Supply Chain Strategy for Contractor in Adopting Industrialised Building System (IBS)

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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 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 limited uptake to IBS. The purpose of the paper is to examine supply chain strategy for contractors in adopting IBS. The paper uses case study as research method. The analysis is based primarily on cross-case analysis and pattern matching technique. The paper observes that IBS supply chain requires close control of materials and resource management to ensure continuity and timely delivery of construction components at site. 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. The case companies involve heavily in the production of IBS components and practices closed supply chain system. To manage the supply chain, contractors need to adopt partnering initiatives and embrace open collaborative environment. In addition, Information Technology (IT) can be useful tool to support collaborative supply chain and improve information flows.

Key words: Industrialised Building System (IBS), supply chain, strategy, Malaysia, contractors.

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).

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 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 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. In general, contractors are organising suppliers and sub-contractors in vertical chains and playing them against each other in search of the lowest short-term costs as a results of which the horizontal flow of information between suppliers-particularly with regard to advances in productions techniques-is blocked. It is also well known that 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 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.

**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 literatures. 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 important 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).

**Method:**
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 extent 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 the largest class in term of capital, 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.

**Case Study Report:**
Company A was formed on 18th March 1981 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 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 and M Concrete Sdn Bhd, a joint venture with Mega Pascal Bhd to produce ready-to-use concrete.
The establishment of these companies was important at that time 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 not manufactured in-house. They also managed installers and Mechanical and Electrical (M&E) specialists. To manage this issue effectively, the company has developed a comprehensive system to pre-qualify its subcontractors and suppliers which determines only experienced and knowledgeable suppliers and subcontractors 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. 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 requires close control of materials and resource delivery. It was observed that 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 collaboration at project level. In 2010, the company set up a joint venture agreement with local construction company in Sarawak to set up prefabrication factory in Kuching, Sarawak. 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 even to the 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. Ability to discuss options with suppliers 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.

RESULTS AND DISCUSSIONS

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 but 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.

There is also evidence that the case companies invest in and sometimes invent systems and do not just depend on existing manufacturers. The case companies or their subsidiaries play the role of designer, producer and installer of an IBS proprietary system across the supply chain. There is evidence that in-house production capability is a decisive factor for successful project delivery. 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, contractor can have control of the process and the profit/loss is more predictable and can be adjusted accordingly across IBS projects embarked by the company.

Although no official partnering agreement 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 services and products. 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), BSRJA (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. Company A developed and implemented a comprehensive system to pre-qualify its subcontractors and suppliers which determines only experienced and knowledgeable suppliers and subcontractors 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. This has accelerated the company’s learning curve. Although there are no direct transfers technologies to the partner company, such partner could learns 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 East Malaysia, 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.

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. 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. IT tools have not been used in neither in logistics nor in the management of supply chain activities.

The Way Forward:

The following recommendations have been derive to assist 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. Supply chain partnering is beneficial in implementing new and unfamiliar technological approach as in IBS. 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 or consortium of 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 and encourage horizontal information flows. In contrast to the traditional construction practice, 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 Implement Co-Makership Agreement (Vrijhoef, 1998):

The establishment of co-makership relationships between a main contractor, subcontractors and direct suppliers is very well possible and could be rather beneficial in IBS. The reduction of the number of direct
suppliers and subcontractors will reduce the span of control of a main contractor considerably. In theory, co-makership focuses attention on bilateral client-supplier relationships existing between two neighbouring supply chain participants, particularly between an assembler and a supplier. Co-makership aims to establish a long-term collaborative relationship in order to make mutual efforts to reduce lead times, inventories, quality defects and total costs and emphasises collaborative realisation and delivery of a product jointly by an assembler and a supplier. Therefore, co-makership requires early, close and intensive involvement of a supplier into an assembler’s processes and operations based on mutual trust, commitment and support. Co-makership implies the transition of a supplier to become a co-maker exceeding the level of an ordinary supplier who has to deliver along detailed and prefixed specifications. Instead, a co-maker is involved actively in the design, development and production of products. Therefore, it is important that a co-maker achieves the status of most-favored supplier with high-standard capabilities. In order to keep up that status, the assembler needs to acknowledge the responsibility to support and develop the co-maker as it were its own business unit.

**d) 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 facilitates 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 supply chain. BIM also enables collaborative concurrent design which improves communication between the project team and supply chain and enables enhanced modes of innovation.

**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. In differs from manufacturing and automotive industry in which routine task are commonplace. Based on this study, there is evidence that the supply chain in IBS requires close control of materials and resource delivery. The case studies show that this is important to ensure continuity and timely delivery of construction components at site. As a result, the case companies involved heavily in the production of IBS components and practices closed supply chain. The supply chain is managed in a manner that allows them to have 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 and improve information flows.

**Future Research:**

Finally, some directions for further research have been indicated. Future empirical studies should extensively examine the integration of supply chain, lean construction, just in time principal, readiness of industry to adopt BIM, co-makership and partnering issue. A framework for supply chain and guideline to adopt partnering strategy in IBS should be developed. The framework and guideline could help to accelerate the uptake of IBS method in Malaysia.

**REFERENCE**


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