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Study on the Fourth Industrial Revolution (IR 4.0) Implementation for Improving IBS Construction Project

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Abstract: The Fourth Industrial Revolution (IR 4.0) is a digital revolution that refers to a process of technical progress in construction industry and is still not properly addressed. Industrial Building System (IBS) is one of the most effective methods of improving quality and efficiency in a building project. However, there are many contractors who are still comfortable with the traditional method application with the assistance of unskilled labour for project activities. Thus, the objectives of this study were conducted to identify the potentials, influencing factors, and steps to promote the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial Building System (IBS) construction project. To achieve the objectives, the research had been conducted using quantitative method for primary data collection and questionnaires as the instrument that was used to collect the data. There were 146 respondents out of 346 respondents among G7 contractors were selected at Selangor state to obtain information for this research. The respondents for this research are 146 respondents from G7 contractors in the state of Selangor. Then, the data analysed by using Statistical Package of Social Science (SPSS) were determined by frequency analysis, percentage, standard deviation, and mean score values. Furthermore, pie charts, frequency, and percentage values for the respondents' backgrounds. The results showed that IR 4.0 implementation had the potential to improve IBS installation skills need a workforce capable of producing and installing building

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components either on-site or off-site. The influencing factors of the IR 4.0 implementation had to upgrade complex machinery to produce quality IBS components. In conclusion, the steps to promote the IR 4.0 implementation had to promote high-quality machine with IR 4.0 implementation for the IBS component assembly process.

Keywords: Construction project, IBS, Improving, IR 4.0

1. Introduction

The construction industry is one of the industries that play an important role in developing and enhancing the economic sector and also the development of one's country. While the construction industry contributes to growth, it is not an environmentally friendly activity as many difficulties may arise if the progress and development of the construction industry are not carefully planned. The construction sector is categorized as one of the sectors that provide high employment opportunities and has a direct relationship with many other major industries, which should be strengthened to enhance national economic development (CIDB, 2019). This industry contributes to all the country's key industrial sectors by supplying capital, services, and housing, among other things. As a result of its vast multiplier effects, the government has placed a fiscal priority on this industry to grow the national economy. Nowadays, the Fourth Industrial Revolution (IR 4.0) implementation is significant for improving IBS in construction projects because the technology must be introduced among contractors in Malaysia to save time in completing projects at construction sites. This revolution represents a physical cyber system that will change the construction process in the future. The need of applying technology, and the requirement to improve skills and knowledge, is a necessary foundation for dealing with these changes (CIDB, 2021).

IR 4.0 is a digital revolution that refers to a process of technical progress in an industry, namely in the production and automation sectors, to a more intelligent and systematic level. This industrial change is also known as the "Smart Factory," in which each system installed is more flexible and methodical, as well as capable of adapting to more difficult new situations (Morrar, Arman & Mousa, 2017). As a result, using the Industrial Building System (IBS) method has brought benefits over traditional systems, such as reducing workers on construction sites, reducing building material waste, and reducing building materials on construction sites. Furthermore, the construction site will be clean and more organized, with better quality and a shorter construction period. IBS is a complex technology that will increase the quality and productivity of construction projects in Malaysia that allows the country to create an infrastructure that is comparable to other countries (IBS Survey, 2003). Lastly, IBS technology should be implemented more generally in Malaysia's construction industry since it can reduce the number of foreign workers in the construction sites. By using IBS technology, each project's time and construction period can be reduced, and social issues among foreign workers can be avoided. When the project is delayed it will cause increased costs. It also caused the construction project to be abandoned due to insufficient financial resources to cover the additional costs. Consequences of delays also contribute to time delays, over-costs, differences of opinion, legal action, negotiations, and even the amount of abandonment (Othuman Mydin, 2014). The IR 4.0 implementation for improving IBS in construction projects because the system can be developed in the construction industry as it can accelerate and simplify the construction process at the construction site. This study aims to examine the potential of IR 4.0 in the implementation of IBS in construction projects.

The Construction Industry Development Board (CIDB) should play a role by encouraging contractors to use the Industrial Building System (IBS) method as there are still many contractors who do not have the technical knowledge and experience related to the IBS method at construction sites. In Malaysia, there are many challenges and problems in construction technology. This problem occurs due to several factors that are still not addressed and it causes the use of technology such as IBS not popular use in the construction industry. As reviewed by Jabar *et al.* (2013), a lack of knowledge in structural analysis and component design in IBS among construction site workers and construction-related people

resulted in many contractors not being involved in the implementation of this IBS system. There are also critical projects that have problems in terms of cracks on structural components, connection of unstructured components resulting in poor quality results (Mohd Nawi *et al.*, 2015). Construction technology requires a high level of knowledge and compliance. So, it is difficult to complete due to lack of knowledge and compliance with the rules of work at the construction site (Rahman, 2006).

