

Success Factors of JIT Integration with IBS Construction Projects— A Literature Review

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Abstract— The Just-In-Time (JIT) philosophy has been used for many decades to increase productivity through waste elimination process. The purpose of this paper is to contribute to the body of knowledge by addressing the issue of transportation, logistic and material delivery in Industrialized Building System (IBS) construction projects. This paper through literature review aims to highlight this issue by investigate the key success factors for integrating JIT and IBS in the Malaysian construction industry. Suggestion on how the concept of JIT can contribute for improving the performance of transportation and material delivery activities in IBS projects will be concluded.

Keywords— *Just in time (JIT); industrialised building system (IBS); transportation, logistic and material delivery; Malaysian construction industry.*

1. Introduction

Construction industry inherently associated with the challenges often attributed to the industry that are being heavily craft-based and producing one of a kind product. With this respect some researcher claimed that this industry were lagged behind others industry and slow in term of adopting new technologies and innovative practice [1]. Malaysia was not an exception to this particular situation. With the growth of construction industry in Malaysia, the conventional construction practice is unable to meet the increase demand due to the consequences of higher cost and low speed of construction [2]. Later, these problems indirectly lead to the introduction of IBS system in Malaysian

construction industry. On the other hand, the usage of IBS in the construction works has a capability to counter the aspect of cost and construction time which have proven to be a major drawback of conventional construction practice. The improvement criteria that offered by IBS in such areas are due to the nature and characteristic of IBS which are speeding up the construction process and reducing the construction cost by repetitive and reuse of mould and optimum usage of material [3], [4]. Ref. [5] added that the reduction of construction cost mirrors the elimination of processing waste and waste of waiting and elimination of unnecessary inventory due to the repetitive use of prefabricated component which is offered by IBS. However, even though the uptake of IBS manages to offer the users with promising advantages, IBS has its challenges on its own. The practical issues during the transportation and deliveries of IBS precast component can hinder the effective implementation of IBS. Studies by Ref. [3] identified that the successful implementation of IBS project are in jeopardy when shortage or late supply of IBS equipment, information and material to site takes place. In addition, Ref. [6] affirms that the smoothness and effectiveness of equipment, information and material deliveries has a strong causal connection with the successful implementation of IBS project. This paper is aimed to provide the overview of JIT, background literature of key success factors and future direction of JIT in Malaysian IBS project looking specifically in the aspect of transportation and material delivery activities. Figure 1 below will provide a summary and overview regarding the literature review process.

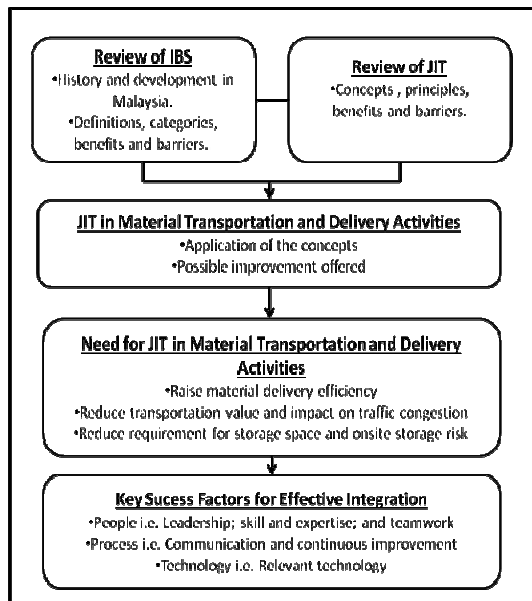


Figure 1. Summary and overview of literature review process.

2. Literature Review

JIT concept was based on the philosophy and methods of the Japanese car manufacturer - Toyota. A group of engineer led by Taiichi Ohno had initiate the system namely Toyota Production System (TPS) in the management of the car manufacturing plant. Back at those times, Taiichi Ohno had put a new starting point in the production philosophy by using JIT method to harvest the benefits of reduction or elimination of waste [7]. Essentially JIT works in a precise ways to provide the production lines what is needed, in the amount needed and when it is needed [2], [3]. Basically JIT look forward to provide their users with the benefits of eliminating waste in the continuous improvement of the production lines. Waste in the context of JIT is the activity or process that does not add to value. While JIT is among one of the component in lean production principle that is TPS, it is fair to say that JIT principle is identical to lean production principle in spirit [8], [9]. According to Ref. [10] generally the principles are; specify value, value stream, flow, pull and perfection. Different from other authors' viewpoint, Ref. [11] and Ref. [12] classified JIT principles in construction industry into seven principles. Those principles are waste elimination, pull system, uninterrupted work flow, total quality control, top management and employee commitment, long term

relationship with supplier and continuous improvement.

