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Comparative Study During Pandemic Between Conventional Construction System and Industrial Building System (IBS) on Workers and Costs in Batu Pahat, Johor

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Abstract: Majority of construction methods that often and still used in Malaysia are conventional construction methods and Industrial Building System (IBS) construction methods. Both methods have their respective advantages and disadvantages that influence the impact of construction during pandemic. During the Covid-19 pandemic that hit Malaysia, the construction sector had to be temporarily shut down. This study is to identify the negative effects that occur on construction during pandemic, and to analyze the more effective construction methods used during pandemic. This study uses a combination of quantitative and qualitative methods. The analysis of the study was done by analyzing the respondents' data given through a questionnaire using the Service Package for Social Science (SPSS) and descriptive system while the observation method (interview) was done on the project engineer. The results of the study found that the most effective construction method during a pandemic is the IBS method. Moreover, most respondents consent that the impact of the pandemic on the construction sector was that the cost and duration of construction increased, and the shortage of workers. Finally, the study also found some recommendations that need to be made to improve the construction sector during a pandemic.

Keywords: Conventional Construction, IBS Construction, Pandemic

1. Introduction

The construction industry in Malaysia is currently growing rapidly. In the field of construction, there are several types of methods for construction. One of the increasingly well -known construction methods is the Industrial Building System (IBS) construction method. This research has two types of construction methods namely conventional construction and IBS which involve construction workers and construction costs. The construction industry in Malaysia is undergoing a transformation from the conventional method to a more systematic method, namely IBS. The IBS system is one of the efforts

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being made to reduce the industry's dependence on foreign workers as well as go further to increase the capability, potential, effectiveness and competitiveness of Malaysian industry. Due to the pandemic that is plaguing Malaysia, the entry of foreign labor has become more difficult and limited. The total construction cost also changed during this pandemic because during the period of the Movement Control Order (MCO) being implemented, any opening of the construction site was not allowed and cause the project time period increased. Based on an excerpt from an Utusan Malaysia article, the Building Material Cost Index (BMI) increased for all categories during the pandemic. The Department of Statistics Malaysia (DOSM) said the increase ranged from 0.1 per cent to 2.3 per cent for Peninsular Malaysia [1].

The aim of this research is to identify the negative effects that occur on construction during pandemic, and to analyze the more effective construction methods used during pandemic. This study was conducted around the Batu Pahat District.

2. Conventional and IBS Method

The conventional system method is a method that is traditionally carried out using old technology. Conventional methods also involve many manual activities such as mixing concrete, doing plastering work, painting, cutting wood, binding bricks, mold box installation work, and other installation work. This method requires a lot of workers to ensure that construction can run smoothly within a specified period of time [2]. Industrial Building System (IBS) is one of the construction methods where all components are made in a controlled condition either on site or off site. All these components will be transported, and assembled into a predefined working structure [3]. IBS components have a very high quality due to careful material selection, use of advanced technology, strict material quality control and are not affected by the problems of good or bad weather conditions. In addition, the IBS component assembly process requires skilled workers so that the quality throughout the construction process becomes more perfect. The IBS process consists of five processes namely preliminary work, production, delivery, installation and closing. The IBS process begins with designing prefabricated components. The components will be manufactured in the factory or any manufacturing area according to the specified size and specifications. The IBS components are then transported to the construction site from the plant for assembly purposes. Finally, the IBS components were assembled and erected at the determined construction site using the sequencing method.

The Covid-19 pandemic in Malaysia has left a big impact on the construction industry sector with work suspensions, as well as project delays. The construction industry sector has suffered losses and unexpected declines during the period of PKP implemented in Malaysia on 18 March 2020 to 14 April 2020. These losses in terms of salary value, building materials, machinery rental, and project management which includes profits that have been disappears when the construction industry sector is not allowed to operate normally. Workers in the construction sector are unable to attend construction sites to continue work as usual and some have been fired by employers in order to maintain the economy of their respective companies. As a result, the number of workers is declining as existing workers have been laid off and the entry of foreign workers from abroad has been restricted. Because the higher the workers consumption, the higher the cost of the construction project. As such, construction sites that use the IBS method are more profitable because the value of wages has been deducted according to the number of workers working on the construction site and the IBS method only requires skilled workers as compared to the conventional method. In general, application of IBS method has saved construction time by 75% when compared to conventional construction systems. The use of IBS will minimize manual activities on site, build and it will reduce construction hazards leading to improved safety and health of workers [4]. This is because there is a lot of reduction in excessive activity and waste, excessive building materials that are not used.