The IBS technology method provides many advantages, including the ability to improve construction quality. It can also save cost in terms of design, being simple to shape and install, and be cost-effective, as well as reducing the danger of accidents on construction sites (Maskurij *et al.*, 2019). The construction sector must remain competitive by using the same technology in construction projects. However, this high capital expenditure involves facilities in construction projects such as bed castings and the purchase of expensive machinery to complete a project. Therefore, it is very important for every contractor in the local construction sector to develop their knowledge and skills about this method of IBS technology to compete in the technologically advanced construction sector (Buyung *et al.*, 2014). Workers in the construction sector such as contractors need to adapt to IBS technology to develop skills to make it easier to do construction work. IBS technology in the Fourth industrial 4.0 (IR 4.0) is very important because it can increase the knowledge and development of the latest technology at the construction site. In addition, the potential and opportunities in the IR 4.0 implementation need to be utilized by the government to meet new demands in the construction projects. In addition, the technology operates more efficiently and has a growing focus on service users.

The Fourth Industrial Revolution (IR 4.0) implementation in IBS construction project can improve the problem of the quality, productivity and safety in the construction sites. The production of IBS components is still under monitoring and is not standard because the building materials used are not of quality resulting in uncontrolled component prices. Poor quality control among these small IBS technology manufacturers makes structures built through this IBS technology unstable and easily damaged (Kamaruddil *et al.*, 2018). This causes huge losses as the life expectancy of the building becomes short. Lack of building materials in the market is also one of the causes of delays in a construction project (Okpala, 1998). Furthermore, the delay in obtaining IBS building materials and equipment is a weakness from the suppliers and the delay in transportation can also cause the construction project to be delayed. Therefore, the objectives of this study are to focuses the potentials, the influencing factors, and the steps to promote IR 4.0 implementation for improving Industrial Building System (IBS) construction project.

2. Literature Review

2.1 Overview of Construction Project

The construction process is also known as the stage in construction work. Construction sites may have many activities. That is why there are various useful suggestions and organizational tools that must be followed by all parties to ensure everything is achieved in a timely and orderly manner. The construction process consists of many stages and is a joint effort of many parties. A large number of participating companies is the result of the wide range of expertise needed. Construction project is divided into three phases which is the pre-construction, construction, and post-construction (Ahmad Latiffi *et al.,* 2018). The construction process starts with pre-construction also known as the early phase, is the process and activities that lead up to and shortly after the decision to conduct feasibility studies and carry out the main project (Kolltveita and Gronhau, 2018). He went on to say that feasibility studies, value analyses, and the formation of project goals are the major activities in this stage of the early phase. The pre-construction phase includes creating a strategic plan for the project, creating a design, securing permits or entitlements, and gathering the labour and resources required for construction (Gilliland, 2019). The second process is construction phase. According to Kirt Gilliland (2019), the next phase of a construction project lasts from the moment physical construction begins until physical construction ends. The construction stage is the period that most people associate with construction projects, partially due to its visibility. The construction phase is the physical process of the building and all other related activities such as landscaping, overhaul, site clearing and demolition. Contractors usually do

construction work. However, it is not uncommon for contractors to divide projects into smaller phases in order to achieve success. In this case, the contractor awards individual level tenders to subcontractors and suppliers (Gerardi, 2021). The construction phase is the backbone of the industry, but contracts need to be awarded through a competitive bidding process prior to construction. Due to the competitive nature of the bidding process, mastering these bids is essential to bringing business to your company. Last but not least, the post-construction phase. Post-construction phase is where the physical construction happens, but it has not yet been handed over to the owner. It includes activities such as demobilization, a punch list, and document closeout (Gerardi, 2021). The period of time that starts from when the physical construction ends until the acquisition of the project to the owner is known as the post -construction phase. During this period, several events and processes took place. The physical work site must be cleaned. All equipment must be returned, and labour is typically demobilized and transferred to another project. Post-construction consists of all the final processes completed in order to hand the building entirely over to the building owner. This includes completing all punch list items, a final walkthrough, training, and others.

2.2 IR 4.0 Implementation for Improving IBS Construction Project

(a) Concept of IR 4.0 in Construction Project

The Digital Revolution is the foundation for the Fourth Industrial Revolution (IR 4.0), which connects technology and people. By blurring the borders between physical, digital, and biological things, the technological advance has discovered new methods to demonstrate its capabilities (Abdullah Zawawi *et al.*, 2020). The introduction of the fourth industrial revolution or IR 4.0 a substantial shift in the construction sector happens with moving the industry in the direction of more digitally developed trades. IR 4.0 is still in its early phases, and the construction industry continues to lag far behind other industries in terms of process automation and digitization (Liew, 2021). Industry 4.0 is predicted to improve construction quality and productivity while also attracting domestic and international investors. Industry 4.0 has lately become a popular term to describe the industrial world's trend toward digitization and automation (Taher, 2021).