2.1 JIT in Material Transportation and Delivery Activities in IBS Project

The Despite the benefits that can be gained through the implementation of IBS strategy, the idea of improving the performance of the construction industry are still being discussed up until this current period. In order to obtain the benefits of clean, organized, and controlled working environments there comes and ideas to improve the construction performance through learning from other industry. In this particular case, JIT concept originated from manufacturing industry [13]. One of the examples is by considering integrating JIT in the IBS project to improve the efficiency and effectiveness of project's transportation and material deliveries activities [11], [12], [14]. JIT philosophy has attracted much attention from other industry to adapt the concept since it's contains a body of knowledge that encompasses set of principles and technique to make operations faster, eliminate waste, improving customer service, achieving continuous improvement and building organizational competitiveness. Inspired by the benefits promised through the implementation of JIT in manufacturing industry, construction industry could achieve the same result. Looking specifically in the transportation and material delivery in IBS project, the delivery process is repetitive and relatively similar to the manufacturing process. In other words, transportation and material delivery mirrors a manufacturing setting. This is where the JIT concepts took parts. The benefit of planning these activities is that the materials are more likely to arrive just in time and can be moved directly to the work process. Following this further, one of the examples is the management of precast IBS component that need to be transferred from casting yard or manufacturing plant to construction site. The common advantage of precast IBS component offers huge advantage in obtaining easier and quicker erection of the building structure. However, the benefits of time saving from the easier and quicker installation will be eroded if the logistical aspects are not properly managed. Additionally, IBS were well know for the cost saving benefit that can be derived from the implementation of the

system, but logistical problem during the performance of the project can affected the profit of the project which later may consume the benefit of cost reduction made on site [15]. In this context JIT seem to have a tremendous potential for improving the movement of the precast IBS component from the casting yard to the construction site [16]. IBS precast concrete component are usually bulky, heavy and big. This situation requires the use of expensive crane to handle the material. Furthermore, the finding from an intensive literature review reflects that limited attention has been paid to this issue in the Malaysian IBS industry. Hence, it is justifiable to put a closer attention to proper management of transportation of precast IBS component.

2.2 JIT Benefits in IBS Project

Since this research is planning to focus into the issue of transportation and delivery of IBS precast component the researcher tend to focus the implementation benefits in such areas. By conducting the extensive literature review it was found out that the obvious benefits that can be gained through the implementation of JIT in the IBS project was minimising waste of time, material and effort in material delivery and eventually increasing material delivery efficiency by using the JIT tools [17] - [18]. Ref. [20] stated that the benefit also can be seen by reduction of transportation value and reduce the impact on the traffic congestion. Additionally, JIT reduce the requirement for the storage space and reduces on-site storage risks such as material damages and theft of inventory [21].

2.3 JIT Barriers in IBS Project

Despite the benefit offered by the implementation of JIT concepts in the material transportation and delivery activities in IBS project, some organisation have trouble implementing JIT due to variety of issues. One of the issues is the benefits of JIT cannot be achieved without initial investment [12]. For example, in order to occupy high skill employees, the organisation must consider investing in higher training mechanism which latter may incurred higher cost. Other than that, it also appears that lack of mutual confident between precasters and contractors would affect the JIT

system delivery. Ref. [14] conclude that this issue emerge because contractors attribute the occurrences of late deliveries while precasters attribute the blame for inaccurate demand schedule, slow update of changes and last minute demand by contractors. They latter suggest that this issue can be manage by having a specific and precise contractual agreements to serve as a good launch pad to harness the mutual confident between both parties. Additionally, lack of top management commitment can become crucial factor that hindering the integration of JIT concept. Management commitment and effort are necessary to ensure that disciplined and correct operations are carried out in accordance with JIT concept [14]. Other than this, top management also responsible to motivate the workforce. JIT is a continuous improvement concept and this concept is only possible if employee involvement is encouraged and top management stay committed to this philosophy. Another important factor that needs to look upon implementing JIT concept is contractors – supplier's relationship. With material deliveries on JIT basis, coordination with the supplier is an important factor in order to ensure the material delivered in right quantity, right time and right place. The challenges for the contractor would be the need for the contractor to reduce the pool of suppliers and try to work on single supply source [14]. This requires both parties to forge a long term business relationship which assured the supplier to invest in related aspect of the business to improve the productivity and reduce cost. This in turn benefited both parties in the long term basis.

