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A Review of Supply Chain Management in IBS Construction Industry: Challenges

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Abstract: A literature review has been made on Supply Chain Management (SCM) in IBS based on a computer-assisted literature search. In addition, a few simple approaches have been made to clarify the matter. The following conclusions are drawn: supply chain management is found to be tools that able to solve and improve the current implementation of IBS but however, there still challenges arise that hinder its implementation in the IBS industry. Therefore, this study aims to highlight the key challenges in implementing SCM in IBS construction industry by revisits study from the previous researcher. From the review, even SCM implementation is said as an effective tool in pursuing IBS implementation it is still a lack of study on finding SCM challenges that hinder successful implementation of IBS by the previous researcher.

Key words: Supply Chain Management (SCM), Industrialized Building System (IBS), construction industry, IBS challenges, SCM challenges, implementation

INTRODUCTION

Supply chain management in IBS is described as a network of commitments which comes out from successive conversations for action. These commitments and conversations are being carried out in the critical phase of IBS construction supply chain. Yunus and Yang (2012) categorized the critical phase of IBS construction supply chain into pre-construction phase (e.g., defining project scope, identifying resources, developing project budget and schedule, identifying risks) construction phase (e.g., execution of project plan) and post-construction phase (e.g., project evaluation, identifying and documenting lesson for better performance on future project).

In a thorough study on IBS pre-construction phase, the central problems found were defined as: "IBS projects are complex and form from various separated components in which numerous designers and sub-designers are needed to deliver design phase of the projects and thus because of participants from this multi-disciplines, conflicts, incon-sistencies, mismatches and misunderstanding have arisen between them" (Delfani *et al*., 2016). In these words, this indicates that conversations for action were either ineffective or missing altogether in the coordination among the participants. In the construction phase, Jabar *et al*. (2013) have concluded that from the literature research it shows that there are twenty eight issues that concerning of IBS project management in the construction phase. The issues referred directly and indirectly to insufficient commitment, coordination and communication such as failures to inform about schedule changes, inaccurate design information, late updating required information, reluctant to accept other's opinion, late confirmation of deliveries and lack of feedback procedures (Mohammad *et al*., 2014). Regarding on post-construction this is the final phase of IBS construction where the designers should consider the service life of IBS buildings and minimize whole-life costs to prevent problems in the constructed building (Yunus and Yang, 2012).

Implementation of IBS is said to be an effective system to provide better performance in construction industry but establishing integration is still the greatest challenge on it due to the lack of supply chain procurement practices (Kamar *et al*., 2009). Blismas and Wakefield (2009) also mentioned that delivering successful IBS approach requires managing the entire supply chain. This also had supported by Mentzer *et al*. (2001) that supply chain integration is important in any situation.

Over a long period ago, building information modelling or BIM also have been introduced as a technology and process to encourages integration and

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close collaboration among project stakeholders. Khalfan *et al.* (2015) had mentioned that the rules of construction supply chain also can be improved using BIM. Since the integrated project delivery can be achieved through collaboration between the design team, procurement, assets management, construction and knowledge management, implementation of supply chain management with the use of BIM may improve coordination of supply chain. In addition, using information technology tools like BIM can be useful to support collaborative supply chain and improving information flows (Kamar and Hamid, 2011).

MATERIALS AND METHODS

SCM challenges in IBS industry: IBS supply chains are facing with the problem of fragmentation and adversarial relationships among players towards adoption and integration of IBS in construction industry. Mohammad *et al.* (2014) had reported that eight subfactors of IBS supply chain management challenges are attitude and relationship, communication and information, contractual and procurement, financial matters, guidelines and requirements, lack of skills and knowledge understanding, technical matters and risk and conflict liability. In addition, Shukor *et al.* (2011) also had found that communication and information, specifically, lack of planning and early involvement, financial matters, knowledge and understanding, risk liability and attitude and relationship are among the challenge factors that hinder successful integration among IBS players. Shukor *et al.* (2011) reveal that role and responsibility, understanding the knowledge, risk liability, financial and contract matters and attitude and relationship are the challenge factors that hinder the successful integration between the contractor and other related parties. Nawi *et al.* (2010) mentioned that problem with project supply chain process (e.g., Lack of integration in design, construction and production process) as a part of the IBS adoption barrier in the construction industry. Table 1 shows the factors and components of SCM challenges in IBS according to researcher's justification.