(b) Application of IR 4.0 Technologies Implementation

According to Kupper *et al.* (2019), there are six applications for IR 4.0 such as manufacturing, Research and Development (R&D), service and after-sale, procurement, logistics and sales, and decision making process. The first, manufacturing are the companies can employ digital technology such as various types of sensors, to monitor, analyse, detect, and predict process and product quality issues by the resulting in a higher level of production visibility. Such implementation can reduce manufacturing time, effort, and cost, improve accuracy, and assist employees in performing their jobs more effectively (Kupper *et al.*, 2019). IR 4.0 can broaden the scope of R&D efforts to encompass previously off-limits services such as logistics and sales, which are all part of the value chain. Furthermore, new simulation programmes enhanced pre-production tests by realistically replicating product testing, ensuring the greatest quality of design and manufacturing process prior to execution (Kupper *et al.*, 2019). Furthermore, new collaboration platforms made it easier to communicate with customers and to better understand the market and client views. As a result, becoming more sensitive to market shifts and changing customer wants is essential. Lastly, quality management relies on fact-based decision-making. The decision-making process in the IR 4.0 paradigm is aided by the real-time flow of analytical data, which can be used to predict different scenarios and choose the best one. At every level of management, at every stage of production, and for every function inside the organisation, quality indicators are displayed. Early detection of non-conformance problems helps reduce quality costs to a bare minimum (Sader *et al.*, 2021).

2.3 Summary of the Literature Review

In summary, from the literature review that has been carried out the first objective which is to identify the potentials of the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial Building System (IBS) construction project. The second objective is to determine the influencing factors of the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial

Building System (IBS) construction project. Lastly, the third objective is to examine the steps to promote the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial Building System (IBS) construction project. These objectives of this research show in Table 1.

Table 1: Summary of literature review

Potential of IR 4.0 implementation	Influencing factors of IR 4.0 Implementation	Steps to Promote IR 4.0 Implementation
• Encourages complete industry participation • Best practices promotion • Influencing user's perceptions • Labour policy • Green construction and sustainable development • Simplified construction procedure	• Increase industry capability • Save money • Proper knowledge and awareness • Integrated cost technique • On-site manual labourers	• Financial resources • Prefabrication and modular building • Improve quality and productivity • Comprehensive preliminary assessment

(a) Potentials of IR 4.0 Implementation for Improving Industrial Building System (IBS) Construction Project

The IR 4.0 implementation for improving IBS plays a key role at the construction project to reduce manufacturing time, improve accuracy and assist employees in performing their jobs more effectively. The literature review shows that IR 4.0 technology has the potential implementation for improving IBS construction project. The IR 4.0 technology also encourages complete industry participation. IBS technology should be made up of modular component-based items that are easy to manufacture and interchange between the projects. IBS technology also can reduce foreign labour dependency and improving image of the construction industry.

(b) Influencing Factors of IR 4.0 Implementation for Improving Industrial Building System (IBS) Construction Project

Although IR 4.0 has been used for many years in the construction industry, the influencing factors of the IR 4.0 implementation were to increase industry capability. IBS technology also had a high-quality, productivity and safety at the construction industry. Therefore, IR 4.0 implementation also can help save money by decreasing incompetent labour, and lowering cost materials. The proper knowledge and awareness also important in IR 4.0 implementation, this is because at a construction industry need a labour who had an experience about the IBS technology and need to be trained to get the knowledge. The integrated cost technique of the IR 4.0 implementation had been able to provide a rational method to determining the projects has the correct cost and did not over the cost. Lastly, due to the increase in demand for machine-oriented abilities on construction sites and in factories, there is also a need for manual labour on site to handle prefabricated components.

(c) Steps to Promote IR 4.0 Implementation for Improving Industrial Building System (IBS) Construction Project

Although IR 4.0 has been used for many years in the construction industry, the influencing factors of the IR 4.0 implementation were to increase industry capability. IBS technology also had a high-quality, productivity and safety at the construction industry. Therefore, IR 4.0 implementation also can help save money by decreasing incompetent labour, and lowering cost materials. The proper knowledge and awareness also important in IR 4.0 implementation, this is because at a construction industry need a labour who had an experience about the IBS technology and need to be trained to get the knowledge. The integrated cost technique of the IR 4.0 implementation had been able to provide a rational method

to determining the projects has the correct cost and did not over the cost. Lastly, due to the increase in demand for machine-oriented abilities on construction sites and in factories, there is also a need for manual labour on site to handle prefabricated components.

3. Research Methodology

3.1 Research Design

This study will benefit by using quantitative methods. This is because quantitative research is more scientific, objective, rapid, focused, and accepted, it is preferred over qualitative research. The quantitative methods in the data collection will be carried out through surveys. This is because research using questionnaires is a reliable and fast method to collect information from respondents efficiently and in a timely manner where time is one of the main constraints. It is also to ensure the data is valid and accurate. According to Ang (2016), stated that the study in descriptive form will involve data collected from the entire general analysis that has been done such as, percentage, standard deviation, frequency and distribution of scores in the presentation of the report. In this study, the researcher uses a quantitative method that is through a questionnaire distributed by the contractor G7 to find out the implementation of IR 4.0 for the improvement of IBS construction projects. To ensure that this study runs smoothly, the researcher will implement several implementation steps so that the study can be completed in the allowed time. The research process is divided into five phases, each of which describes the full range of techniques and activities from start to finish. There are several methods that have been arranged in stages to ensure that all of the information acquired is sufficient to enable the study's seamless operation. This study has five stages a preliminary study, literature review, data collection, data analysis, conclusion and recommendation. The five stages of research methodology process as a shown in Appendix A.