3. Methodology

Methodology flow chart is the most important element in research to ensure the layout or course of research runs smoothly and orderly. This flow chart also provides an overview of the work process to achieve the objectives and results of the study. Figure 1 shows the flow chart for this study.

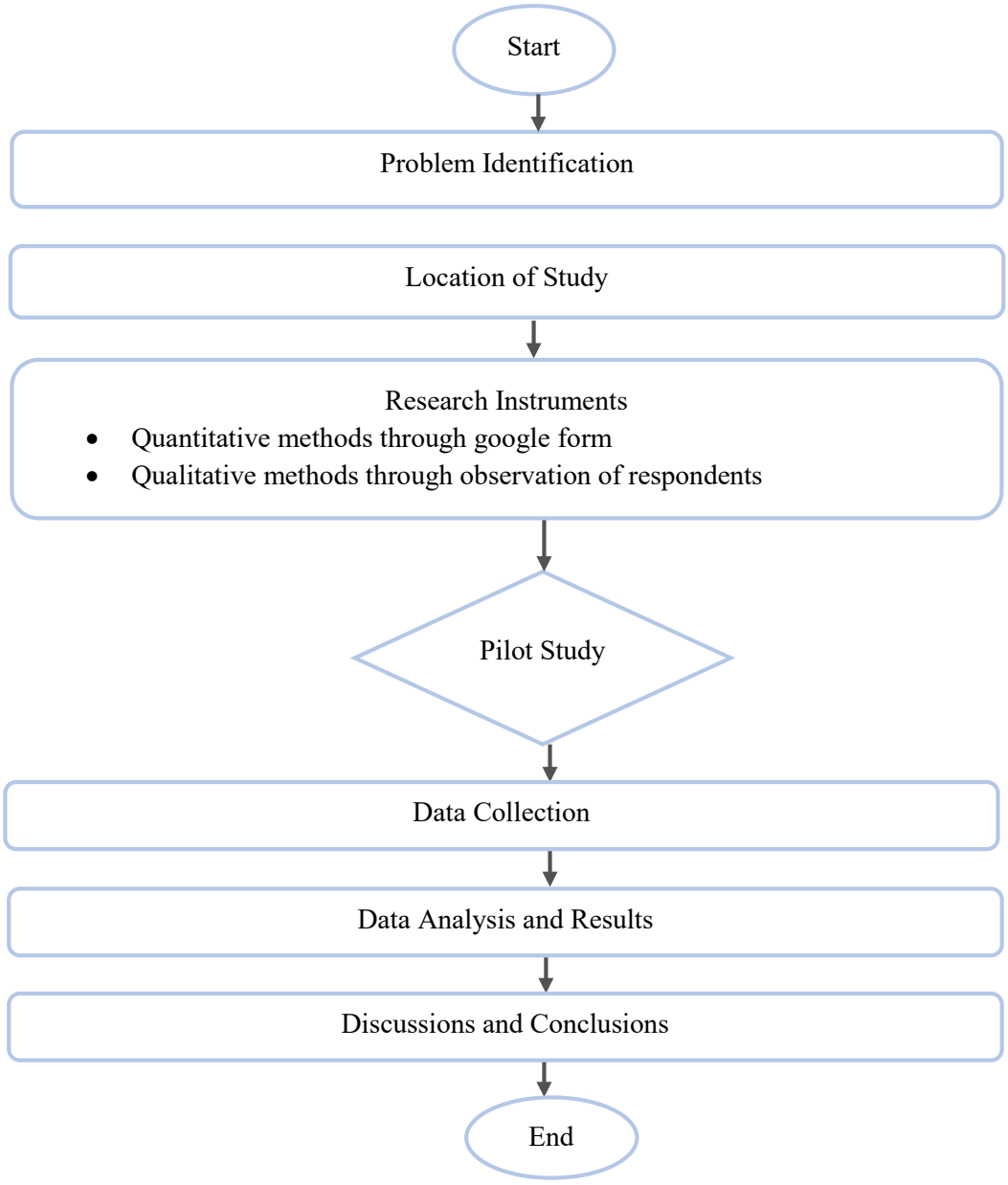

Figure 1: Flowchart of methodology

For data collection, there are two types of methods, namely qualitative methods, and quantitative methods. The survey study was conducted online by email and phone call. This study has its own target, namely employees who work in construction companies around Batu Pahat Johor, such as project managers, site engineers, contractors, consultants, and so on. The target number of respondents for this study is 35 respondents.

3.1 Quantitative Method

For quantitative method, questionnaire using google form were distributed to targeted respondents. The questionnaire was divided into three sections which is Section A, B, and Section C. Each section contains related data and information on comparisons between methods constructions (conventional and IBS) based on total workers and cost construction. during the Covid-19 pandemic in Batu Pahat Johor. Statistical Package of Social Science (SPSS) software applied for the suitability of researchers who conduct research by following all the processes from the beginning to be able to produce output for this SPSS report. For the SPSS software, the result output is by descriptive analysis. Descriptive analysis was summarizing the collected data into a simple description in the form of a visual summary such as a pie or histogram. The analysis also determines populations such as frequency, mean score and standard deviation [5].

