor or assembler. The case companies operate manufacturing facility owned by themselves or by their holding company. The companies established themselves as a one-stop centre for IBS providing a wide range of

products and services from design to installation with the capability of providing turnkey services. The close system approach allows the companies to manage and control their supply chain effectively.

The case companies also invest in and sometimes invent systems, and do not just depend on existing manufacturers. The in-house production capability to supply in their project is important and is perhaps decisive factor for successful project delivery, since profit distribution is not the same as in the conventional method. Unlike in the conventional project, an IBS contractor operating without the manufacturing capability is required to purchase components from other manufacturers and this has put away a huge amount of the contract sum from them. As a result, the contractor was left to work on a very thin profit margin. The price of components was also easily manipulated by the suppliers. By acquiring manufacturing capability, one can have control of the process, and the wealth distribution can be adjusted accordingly across IBS projects embarked upon by the company. The case companies or their subsidiaries play the role of designer, producer and installer of an IBS proprietary system across the supply chain. This can only be done by having all the activities to be conducted in-house, in one link of subsidiary companies and in a close system. Although no partnering has been initiated in their supply chain, companies still maintain good relationships and work in collaboration with other manufacturers and suppliers who produce or deliver other services and products which they did not produce in-house. A close relationship suppliers and sub-contractors from the earliest project stages can be vital to ensure efficient and timely delivery of components and services. This was previously highlighted in Malik (2006), BSRIA (1998), and Pan *et al.* (2007) and Pan *et al.* (2008).

Management of supply chain as observed in all cases, in fact requires very careful definitions and management of interfaces between contractors and suppliers and good communication channels. This includes attention to detail from management during all stages of the supply chain, enabling correct and timely information to be available. It also involved comprehensive system to pre-qualify its subcontractors and suppliers which determines only experienced and knowledgeable suppliers and sub-contractors to be selected. Collaboration and joint venture agreement create opportunities for sharing knowledge and new innovative ideas to be incorporated into new building systems of IBS in Malaysia as in the case of Company A and Praton Haus. Company A starts their trade by doing joint venture or partnership agreements with international firm. This has accelerated the company learning curve. Effective knowledge sharing is an important element in the knowledge manipulation process in construction industry which has been identified as a vehicle for technology transfer between foreign and local companies. Although there are no direct transfers technologies to the partner company, such partner could learn the transferred technology during construction stage and later internalises the knowledge learned into their own organisation. In Company B, collaborative practices has suited the company and a small local firm in Sarawak, allowing numerous opportunities to improve their conduct of business such as wider diffusion of products without costly physical presence in the markets, risk and reward sharing, resource pooling, reduction in the coordination and transaction cost, ability to concentrate on core competency and rapid response to market needs. A supply chain partnership with clients as observed in Company C is also significant as it improve project performance and allows the company to plan in advance and optimise their production.

However, appropriate supply chain training programs, especially skills to manage the supply chain process, have been missing in each case company. Lack of initiatives in promoting values throughout the value chain has also been recognised as one of the important issues. It was also observed that all case companies have yet to fully utilise Information Technology (IT) at the maximum level where the utilisation was only limited to accommodate design activities. No IT tools have been observed to have been used in either logistics or supply chain activities.

7. The Way Forward

The following recommendations have been derive to assist IBS contractors in managing their supply chain:

a) To adopt partnering strategies in supply chain

- Strategic partnering has suited both large and small firms allowing numerous opportunities to improve their conduct of business such as wider diffusion of products without costly physical presence in the markets, risk and reward sharing, resource pooling, reduction in the coordination and transaction cost, ability to concentrate on core competency and rapid response to market needs. Supply chain partnering is essential for construction to address the entire lifecycle of the construction product and take account of not only primary functionality but also productivity, buildability, serviceability and even recyclability.
- Supply chain partnering creates opportunities for sharing knowledge and new innovative ideas to be incorporated into new building systems in Malaysia. Effective knowledge sharing is an important element in the knowledge manipulation process in construction industry which has been identified as a vehicle for technology transfer between foreign and local companies.
- Supply chain partnering is beneficial in implementing new and unfamiliar technological approach. The IBS construction approach require a lot of knowledge in terms of technological and innovation in the construction process. This factor is also important to those industry players who are not familiar with the IBS method to merge with experienced contractors through a partnering approach. The other factor is risk and profit sharing amongst partners could be shared in a collaboration or partnership. The contractor can attempt to own the prefabrication technology by devising a special relationship with one or more prefabrication sub-contractors, such as project –based joint venture, vertical integration or even internalisation.
- Supply chain partnering facilitates just in time delivery of material on site by initiating upstream and downstream relationship between players. Without this, IBS projects may not be able to be delivered on time, within the cost and at the stated quality.