3.2 Data Collection

Data collection for this study consists of two categories, namely primary data collection and secondary data collection. According to Kabir (2016), data collection is one of the most important stages in conducting research. This method was used to collect the data needed to complete this study. Data collection starts with determining what kind of data required followed by the selection of a sample from a certain population. In statistical analysis, data collecting is extremely important. There are various methods for gathering information in research, all of which fall into two categories: primary and secondary data (Douglas, 2015). Primary data is one which is collected for the first time by the researcher while secondary data is the data already collected or produced by others. In addition, the primary data is the main data obtained by the researcher himself or it is obtained directly from an individual or group involved. The study's primary data will be collected by quantitative methods, such as the distribution of questionnaires to target respondents. The questions in the surveys will be focused on the research objectives. The quantitative research contains generating numerical data or data that may be turned into useable statistics to quantify a problem. Data collected from a source that has already been published in any form is called as secondary data. The review of literature in any research is based on secondary data. According to Ajayi (2017), secondary data collection sources are government publications, websites, books, and journal articles by referring the previous researcher to finding the information that can be used the related on this study. The secondary data is to provide a broader understanding and is available from library and internet services. Therefore, the use of secondary data as data collection can help researchers to conduct research in more depth and can save researchers' time. In this study, by referring to these sources has provided a lot of guidance in understanding the use of IR 4.0 to implementation of IBS technology as well as explain how to use this technology in construction projects. Secondary sources have also helped researchers to know about IR 4.0 in improving IBS in construction projects. This secondary data is a secondary data used in this study to support the primary data obtained.

In this study, G7 contractors registered with CIDB companies are as the population that has been

selected to achieve this study conducted. G7 grade contractors were among the respondents in this survey who used IBS. According to CIDB, in the state of Selangor have 3014 G7 grade contractor companies were registered with CIDB in 2022. Therefore, the sampling was selected based on the Krejcie & Morgan, (1970), the sample size determination table as in Table 3.1 below. The sample that was selected was 346 respondents out of 3014 respondents. The respondents of this study consisted of positions as project managers, site engineers, and construction site supervisors. Therefore, the sampling was selected based on the Krejcie & Morgan by referring the sample size determination table as in Table 3.1 below. The sample that was selected was 346 respondents out of 3014 respondents. The respondents of this study consisted of positions as Project Managers, Engineers, Quantity Surveyors (QS) and Construction Site Supervisors.

Research instruments are tool that are used to collect, measure, and analyse data pertaining to a specific research topic. The researcher has chosen a research instrument in the form of a questionnaire in the study given to the G7 contractors who operate or use IBS technology in construction projects. The researcher usually determines it and links it to the study process. A pilot study can be conducted as an external pilot study apart from the main study or as an internal pilot study integrated into the main study's research plan. This article discusses the main components of an external pilot study, as well as common misconceptions and ethical concerns, and explains the proper approach for reporting the study's findings (Junyong In, 2017). This research will be focused on the G7 contractors as a respondent in this study. The purpose of this pilot study was to determine the study's reliability and validity. The validity and reliability of a study's findings are critical factors to examine in every investigation. Table 2 shows every section and content in the questionnaires used for data collection.

Table 2: Questionnaires contents

Section	Questionnaire	Measure Technique
A	The questions will be asking about the demographic of the respondents.	Frequency
B	The questions will be asking about how to identify the potentials of the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial Building System (IBS) construction project.	Likert Scale
C	The questions will be asking about how to determine the influencing factors of the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial Building System (IBS) construction project.	Likert Scale
D	The questions will be asking about how to examine the steps to promote the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial Building System (IBS) construction project.	Likert Scale

3.3 Data Analysis

Data analysis is defined as a process of cleaning, transforming, and modeling data to discover useful information for business decision-making. Data analysis is the process of extracting usable information from data and making decisions based on that knowledge. Data analysis is the process of applying logical and analytical thinking to evaluate and analyse data. The information and data gathered during these interviews were examined. Following the interviews, all the data was examined after being properly recorded. The data was organised and analysed using statistical software, such as SPSS Statistics Software. A variety of descriptive statistics, including frequencies and means, were computed from the quantitative data to disclose information about respondents' demographic characteristics, the most essential of which is learning about the IR 4.0 implementation for improving IBS construction project.

