

## **INVESTIGATING FACTORS OF DELAY IN IBS CONSTRUCTION PROJECT: MANUFACTURER PERSPECTIVES**

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### **Abstract**

Government of Malaysia has enthusiastically supported the implementation of Industrialized Building System (IBS) that was early introduced in 1960's. IBS is seen capable to ease the problem of delay that has been long haunting Malaysian construction industry. However, the issue of delay still exists even though IBS has been implemented in construction project and it is believed that there are other factors causing delay in IBS project. Thus, this paper aims to identify the factors of delay in IBS construction project through semi-structured interviews. Data on the study variables has been collected through interviews were conducted to explore the real-life construction situation in Malaysia. Factors of delay in IBS construction project are application of casting in-site by client, usage of dry mix cement, not fully implementation IBS method by clients in construction works, changes in design by client, delay in conforming the building design by client, delay in payment from client and delay of materials delivery from supplier. As an overall, results indicated that client-related factors are the most significant contributors in the delay of IBS project. The phenomena of delay in IBS construction project may require serious attention in overcoming the potential of delay factors and enhance the sustainability of IBS implementation in Malaysian construction industry.

Keywords: Construction industry, Delay, IBS project, Industrialised building system.

## 1. Introduction

The delay in Industrialized Building System (IBS) construction project is increasingly becoming a big concern by many participants in this industry. IBS is a technique applied in Malaysian construction industry to manufacture of the components in a controlled environment, either off site or at site, placed and assembled into construction works to form the structure of a building. Malaysian construction industry has great advocates on IBS technique implementation in construction works as it is believe to improve the performance of time management of the construction project [1]. In the meantime, IBS implementation would boost the production output, apply less usage of labour resource and improve the quality of construction works [2].

However, the effectiveness of its implementation in improving time performance of project completion is no longer stable because many of IBS projects nowadays are facing the issue of delay. IBS manufacturers are the top players in Malaysia with higher technology investment [3]. Their roles also are highly important in ensuring the production and delivery of the components on time to the construction site for assembly process. However, the issue of delay in project completion through IBS method is still unavoidable. IBS manufacturers are able to give valuable information that can help for future mitigation process in order to reduce the rate of delay in IBS construction project. Therefore, this research is focused on determining the factors of delay in IBS construction project through manufacturers' point of view.

## 2. Literature Review

Currently, the implementation of IBS method in construction project has been driven by Malaysian government, as it is able to speed the time completion of the construction project and minimize cost incurred [4]. The process where the components were manufactured is under controlled environment to keep the quality of product at satisfied level, delivered to construction site and assembled to form a building structure. The component of IBS consists of pad footing, prefabricated beams, prefabricated column, prefabricated floor slab, prefabricated wall panels, staircase and prefabricated lift core [5].

The transformation of IBS components categorization was influenced by the set-up of IBS manufacturing factories and the expansion of new technology, concept of open manufacturing plant, efficiency of transportation and erection, best practice, design and build, and qualified workers [6]. However, even though the implementation of IBS nowadays is driven by sophisticated technology and qualified workers, the issue of delay in IBS construction project still exists due to several circumstances.

Risk is a situation where things can turn into something negative. IBS adoption also has its own risk, even though it was known as a method, which can speed the construction works and improve the time performance for particular projects. Other than that, knowledge of mechanical and electrical (M&E) engineer is not aligned with civil and structural (C&S) engineer, thus leading into redesigning drawings during the design stage of IBS projects [7]. Local authorities also need to fully understand IBS guidelines improve their knowledge and awareness at the best level in order to avoid further delay in approval [8]. By

this way, we can achieve a sustainable tomorrow with a bright future. IBS would speed up construction and at the same time will ensure safety, quality as well as sustainability.

### **3. Research Methodology**

The focus of this paper is gathering perspectives of manufacturers about factors causing of delay in IBS construction project qualitatively. In order to gather more information about factors of delay in IBS project from manufacturers perspective, semi-structured interviews were conducted towards 5 people of respondents. The interviewees were selected based on more than 6 years' experience in IBS manufacturing, manufacturer of IBS component located in Malaysia and wide knowledge in IBS construction process.

In order to identify perspective from manufacturers into factors of delay issue, short open-ended questions were developed by using a terms which respondents can understand to cover rich descriptive data on the personal experience of the participants. Semi structured interviews is start with a general topic includes experience in facing delay IBS project and to more specific insights which is factors of delay in IBS construction projects. Data collected from the semi-structured interviews were analysed qualitatively as the information's were in form of opinions, comments and statements.