The Cronbach's alpha value for part C which is, the pandemic effect of Covid-19 on construction was 0.955. The value is almost 1 therefore the result is valid and very good to continue this study. All items in the questionnaire can be used for this study.

3.2 Qualitative Method

Interviews are generally a qualitative research technique that involves asking open -ended questions to converse with respondents and collect data on a subject. Through this method, information will be obtained directly by the researcher. There are three basic types of interviews in research namely structured interviews, semi -structured interviews and unstructured interviews [6]. There were 3 site engineers interviewed who were undertaking different construction projects. 2 of the construction projects used conventional method while 1 construction project used IBS method.

4. **Results and Discussion**

This results and discussion section is related to comparative study between conventional construction and Industrial Building System (IBS) for construction workers and construction cost in Batu Pahat Johor. From this study, it is hoped to achieve the objective of the project which is to identify the negative effects that occur on construction during pandemic, and to analyze the more effective construction methods used during pandemic.

4.1 Quantitative Method (Descriptive)

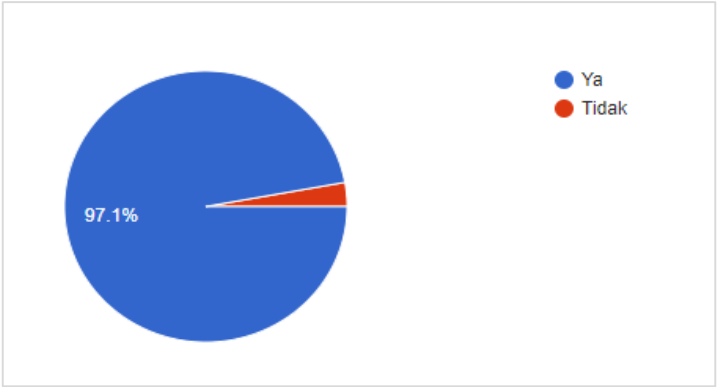

Figure 2: Pie chart of respondents' experiences related to conventional projects

Figure 2 shows a pie chart of respondents' experience percentage. Based on the diagram, respondents' experience in conventional construction projects is 97.1% (34 respondents). While the percentage of 2.9% (1 respondent) for respondents who are not experienced in conventional construction projects. It is proven through CIDB, the majority of construction companies in Batu Pahat implement conventional construction methods.