4. Results and Discussion

4.1 Response Rate and Reliability Test

The data obtained from the questionnaire was analyzed more consistently using the descriptive analysis method to find out the frequency, percentage and mean. The respondents of this questionnaire are contractors, of which the total number consists of 3500 G7 contractors in Selangor and 346 are taken as the sample size for this study. Questionnaires began to be distributed on November 05, 2022 and it took about a month by the deadline of December 15, 2022 to receive back 42% of the distributed questionnaires. Table 3 shows the rate of distributed questionnaires, received with their respective percentages.

Table 3: Response rate of questionnaire

Questionnaire	N	Response Rate (%)
Questionnaire Distributed	346	100%
Questionnaire Received	146	42%
Questionnaire Not Received	200	58%

The objective of reliability measurement is an assessment to determine the quality of data in the questionnaire and generate an accuracy result. Cronbach's alpha is a statistic commonly quoted by authors to demonstrate tests and scales that have been constructed or adopted for research projects that fit the purposes. Cronbach's Alpha Coefficient was also used to determine the level of reliability of the variables (Taber, 2018). Table 4 shows Cronbach's Alpha Coefficient to determine the level of reliability of the variables.

Table 4: Cronbach's alpha coefficient (Shamsuddin, 2015)

Coefficient Alpha, α	Level of Reliability
$\alpha > 0.9$	Excellent
0.8 to 0.9	Very Good
0.7 to 0.8	Good
0.6 to 0.7	Moderate
$\alpha < 0.6$	Poor

This research used Cronbach's Alpha to evaluate the reliability of variables and 146 sets of questionnaires were used to evaluate the reliability analysis. According to Table 4.3, an alpha value greater than 0.9 is excellent. If the coefficient alpha is between 0.8 and 0.9, it is considered very good. But if the coefficient alpha is between 0.7 and 0.8, it is considered good. However, if the coefficient alpha is between 0.6 and 0.7, it is considered moderate. Last, an alpha value less than 0.6 is considered poor. The reliability test included parts A, B, C, and D. The following Table 5 illustrated 146 questionnaires, which included the background of the respondents and the main test objectives under the reliability assessment.

Table 5: Reliability statistics

Cronbach's Alpha	Number of Items (N)
0.932	51

4.2 Respondent Background

All the background data of the respondents included respondent ages, highest academic qualification, job position, working experience, experience in IBS usage, and IR 4.0 technology usage

as shown in the following Table 6. The frequency and percentage of respondents who participated were included in the data. According to the table below, most of the respondent's ages are 41 years and above (45.9%). Apart from this, the bulk of the highest academic qualification is master (45.2%), owing to the fact that the majority of areas of study. Therefore, this also showed that the master was highly participatory.

In addition, the most job position was project manager (27.4%), owing to the fact that the majority of respondent participants are project manager. Following that, the majority of respondents had 10 years and above of working experience (55.5%), which is consistent that they had a lot of experience in construction industry. The majority of working experience in IBS usage was pre-prepared wooden frame system, accounting for 37.0%, which also means that IBS usage already implement at construction industry. Furthermore, with 33.6% of the total, the Building Information System (BIM) is the most commonly used IR 4.0 technology usage in the industry. This is because it can save time when using the technology.

Table 6: Summary of respondent's background

Item		Frequency	Percentage (%)
Respondent ages	22-25 years	14	9.6
	26-30 years	26	17.8
	31-40 years	39	26.7
	41 years and above	67	45.9
Highest academic qualification	Diploma	3	2.1
	Bachelor Degree	61	41.8
	Master	66	45.2
	PhD	16	11.0
Job Position	Site Supervisor	30	20.5
	Engineer	32	21.9
	Architect	39	26.7
	Project Manager	40	27.4
	Other (Quantity surveyor, Professional & Quality control)	5	3.4
Working experience	Less than 3 years	14	9.6
	4 - 6 years	24	16.4
	7 - 9 years	27	18.5
	10 years and above	81	55.5
Experience in IBS usage	Precast concrete system	52	35.6
	Pre-prepared wooden frame system	54	37.0
	Precast block system	19	13.0
	Steel frame system	12	8.2
	Steel mold system	9	6.2
IR 4.0 technology usage	Prefabrication and modular construction	37	25.3
	Cloud-based system	1	0.7
	Big data	6	4.1
	Building information modelling (BIM)	49	33.6
	Autonomous construction	3	2.1
	Augmented reality	28	19.2
	Artificial intelligence	11	7.5
	Internet of thing	1	0.7
	Advanced building materials	10	6.8

4.3 Potentials of the Fourth Industrial Revolution (IR 4.0) Implementation for Improving Industrial Building

According to Table 7 below, it determines the potentials of the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial Building System (IBS) construction project. The highest means for potentials of the IR 4.0 is 3.96 which "*improve IBS installation skills*" within 146 respondents and at the same time the standard deviation is 1.030. The lowest mean for potentials of the IR 4.0 is

3.40 in ranking 18 which is "*provide a comprehensive training program on IR 4.0 technology implementation in IBS project"* and the standard deviation is 1.284. Thus, the average mean is higher with 3.67.