b) To create IBS cluster, consortium and integrated team

- The contractors might consider creating an IBS cluster, consortium or integrated team by creating a partnership when and where it is needed. The positive integration of supply chain has become a major factor in delivering successful construction projects. The integrated team brings together a series of different organisations consisting of IBS key players (client, designer contractor, and specialist/manufacturer), which is linked by a flow of practices, information, financial, and contractual relationships. This is to allow them to work together toward design and construction practices within the context of the project procurement delivery arrangement approach with the same common goals and objectives.
- The cluster or consortium integrates people, systems, business structures and practices into a construction process. In contrast to the traditional construction practice, the team members the team members are demanded to work together in concurrently either in making a decision process or when trouble arises throughout of design, fabrication, and construction phases. This approach will help to create a new environment within which IBS can flourish in a much shorter time and create more integrated and capable supply chain.

c) To utilise Information Technology (IT)

- The advancement and explosion of Information Technology (IT) driven by the liberalisation of global economies has also tremendously facilitated and improved the supply chain

relationship with borderless connectivity. Through the use of IT, companies enhance their collaborative activities, keep all parties up to date regarding the progression of the project and also help in solving problems at site regarding the supply chain.

- With the use of IT in supply chain, the industry can facilitate the information dissemination all along the supply chain, and this the chain itself can move as a coordinated entity to anticipate any problems and contribute towards the completion of the project on time.
- The utilisation of Building Information Modelling (BIM) should be encouraged. BIM is used throughout the design, delivery and lifecycle of the project to manage coordination down to fabrication level detail.
- BIM improves accuracy and effectiveness of cost control resulting from precise, real-time quantity management linked directly to project design and fabrication information in the BIM process. Fully interconnected collaborative project teams with full-time, real-time access to all information about project pro-forma, life cycle design, supply chain and mode of delivery, can bring about improved life cycle outcomes in the built environment
- BIM also enables collaborative concurrent design which improves communication between the project team and supply chain and enables enhanced modes of innovation. The 3 dimensional BIM elements can be used to simulate and optimise the delivery sequence, thereby reducing time and risk in the delivery.

8. Conclusion

The current state of the supply chain in the construction industry is fragmented and underpinned by poor communication, adverse relationships and lack of trust and commitment and the relationship between parties has been driven by the cost agenda. In addition to the above, the construction industry possesses a unique nature where most of the construction projects are short term and non-repetitive. It differs from manufacturing and automotive industry in which routine tasks are commonplace. Thus, it is difficult to practice good supply chain in consistent manner. However, the supply chain in IBS requires close control of materials and resource delivery. The case studies show that the IBS supply chain requires close control of materials and resource management to ensure continuity and timely delivery of construction components at site. The case companies involve heavily in the production of IBS components and practice closed supply chain. The supply chain is managed in a manner that allows the contractors full control of the process with the intention to improve efficiencies and competitiveness. As the way forward, this paper suggests contractors to adopt partnering initiatives, and embrace open collaborative environment to be competitive. In addition, Information Technology (IT) tools such as Building Information Modeling (BIM) can be useful to support collaborative supply chain. Partnering with suppliers and sub-contractors from the earliest project stages is vital to ensure efficient and timely delivery of components and services. The contractor also partners with overseas partners to acquire the technologies and know-how. Partnering with established IBS companies at the beginning will cut the learning curve and partnering with clients will significantly improve project delivery. IT tools such as Building Information Modeling (BIM) can be useful to support collaborative supply chain. Therefore, the application of IT tools needs to be utilised in a more widespread manner, in order for the IBS industry to improve efficiencies, productivity and reliability of delivery particularly in supply chain perspective.

As IBS construction is a new industry in Malaysia with an endless market, one must no longer feel threatened. Instead, one needs to start strategising and capitalise market positioning in this new playing field that have been created to spur our growth. It is time now to induce an open collaborative business environment which can be mutually benefiting to the industry and the nation as a whole. Future empirical studies should extensively examine these areas, especially the integration of supply chain players with the procurement process and its implementation. A framework of supply chain and partnering strategy for IBS construction should be developed. The framework could help to accelerate the uptake of IBS method in Malaysia.

9. Reference

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