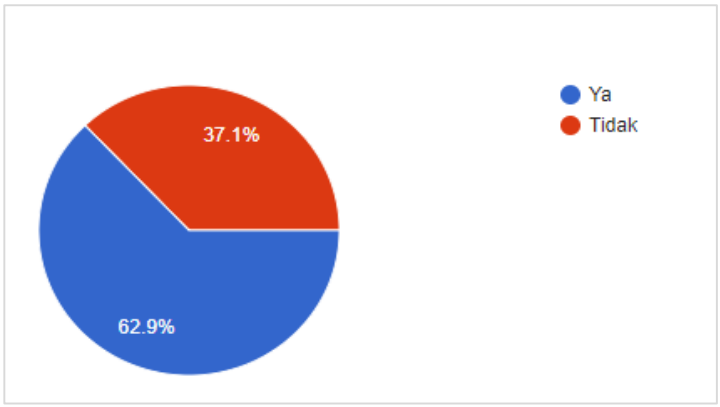

Figure 3: Pie chart of respondents' experiences related to conventional projects

Figure 3 shows a pie chart of respondents 'experience percentage. Based on the diagram, the respondents' experience in IBS construction project is 62.9% (22 respondents). Meanwhile, the percentage of 37.1% (13 respondents) for respondents who are not experienced in IBS construction projects. Based on the company registration on CIDB's official website, there are only 27 IBS companies registered with CIDB involving B01, B02, B22, and B23 specializations [7]

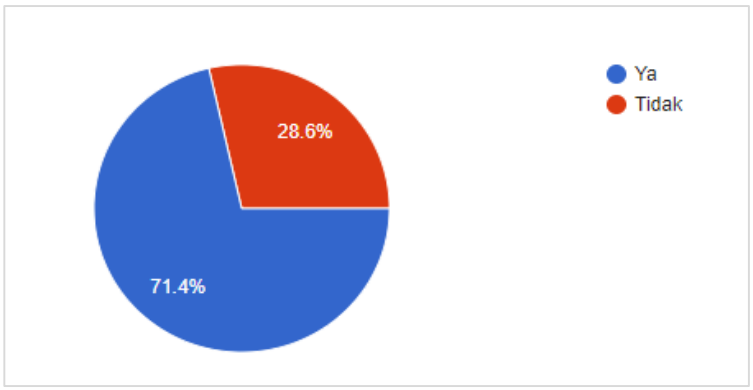

Figure 4: Pie chart of respondents' understanding of project cost

Based on the figure 4 above, a total of 71.4% (25 respondents) agreed that the construction cost for IBS method is more economical than the construction cost of the conventional method. Meanwhile, a percentage of 28.6% (10 respondents) did not agree that the construction cost for the IBS method is more economical than the construction cost of the conventional method. This is associated with a greater number of construction workers than the number of IBS construction workers. The less the number of workers that required, the lower the cost of the construction project.

Table 1 below shows the respondents 'understanding of the difference between the conventional method and the IBS method was 100% (35 respondents). All respondents understood the differences between these two methods. Respondents who agreed that the conventional construction method requires a longer period of time compared to the IBS method to complete a construction project was 100% (35 respondents). This is because, the IBS method only uses the prefabricated panel method that has been ordered at the factory according to the desired specifications and criteria. As for the conventional construction method, it takes a long time to complete the construction because it must go through a process such as plastering the walls and waiting for the concrete to dry completely.