From the table below, the average mean for potentials of the IR 4.0 implementation for best practices promotion was 3.84. While the average mean for potentials of the IR 4.0 for encourage industry participation was 3.83, and for simplified construction procedure was 3.64. The average mean for potentials of the IR 4.0 for sustainable construction was 3.60 and for influencing user's perceptions was 3.58. Lastly, the average mean for potentials of the IR 4.0 for labour policy was 3.54.

The highest mean for potential of the IR 4.0 implementation which was "*improve IBS installation skills*" (3.96) and the standard deviation was 1.030 within 146 respondents. IBS need a workforce capable of producing and installing building components either on-site or off-site. Workers are expected to be informed about the materials, procedures, and tools used in the construction of structures such as houses, buildings, highways, and roads. In reality, construction employees are frequently found to have little knowledge and abilities, and to be acclimated to traditional techniques rather than IBS (Ahmad Mohsen *et al*., 2019). Meanwhile, the lowest mean was "*Provide a comprehensive training program on IR 4.0 technology implementation in IBS project"* which was 3.40 and the standard deviation was 1.284 as shown in table 4.58 below. Construction professionals have limited information about this new implementation in construction projects, resulting in inadequate knowledge about this transition process (Aripin *et al*., 2019). However, most respondents believed the IBS technology can reduction cost when using Fourth Industrial Revolution (IR 4.0) implementation.

Table 7: Summary of potentials IR 4.0 implementation

No	Item	N	Mean	Standard Deviation	Ranking
Encourage industry participation					
1.	Improve the image of the construction industry	146	3.65	1.14	7
2.	Increase IR 4.0 technology usage in the IBS project	146	3.87	1.01	3
3.	Improve IBS installation skills	146	3.96	1.03	1
	Average Mean			3.83	
Best practices promotion					
1.	Increase the promotion of IBS production globally	146	3.85	1.09	4
2.	Improving supply chain management in the IBS project	146	3.90	1.03	2
3.	Effective management with well-organized	146	3.76	1.15	5
	Average Mean			3.84	
Influencing user's perceptions					
1.	Improve the quality of IBS production with IR 4.0 technology implementation	146	3.60	1.25	12
2.	Increase awareness if IR 4.0 technology implementation in IBS project	146	3.59	1.22	13
3.	Improve the quality of IBS design with IR 4.0 technology implementation	146	3.54	1.23	15
	Average Mean			3.58	
Labour policy					
1.	Increase labour competitiveness on IR 4.0 technology implementation in IBS project	146	3.64	1.25	9
2.	Improve labour skill training on IR 4.0 technology implementation in IBS project	146	3.58	1.19	14
3.	Provide a comprehensive training program on IR 4.0 technology implementation in IBS project	146	3.40	1.28	18
	Average Mean			3.54	
Sustainable construction					
1.	Potential of IR 4.0 technology implementation for sustainable IBS projects	146	3.63	1.13	11
2.	Potentials of IR 4.0 technology to preserve buildings for sustainable IBS projects	146	3.64	1.17	9
3.	Potentials of IR 4.0 technology to avoid accidents for sustainable IBS projects	146	3.51	1.22	17
	Average Mean			3.60	
Simplified construction procedure					

1.	Cost and time saving with IR 4.0 technology implementation in the IBS project	146	3.73	1.17	6
2.	Improve the quality of the IBS project with IR 4.0 technology implementation	146	3.54	1.22	15
3.	Reduce construction workers with IR 4.0 technology implementation for the IBS project	146	3.65	1.18	7
	Average Mean			3.64	
	Total Average Mean			3.67	

The other potentials of IR 4.0 implementation were cost reduction and less construction time. Using IBS technology on construction industry can reduce cost, this is because used a prefabricated technology can reduce the labors at the construction site. Meanwhile, IR 4.0 implementation also can reduce time. This is because the construction project used IBS technology better than traditional technology. Additional feedback from the respondents based on potentials of the IR 4.0 implementation as follow.

- Cost reduction
- Environment friendly
- Less construction time
- High quality and better finishes

4.4 Influencing Factors of the Fourth Industrial Revolution (IR 4.0) Implementation for Improving Industrial Building System (IBS) Construction Project

Table 8 below illustrated the influencing factors of the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial Building System (IBS) construction project. The highest mean for influencing factors of the IR 4.0 was 3.72 which "*Upgrade complex machinery to produce quality IBS components*" within 146 respondents and at the same time the standard deviation is 1.131. The lowest mean for influencing factors of the IR 4.0 is 3.05 in ranking 15 which is "*Provide education on professional skill training of IR 4.0 technology implementation for the IBS project"* and the standard deviation is 1.312. Thus, the average mean is higher with 3.40.

From the table below, the average mean for influencing factors of the IR 4.0 implementation for proper knowledge and awareness was 3.57. While the average mean for influencing factors of the IR 4.0 for increase industry capability was 3.53, and for save money was 3.45. Lastly, the average mean for influencing factors of the IR 4.0 for integrated cost technique was 3.39 and for on-site manual laborers was 3.27.