### **4. Findings and Discussions**

#### **4.1. The application of casting in-site by client**

According to the interviews conducted with manufacturers, R1 claimed that clients are more likely to implement casting on-site for certain part in construction works. Casting in-site is more exposed to outdoor weather conditions, which can affect the quality of casting parts compared to the process of pre-cast from the factory under controlled environment. Based on a project in Hong Kong, pre-cast concrete method is able to improve the performance of the environment [9]. Quality of components also could positively affect construction works and contribute for a better national economic [10].

Respondents also agreed that casting of sub-structure in site is time-consuming and it may slow down the progress of the construction project. In addition, massive structures in the conventional method take a long time to be completed and it is a main delay to the construction project [11].

Based on interviews, R1 stated that, "Quality control in factory is much better. There is a facility in our office. For the cast in-site, if there is design problem, we cannot solve it immediately. Your office is here, but it is hard to build another design team in site. Whatever, if you use mobile phone to communicate about the issue, it will take time."- Respondent R1

Other than quality issue, there is a probability for design problem to occur. Hence, with the implementation of casting in-site by client, design problem need a special team to solve the issue. The distance between the factory of IBS and the construction site, turns in the issue of design problem, which is time consuming to be solve while waiting for design team from IBS manufacturing plant to reach the site. Thus, it causes delay in time completion of the project.

#### 4.2. The usage of dry mix cement

Acquisition of concrete or material supplier from outsources usually in the form of dry mix cement. The way aggregate sand, cement and water revolve in the truck mixer to form a concrete is not well managed. According to Ferraris [12], the performance of concrete is established by its microstructure.

Result from the interview, R1 claimed that, “Concrete that selling from outsource is a dry mix type. Once the concrete and sand are put into concrete mixer machine, it will revolve to mix all the components. However, the way it mixed not really well compared to our wet mixer. Wet mixer is a machine likes a blender. This kind of mixer is more perfect. If we use lorry truck, it just simply revolve without having well blend. Once the cement arrived in the factory, cement still not well blend. So, we need to remove it.”- Respondent R1

R1 stressed that dry mixer cement used by outsources to form a concrete has a poor quality compared to wet mixer on site. Wet mixer that is owned by IBS manufacturer produce a fine concrete where all materials are well mixed together without any materials left behind. The issue of cement, which is not well blended once it arrives at the IBS factory, causes a waste in term of materials. As a consequence, IBS manufacturer has to bear the cost of material and transportation from IBS factory to the construction site become delay and as well affecting the time completion of IBS construction project.

#### 4.3. Clients are not fully implementing IBS method in construction works

The implementation of IBS is still poor among government agencies even though an IBS technology has been promoted by the Construction Industry Development Board (CIDB). Many players from construction industry are reluctant to adopt IBS system due to cost issues and already familiar with the conventional system [13].

The participant of R1 further explained that, “Most of the JKR projects are designed by themselves. Even though, at that time JKR has drawing, we still can propose our design. At that time, we consider it as an IRSP. But then, it was not use anymore. Even though JKR design by them, they are not fully implementing IBS. A lot that has been done by JKR, I also not understand. Sometimes they have in-situ beam and column. But, once I observe, precast is still can be apply. But there are not fully implement IBS method in construction.”- Respondent R1

Most of the government projects, which are Public Works Department (JKR) as a client, has design their own projects. According to R1, clients mainly preferred to use cast in-situ in their construction method whereby components were cast on the building site. Even though Malaysia has enough capacity to implement higher IBS technology [8], based on R1 observation, although some components can be formed by using precast method but client insist to apply cast in-situ method. Therefore, while waiting for the cast in-situ components completely formed before continuing by IBS component with the assembly process, manufacturer of IBS would not transport any component to the construction site. R1 believed that this cause delay in the completion of the project. Therefore, fully IBS implementation by client would enhance the duration of project completion.

#### **4.4. Changes in design by client**

The issue of delay in IBS construction project also was determined by the changes in building design after contract is awarded to contractor. According to R1, it is part of the significant factors, which inhibit construction project performance and occurred regularly on most construction project, including IBS projects. In addition, design changes become the most driven factor towards construction project in Malaysia [14].

“There is no excess of goods because all casted part was built based on 100% drawing. Unless, client needs to change the design. Let say, we already count it capacity, suddenly the design changed. It really happened. Usually we are not arguing. Human always make a mistake. So, the solution is we will make another part for them based on the latest design.”- Respondent R1

Manufacturer willing to rebuild part of the components in order to full client needs and provides the best possible value as a service providers to their client. The perception of client towards their service provider is influenced by the type of client in construction sector [15]. However, this kind of situation would cause time consuming to produce new parts, which are not previously agreed with the client. As a consequence, time for the construction works becomes longer than scheduled which cause delay in the project completion.