3. Discussion of Success Factor

Whilst the literature review has highlighted the recommendation for improving IBS through using JIT as a tool in the transportation and material delivery activities, the study of key success factors to achieve effective integration especially for the Malaysian construction industry have yet to be systematically compiled and documented by researchers. This paper identifies the potential key success factor that may possibly contribute to the success of the approach. By identifying the key success factors the researcher believes that it will guide IBS stakeholders in developing systematic and comprehensive guidelines for improving IBS in Malaysian construction industry. Based on a thorough review

of current best practice of frameworks, concepts and approaches in logistic of construction supply chain; success factors for lean change method; and barriers to the implementation of JIT concept, this research present the key success factors for effective integration between JIT and IBS, especially in the context of JIT transportation and material delivery of IBS component. The key success factors listed mainly under three elements; people, process and technology. The 'people' in this research refers to the individual and human factors in such context of leadership; skills and expertise; and teamwork. In term of 'process' refers in the context of communication process and continuous improvement. Finally, technological aspect; described in this context as an appropriate tool or instrument for improving JIT integration to support project's activities. The explanations of the key success factors are described in the next section.

Table 1. List of key success factors identified.

Factor	Element
People	Leadership
	Skill and expertise
	Teamwork
Process	Communication
	Continuous improvement
Technology	Relevant technology

3.1 Leadership; Skill and expertise; and Teamwork.

Leadership in this study means cooperation between leaders and employees in their mutual striving for perfection. In order to address this trait, executive personnel must develop themselves over the years [22]. They have to get to know the company very well and responsible for the development of the employees, but first thing first, leaders have to identify their individual potential before they are able to direct others. Ideally leaders should work their way up from operational level because deep process knowledge is paramount before they can put themselves to coach others [23]. In this scope of study, skill and expertise is

defined as technical and non-technical knowledge on particular field. Training can be a proper instrument to obtain such related knowledge. The biggest effect of training at the individual level as it can strengthen individual's knowledge and problem solving capabilities and effectively responding to the achieving organization's goal and objective [24]. Teamwork refer to a group of people working collaboratively in a systematic structured and managed way to carry out all defined task and goal. Ref. [24] reported that in order to execute the effective teamwork among stakeholders involved in the project, the project should adopt proper mechanism to coordinate and organize the effort. For instances, mutual cooperation with suppliers, formal support for employees autonomy and facilitating collaborative partnership.

3.2 Communication and Continuous Improvement

Communication is extremely important for addressing employee concern regarding their role, declaring management commitment and providing feedback. A good communication practice can assist in preventing delayed in decision making and preventing misallocation of support and resources from top management [24], [25]. Ref. [20] reported that a good communication and mutual coordination among all stakeholders were able to successfully implement JIT concept. Additionally, good communication practices were important to the construction project due to the different requirements and priorities between client, consultant, contractor and supplier and to avoid confrontation and miscommunication [26], [27]. According to Ref. [28] continuous improvement is defined as effectiveness of an organization to achieved its objectives subjected to business strategy, business result, customer, employee and supplier relationship. In a simple words getting better over the time. It is about supporting organizations to build capability and to utilize ideas of all employees in order to deliver the value to the customer. The initiatives in implementing continuous improvement within an organization can harvest the benefits that are available to organization at all sizes and sectors. For examples small capital investment since continually making small not large dramatic improvement, improved employee commitment, reduction of cost and waste and improved customer satisfaction [16].

3.3 Relevant Technology

The term technology in this context refers to suitable equipment or medium to support the project activities, enhancing interaction and information sharing between stakeholders [29]. Irrelevant technological support may hinder the project activities in order to coordinate construction's design and method, cost and schedule in a project. Several authors stated that it is vital to acquire an appropriate technology for a successful integration of team [16], [24], [25], [29]. Recently such example of available tools or applications that become available to the construction industry such as Building Information Modeling (BIM), Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), groupware system and decision support software that aids communication and coordination between stakeholders for successfully project integration [4], [30], [31], [32].

4. Conclusion and Further Research

Based on the above discussion, it is suggest that there is a need for integrating JIT concepts in material transportation and delivery activities in Malaysian IBS project. The literature search has discovered that there is possible improvement that can be achieved by integrating these two concepts. Looking from locality perspective in the context of Malaysian IBS project, to date, research conducted on this integrated practice is scarce; hence there is a need for a research to be conducted on this potential area especially in the area of key success factors of integrated practice. Finally, the review presented in this paper is part of the ongoing research, which eventually attempts to enhance the practice and implementation strategy in Malaysian IBS industry.

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