The highest mean for influencing factors of the IR 4.0 implementation which was "*Upgrade complex machinery to produce quality IBS components*" (3.72) and the standard deviation was 1.131 within 146 respondents. IBS manufacturing facilities are also looking for strategies to attain a condition where machines are very efficient and able to perform repetitive operations with standardised components. The government enforced regulations requiring the construction sector to utilised IBS components (Azman *et al*., 2011).

Next, the lowest mean was "*Provide education on professional skill training of IR 4.0 technology implementation for the IBS project"* which was 3.05 and the standard deviation was 1.312 as shown in table 4.58 below. According to Franken (1993), the 'tendency to produce or recognise ideas, alternatives, or possibilities that may be beneficial in solving issues, interacting with others, and amusing ourselves and others' is defined as creativity. To fully realise the advantages of all the new things for the future of the new goods, ways of working, and technologies, human employees in the future will need to be creative. Robots cannot presently compete with humans in terms of inventiveness. The future workplace will necessitate new methods of thinking, and human ingenuity will be essential.

Table 8: Summary influencing of IR 4.0

No	Item	N	Mean	Standard Deviation	Ranking
Increase industry capability					

1.	Improve the quality and productivity of the IBS project	146	3.53	1.19	5
2.	Upgrade complex machinery to produce quality IBS components	146	3.72	1.13	1
3.	Provide competent employees for IBS projects	146	3.34	1.23	10
	Average Mean			3.53	
Save money					
1.	The optimal coordination of IBS components by IR 4.0 technology	146	3.63	1.19	4
2.	Reduce manpower with IR 4.0 technology implementation in the IBS project	146	3.37	1.20	9
3.	Save space construction site with IR 4.0 technology implementation in the IBS project	146	3.34	1.33	10
	Average Mean			3.45	
Proper knowledge and awareness					
1.	Improve skill knowledge with IR 4.0 implementation for IBS components installation	146	3.68	1.22	3
2.	Tightening the rules for labor workers during the implementation of IR 4.0 for the IBS project	146	3.33	1.34	13
3.	Increase training level for skilled workers with IR 4.0 technology implementation for the IBS project	146	3.69	1.17	2
	Average Mean			3.57	
Integrated cost technique					
1.	Provide accurate work planning and scheduling in the implementation of IR 4.0 for the IBS manufacturing process	146	3.42	1.31	7
2.	Provide dynamic IBS project processes with IR 4.0 technology implementation	146	3.34	1.25	10
3.	Provide real-time cost price of IBS components by the implementation of IR 4.0 technology	146	3.41	1.21	8
	Average Mean			3.39	
On-site manual laborers					
1.	Improve labor skills on IBS component coordination with the implementation for the IBS project	146	3.32	1.29	14
2.	Provide education on professional skill training of IR 4.0 technology implementation for the IBS project	146	3.05	1.31	15
3.	Provide safety equipment with IR 4.0 implementation to control labor activity in the IBS project	146	3.45	1.15	6
	Average Mean			3.27	
	Total Average Mean			3.40	

The other of the influencing factors of the IR 4.0 implementation were high technology and improve labor skill. IR 4.0 implementation for improving IBS construction project is the high technology. This is because IBS is the modern technology in construction industry and it can produce the high-quality products. However, IR 4.0 implementation also need a labor who had the experience and knowledge about the technology, so the labors can manage and handle the machines safely. Additional feedback from the respondents based on the influencing factors of the IR 4.0 implementation as follow.

- High technology
- Improve labor skill
- Reduce workers at site
- Provide safety equipment at construction site

4.5 Steps to Promote the Fourth Industrial Revolution (IR 4.0) Implementation for Improving Industrial Building System (IBS) Construction Project

Based on Table 9 below determines the steps to promote the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial Building System (IBS) construction project. The highest mean of steps to promote IR 4.0 is 3.51 which "*Promote high-quality machine with IR 4.0 implementation*

for the IBS component assembly process" within 146 respondents and at the same time the standard deviation is 1.244. The lowest mean for influencing factors of IR 4.0 is 3.10 in ranking 12 which is "*Promote the systematic use in financial resources with IR 4.0 technology implementation in IBS projects"* and the standard deviation is 1.261. Thus, the average mean is higher at 3.30.

From the table below, the average mean for the steps to promote the IR 4.0 implementation for prefabrication and the modular building was 3.37. While the average mean for steps to promote the IR 4.0 for improving quality and productivity was 3.30, and for comprehensive preliminary assessment was 3.26. Lastly, the average mean for steps to promote IR 4.0 for financial resources was 3.24.