#### **4.5. Delay in conforming the building design by client**

Instead of changes in design made client, R1 also agreed that their clients are often late in conforming the building design to manufacturer for component manufacturing purpose. Once IBS manufacturer receive design of the building, IBS manufacturer needs to hold manufacturing precast component until design is confirmed by client. R1 said; “As long as the design has not been decided by the client, we cannot proceed to the next action.”- Respondent R1

Once the client confirmed the design, manufacturer would start to build precast component. R1 added; “Sometimes, our pre-cast parts are late arrived at construction site. Yes, it happened due to client not inform early.”-Respondent 1

Manufacturer required specific duration of time until components can be transported to the construction site for assembly. Late in conforming design by client has caused delay in the next steps of construction affected the time completion of IBS project.

#### **4.6. Delay in payment from client**

The issue of late payment by client is considered as a significant factor of delay in most construction project and very costly for client as it potential revenue going to loss. Delay in payment from client will also affect cash flow of contractor as they are not prepared for such extra costs to support the project [16]. Based on respondent's point of view, payment disputes in terms of procuring IBS components is a common thing happened in their industry. R1 also stressed that payment to IBS manufacturers is very crucial due to initial costs and set up costs incurred which are very high. It also determines the level of productivity and on time delivery to the construction site.

R1 said; “The issue of late payment from client is rarely happened until now.”- Respondent R1

The respondent explained that payment should be performed by client once order for IBS component is confirmed. Most of the situations, the payment was made after the IBS components are manufactured.

R1 added; “Payment for IBS component delivery on construction site is as much 75% and another 25% is after all the assembly process of IBS components are completely done by manufacturer.” - Respondent R1

Issue of late payment by client will delay the manufacturing process for IBS components as well as delay the delivery of IBS component to the construction site. As a consequence, project completion delays compared to original planned schedule.

#### **4.7. Late of materials delivery from supplier**

Late supply of materials is among the factors that have been stressed by manufacturer, which contributes to the issue of delay in IBS construction project.

“Delay in transportation of material supply from the third party on our factory also happened. Sometimes their lorry has a technical problem and at a same time, this lorry was used to supply materials to other company. On the particular day, supplier promised with us that they will deliver within 2 or 3 items. So, our construction planning on that day is to install for 3 houses, maybe we only able to install for 2 houses only due to the technical problem from supplier side”- Respondent R1

Material supply is very important for IBS components production. According to the respondent, transportation of materials to IBS factory some time faces a delay due to lorry from supplier side having a technical problem. The insufficiency of IBS raw materials in factory has caused delay while waiting for the next batch of materials to reach the factory. Hence, the amount of IBS components delivered in construction site is also insufficient and the activity of assembly also half way compared on planned activity on schedule. This situation has cause delay in IBS project.

Based on Table 1, client-related factors are the most mentioned by respondents, which affect the time completion of IBS construction project. According to Zhang [17], client expectations towards projects cost have changed over time due to higher need requirements and technological advancements in construction methods. Plus, high financial requirement in advance technology of construction method also has influenced client to stick to the conventional method. It is part of client objective to reduce cost of expenditure of their construction project. Other than that, design changes made by client are taken as a part of the incompetence from architect, engineer and project manager [17]. Meanwhile, manufacture and supplier related factors are the least factor mentioned by respondents. It clearly shows that client related factors are the most contributors towards delay in IBS construction project. More attention should be focused on client related factors by providing mitigation towards delay factors in order to achieve the sustainability of IBS implementation in Malaysian construction industry.

**Table 1. Factors of delay in IBS construction projects.**

Code	Delay factor in IBS construction project	Related Factor
DF1	The application of casting in-site by client	Client
DF2	The usage of dry mix cement	Manufacturer
DF3	Clients are not fully implementing IBS method in construction works	Client
DF4	Changes in design by client	Client
DF5	Late in conforming the building design by client	Client
DF6	Late in payment from client	Client
DF7	Late of materials delivery from supplier	Supplier

Note: \*DF represents Delay Factor

## 5. Conclusions

Delay in IBS construction project could be reduced by identifying the root causing the delay. It is generally agreed that the sustainability of IBS implementation in construction industry requires a best practices from players involved including manufacturers of IBS, client and also contractors. There are seven factors of delay in IBS project found in this study which are application of casting in-site by client, usage of dry mix cement, poor IBS implementation in construction works, changes in design by client, delay in conforming building design by client, delay in payment from client and delay of materials delivery from supplier to IBS factory. It recommends that more intensive researches emphasizing on how to mitigate these seven factors of delay in the future.

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