Table 1: Summarization of SCM challenges in IBS

Factors	Components
Attitude and relationship (Mohammad *et al.*, 2014; Nawi *et al.*, 2010; Ankomah *et al.*, 2015; Wilding and Humphries, 2009)	Lack of trust; less transparent; arrogance; reluctant to change; no respect; blame culture; poor relationship; self-interest
Communication and information (Mohammad *et al.*, 2014; Shukor *et al.*, 2011; Ankomah *et al.*, 2015; Akintoye *et al.*, 2000)	Lack of cooperation; poor information control; misunderstandings; lack of collaboration; poor communication
Contractual and procurement (Mohammad *et al.*, 2014; Akintoye *et al.*, 2000; Salleh *et al.*, 2014)	Poor organization; lack of commitment from top management
Financial matters (Mohammad *et al.*, 2014; Shukor *et al.*, 2011)	Payment method
Guidelines and requirements (Mohammad *et al.*, 2014; Shukor *et al.*, 2011)	Design mistakes; absence of code of practice; professional indemnity
Lack of skills and knowledge understanding (Mohammad *et al.*, 2014; Shukor *et al.*, 2011)	Lack of knowledge and expertise; lack of training
Technical matters (Mohammad *et al.*, 2014; Shukor *et al.*, 2011)	Resist innovation; lack of planning and early involvement
Risk and conflict liability (Mohammad *et al.*, 2014; Shukor *et al.*, 2011)	Design and supervision issue

RESULTS AND DISCUSSION

Key challenges factor and attributes on scm in IBS construction industry: IBS construction industry differs from the conventional method of construction since IBS is a pre-fabricated component which is manufactured in the factory and then will transport to the construction site for the installation process. Due to this process, the role of the contractor may fully reverse from the builder to the installer. The contractor also plays an important role where they need to integrate with suppliers and manufacturers to ensure project delivery and to meet other requirements from client.

Thus, SCM system is applied to resolve this scenario. However, the implementation of SCM had faced challenges that hinder the effectiveness and efficiency of this system. The challenges arise in implementing SCM in IBS industry is summarized as due to attitude a relationship among stakeholders, the ineffective flow of communication and information, contractual and procurement issue, financial matters, guidelines and requirements, lack of skills and knowledge understanding, technical matters and risk and conflict liability.

Attitude and relationship: Attitude and relationship are referring to the personal working attitude of IBS players representing their individual's degree of like or dislike for work. Nawi *et al.* (2014) mentioned that having excellent personal working attitude may create a powerful motivator of group performance including commitment, continuity and positive self-improvement. Currently, according to the Shukor (2011) there is no respect, understanding and commitment among IBS players. Thus, it is important to have an excellent personal working attitude in other to collaborate well with another team member. In addition, avoiding blame culture among team member also may help in improving supply chain integration for successful project delivery. The elimination of "blame culture" may

decrease integration among participants to enhance project procurement and project delivering process (Nawi *et al*., 2016; Baiden, 2006; Baiden *et al*., 2006).

Communication and information: In IBS construction, communication is very important since often construction problems arise is due to communication problem. The efficiency and effectiveness of the construction process may strongly depend on the quality communication among the project team. Baiden *et al*. (2006) mentioned that high communication and collaboration among stakeholders towards a mutually beneficial objective is required to achieve fully integrated supply chain among construction players. In IBS construction, this industry has been heavily criticized for poor communication, lack of cooperation and collaboration, misunderstandings and poor information control among design and construction team (Kamar *et al*., 2009).

Contractual and procurement: The team delivery has a single focus, objective and responsibility towards project may increase the effectiveness of supply chain between players (Baiden, 2006). Salleh *et al*. (2014) also mentioned that the challenge in promoting SCM in the construction industry is the less understanding of SCM among the top management. Usually, top management only pays attention to the supply chain when they want to cut costs or when something is wrong and thus reduce integration among players.