Furthermore, the respondents who agreed that the use of IBS construction method can reduce the workers that required in the construction project was 100% (35 respondents). All respondents agreed that construction using IBS method can reduce workers compared to conventional methods. IBS construction only requires skilled workers to do the installation of IBS panels while conventional construction requires many workers including skilled workers, semi -skilled workers, and unskilled workers, because it has to go through many processes in stages [8]

Table 1: Respondents 'understanding to construction methods, differences, duration, and labor

	No. of Respondent Agreed	No. of Respondent Not Agreed	Percentage (%)
Understand the Differences between Conventional Methods and IBS	35	0	100
Construction Time Period	35	0	100
Workers	35	0	100

Based on the table 2 below, the highest mean score is on the statement about Covid-19 pandemic contagion resulting in lack of workers in construction projects with 4.69 (68.6%, Strongly Agree). Next, the second highest mean score was on construction work to be continued during pandemic with 4.60 (57.1%, Strongly Agree). Statement that IBS construction method is more effective than conventional construction method during pandemic, the mean was 4.57 (62.9%, Strongly Agree) and followed by the same mean score that Covid-19 pandemic affects the company's economy (construction project cost increases) with 4.57 (60%, Strongly Agree). Then, mean score followed by the Covid-19 pandemic statement caused more construction projects to abandon with 4.51 (45.7%, Strongly Agree) and followed by the same mean score that Covid-19 pandemic spread caused the construction project time period increase with mean score of 4.51 (51.4%, Strongly Agree). Based on section C, the researcher was able to identify the main effects of the pandemic for both construction methods.

Table 2: Mean and Standard Deviation for the effect of pandemic on construction

Statements	Mean	Standard Deviation
IBS construction method is more effective than the conventional construction method during a pandemic	4.57	0.502
Construction work needs to continue during a pandemic	4.60	0.497
Pandemic of Covid-19 caused more construction projects to be abandoned	4.51	0.507
The outbreak of the Covid-19 pandemic affects the company's economy (construction project costs increase)	4.57	0.502
The outbreak of the Covid-19 pandemic resulted in a shortage of total workers on construction projects	4.69	0.471
The outbreak of the Covid-19 pandemic caused the duration of the construction project to increase	4.51	0.507

Based on table 3 below, total of 35 respondents gave the opinion that the most effective construction method for cost and appropriate construction workers during the Covid-19 pandemic was the IBS construction method while a total of 10 respondents gave the opinion that the most effective construction method was the conventional construction method. As such, the majority of respondent's opinion that the most effective construction method used during a pandemic is the IBS construction method. Because the majority of respondent's feedback that the IBS construction method is easier, faster, and saves construction costs. In addition, this method can also reduce the total numbers of workers at the construction site

Table 3: Findings of the respondent study for effective methods used during the Covid-19 pandemic

No	Construction Method	Description
1	IBS	The construction process is easier
2	IBS	The construction of IBS does not require many workers and the cost is reasonable
3	IBS	Save time
4	IBS	This method uses less workers and shorten the duration of the project. It can reduce the cost of worker's payments a lot
5	IBS	The price of building materials is getting more expensive and not worth it if using conventional during a pandemic
6	IBS	Able to save workers wage cost
7	IBS	The construction process is simple and shortens the construction period
8	IBS	Easy and less workers (avoid congestion at work)
9	IBS	IBS is very good and suitable to use during pandemic but is an exception for small companies
10	IBS	But the Malaysian government still does not make the use of IBS mandatory
11	IBS	Able to reduce project costs and save time in the event of another PKP
12	IBS	IBS is expensive but more effective than conventional
13	IBS	The IBS method is more suitable during pandemic because of the small number of workers
14	Conventional	Save project cost
15	IBS	The larger the project, the higher the cost price
16	IBS	To improve the safety of workers on construction sites. It's also faster and easier to complete and does not involve many workers
17	IBS	Does not require many workers
18	Conventional	The cost of the project is cheaper than the construction of IBS
19	Conventional	Small construction companies have more advantages to use this method due to the lack of knowledge and materials for the IBS method
20	IBS	Save cost and project time