Financial matters: Shukor *et al*. (2011) reported that to improve IBS project delivery and enhance the relationship between client and contractor the client should trust the contractor and make improvement in their method of payment. Currently, the progress payment of contractor only being paid by the client once the materials are already on site, thus this becomes one of the obstacles for the contractor since they must pay huge amounts of payment at the initial stage for manufacturers to proceed with the precast components. In this case, normally the contractor may apply for a bond as a guaranteed source of finance for their company but some of the contractor especially who are new in the industry, failed to acquire the bond and thus affect the project delivery process (Nawi *et al*., 2010).

Guidelines and requirements: Rahman and Omar (2006) mentioned that no standard design or guidelines on the IBS building materials and installation methods system have led to the low quality of final products. According to Shukor *et al*. (2011) lack of integration among relevant IBS players in the design stage has resulted in the need for plan redesigning and additional costs incurred if IBS is adopted. As IBS is a tailor-made component, it is essential for IBS industry to develop a standard plan and standard component drawing for standard use.

Lack of skills and knowledge understanding: Lack of understanding of the concept that applied within IBS and non-integration among IBS team players may hinder successful implementation of IBS in the construction industry. As different from the traditional construction method, IBS approach is an ideal conceptualization and simplifying construction work where knowledge understanding is very important to deliver successful of IBS delivery.

All the participants in IBS industry especially designer should be familiar with and understand IBS manufacturing systems such as the way of working, layout dimension and the limitation of the system (Shukor *et al*., 2011). IBS is not limiting the idea of participants but more integrated design skills and understanding are required to ensure system interfaces are managed and designed for production, erection and performance (Blismas and Wakefield, 2009). In addition, any changing in design after pre-construction phase may require a lot of further adjustment which may result in the rise of initial time and cost for the proposed project.

Technical matters: Lack of planning and early involvement from contractor and IBS manufacture at design phase has become one of the main barriers to implementing IBS due to the lack of integration between design and construction phase of the project. Usually, contractors and manufacturers only involved after the design phase which makes them unable to contribute their opinion on the design and construction aspects of the system (Shukor *et al*., 2011). Due to this traditional approach implementation, problems such as delay, an increase in lead time and late supply of material had arisen in construction process (Baiden, 2006; Jha and Iyer, 2006; Vrijhoef and Koskela, 1999; Evbuomwan and Anumba, 1998; Love *et al*., 1998). IBS requires the most coherent structure of process planning and control from start to the end of the project to reach the goals and reduce defects and errors (Warszawski, 1999). Thus, providing an equal opportunity to contributes on delivery process may increase the integration between project teams towards project goals (Austin *et al*., 2002).

Risk and conflict liability: In manufacturing IBS components, risk liability between structural designers and specialists or manufacturers is very important to care about since the conflict may arise due to non-integration between both players. According to Hallowell and Tool (2009), manufactured components must have a proper engineering design because each of the components has a direct impact on the performance of the final structure. Shukor *et al*. (2011) investigate that risk and conflict liability arise in design and supervision issue due to difficulties to work together and coordinate among team members. This happens due to the unwillingness of structural engineer to verify and be responsible for the drawing that has been designed and produced by manufacturer even it is a proper engineering design. Other than that, the unwillingness of an engineer to supervise the work that has been accounted for in their professional fees and the unwillingness of specialists/manufacturers to supervise the work on the site because they are not being paid for that supervision becomes one of the challenges to integrating all the players involved.

CONCLUSION

Construction project teams are unique entities, created through a complex integration of factors with inter-disciplinary players, varying roles, responsibilities, goals and objectives (Chinowsky and Goodman, 1996). Thus, collaboration and teamwork among the project teams are crucial since sharing up-to-date information between participants leads to minimizing errors, reduction of time delays and breaking the widespread rework cycle which allows a sustainable relationship between participants to evolve (Rowlinson and Cheung, 2004). According to the report for the UK construction industrial strategy, the analysis concludes that other than financial arrangements, selection of the supply chain, design management, construction site management and price determination, supply chain integration also is classified as the main drivers for high performance in the supply chain. Greater integration of the supply chain is an effective means of reducing cost and eliminating waste, however implementation of supply chain management also had faced a lot of hindrances. These hindrances include in term of player's attitude and relationship, communication and information, contractual and procurement, financial matters, guidelines and requirements, lack of skills and knowledge understanding, technical matters and risk and conflict liability.

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