No	Construction Method	Description
21	Conventional	Both methods have pros and cons, but if seen with the current construction scenario in Malaysia, conventional construction is more suitable although IBS is easier
22	Conventional	Small construction companies are focused on the use of the IBS method only
23	Conventional	Malaysia is not a country that is too high technology to make the use of IBS mandatory
24	Conventional	Small construction companies are not exposed to the use of IBS
25	Conventional	Project costs are suitable for both small companies and large companies
26	IBS	To save project time and workers consumption on construction sites
27	IBS	Low workers consumption
28	IBS	Because the construction time is shorter (use of prefabricated panels) and cost savings (less workers)
29	IBS	Due to its advantages that facilitate the contractor, but this method is not widely used in Batu Pahat
30	IBS	Prefabricated method and simplifies the construction work process
31	IBS	IBS because if conventional, the price of materials increases so it is not worth it to pay material producers with rising prices and many workers. IBS is a prefabricated method and requires only a small number of workers. However, Malaysia does not mandate the use of IBS and does not emphasize this use in construction
32	Conventional	It has been practiced for a long time in Malaysia
33	IBS	Increase the use of technology in the construction sector
34	Conventional	Reduce the percentage of unemployed in Malaysia
35	IBS	More effective during pandemic because of cost savings and less workers consumption

4.2 Qualitative Method

The table 4 below, summary of interviews with site engineers. There were 3 site engineers interviewed who were undertaking different construction projects. 2 of the construction projects used conventional method while 1 construction project used IBS method. Based on the interviews, the conventional construction method faces more challenges during a pandemic than the IBS method. Moreover, based on observations as well, the construction period using the IBS method is faster and the cost is lower than the conventional method. moreover, for the difference in construction costs before the pandemic and during the pandemic, the IBS method did not experience the effect of a sudden increase in the price of building materials due to the use of a panel frame system.

Table 4: Summary of interview observations

Interviewer	Construction Methods	Construction Cost	Total Worker	Period of Construction	Impacts/Challenges of Pandemic
1	Conventional	RM 8 000 000	21	19 months	• Duration of the construction project increases • Price of building materials is rising • Project costs increase • Lack of workers
2	Conventional	RM 90 000 000	34	24 months	• The price of building materials is rising • Project costs increase • Lack of workers
3	IBS	RM 30 000 000	6	22 months	• Abandoned for 2 months • Construction project time not delayed

5. Conclusion

For the first objective, which is to identify the negative effects that occur on construction during pandemic, it was found that the negative effects that occurred on construction during a pandemic was the cost of construction. Estimated construction costs increase when raw material prices rise during a pandemic. In addition, the projects are abandoned when MCO and the duration of the project increase. Construction sites also lack of workers during pandemics as employers must change employee schedules to reduce workers at construction sites. This is to reduce the risk of Covid-19 infection.

Second objective, which is to analyze the more effective construction methods used during a pandemic, the analysis from SPSS shows that the construction of IBS method was more effective construction method than conventional methods. Because the mean score for the statement about the IBS construction method is more suitable to be used than the conventional construction method when the pandemic is the third highest. In addition, a total of 25 respondents gave the opinion that the effective construction method during the Covid-19 pandemic was the IBS construction method while a total of 10 respondents argued that the most effective construction method was the conventional construction method. Majority of respondent's opinion for the most effective construction method used during a pandemic was the IBS construction method.

In conclusion, the full objectives of this study have been achieved and discussed. Among the objectives of the study achieved is to identify the negative effects that occur on construction during pandemic, as well as to analyze the more effective construction methods used during pandemic. Based on the study, there are some suggestions that need to be done to improve the construction sector during a pandemic:

i. Opening the construction sector during pandemic but stricter about the Standard Operating Procedures (SOP) that are equivalent at all construction sites. In addition, workers are required to do Rapid Test Kits (RTK) every 3 days and make a schedule of workers to reduce the number of workers at the construction site.

ii. Provide flexible work schedules to encourage social incarceration by allocating time for different project and break groups and limit the number of people working in each zone.

iii. Perform contractor evaluations to increase productivity that can help identify delays, current schedule status and procurement status of keeping building materials. It can also increase the project timeline to allow employees to follow safety guidelines

iv. Expanding the use of technology. Provide technologies such as Building Information Modeling (BIM) to share information between team members and practice the use of Augmented Reality (AR) and Virtual Reality (VR) for virtual inspection operations.

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