The highest mean for steps to promote the IR 4.0 implementation was "*Promote high-quality machine with IR 4.0 implementation for the IBS component assembly process*" (3.51) and the standard deviation was 1.244 within 146 respondents. According to Kasim (2015), rather than traditional ways, IBS implementation has been identified as a suitable strategy to boost capabilities within the industry. IBS is a building technique in which the components are created in a factory rather than on the job site. IBS adoption has proven to be more cost-effective since it can assist save money by eliminating incompetent labour and construction materials while also being more efficient, safe, and cleaner with enhanced and higher quality (Bon *et al*., 2000).

Next, the lowest mean was "*Promote the systematic use in financial resources with IR 4.0 technology implementation in IBS projects"* which was 3.10 and the standard deviation was 1.261 as shown in table 4.58 below. According to Kiel *et al*. (2017), Companies appear to be having difficulty obtaining adequate financial resources to engage in and stay up with the latest IR 4.0 technologies. The application of IR 4.0 in construction necessitates a large investment with an undetermined rate of return. Furthermore, providing suitable technical training for workers to become familiar with the latest technology necessitates a significant investment (Abubakar *et al*., 2014).

Table 9: Summary steps promoting IR 4.0

No	Item	N	Mean	Standard Deviation	Ranking
Financial resources					
1.	Promote the systematic use in financial resources with IR 4.0 technology implementation in IBS projects	146	3.10	1.26	12
2.	Promote automation of financial components with IR 4.0 implementation in the IBS project	146	3.24	1.19	8
3.	Promote comparable quality components with IR 4.0 implementation in the IBS project	146	3.39	1.13	3
	Average Mean			3.24	
Prefabrication and modular building					
1.	Promote the use of IR 4.0 technology for prefabrication and modular building process in the IBS project	146	3.40	1.22	2
2.	Use of cutting-edge technologies such as 3D modelling in IBS projects	146	3.19	1.28	11
3.	Promote high-quality machine with IR 4.0 implementation for the IBS component assembly process	146	3.51	1.24	1
	Average Mean			3.37	
Improve quality and productivity					
1.	Promote digital production system with IR 4.0 technology implementation for IBS components	146	3.27	1.16	7
2.	The use of modern applications such as gadgets and devices in IR 4.0 technology for the IBS project	146	3.39	1.12	3
3.	Improving digital interoperability in an integrated	146	3.23	1.24	9

	manner in the IBS project by using IR 4.0 technology				
	Average Mean			3.30	
Comprehensive preliminary assessment					
1.	Provide a comprehensive training program with IR 4.0 technology implementation in the IBS project	146	3.29	1.22	5
2.	Increase the skill level in the production of IBS components through IR 4.0 technology	146	3.21	1.16	10
3.	In the construction industry, IR 4.0 technology will be used to set the timeline for implementing the IBS project	146	3.28	1.06	6
	Average Mean			3.26	
	Total Average Mean			3.30	

The other steps to promote the IR 4.0 implementation were applying for modern applications and promotion through CIDB Malaysia. The IR 4.0 implementation for improving IBS construction projects also modern applications, this is because IBS technology can optimised the used of material and easy installation. However, IR 4.0 implementation also need to do the promotion through CIDB Malaysia because it had been more widely introduced in other country. Additional feedback from the respondents based on the steps to promote of the IR 4.0 implementation as follow.

- Support from government
- Promotion through CIDB Malaysia
- Applying modern applications
- Optimised used of materials

5. Conclusion

The main potentials of the IR 4.0 implementation recorded as the total average mean was 3.67. The highest average mean was 3.84 which is “best practices promotion”. Therefore, the IR 4.0 implementation are the best practices promotion in construction industry. Meanwhile, the moderate average mean of potential of IR 4.0 was 3.60 which is “sustainable construction”. However, the lowest average mean of potential of IR 4.0 is 3.54 which is “labour policy”. The main influencing factors of the IR 4.0 implementation recorded as the total average mean was 3.40. The highest average mean was 3.57 which is “proper knowledge and awareness”. The moderate average mean was 3.45 which is “save money”. The lowest average mean was 3.27 which is “on-site manual laborers”. The main steps to promote the IR 4.0 implementation recorded as the total average mean was 3.30. The highest average mean was 3.37 which is “prefabrication and modular building”. The moderate average mean was 3.30 which is “improve quality and productivity”. Lastly, the lowest average mean was 3.24 which is “financial resources”. Most of the respondents disagreed because IR 4.0 technology need a highest cost in construction project.

This research was to study on the fourth industrial revolution (IR 4.0) implementation for improving IBS construction project. Research limitations for G7 contractors that state in Selangor. During this analysis, there were a few challenges and limitations encountered. The first limitation is difficulties of contacting respondent. Some of the respondents were missed and had unanswered queries which caused an issue in data collection. This is because the respondent, who are not able to engage in this study were in a rush hour and did not have any time to complete the questionnaire. The next limitation is time constraint in getting the data from the respondents. This is because the respondents who will react to the question will need a period of time to address the question. Additionally, respondents were unmotivated in filling out the questionnaire. Accordingly, the cumulative data gathered by the researcher is just 146 out of 346 respondents.

The contribution of this research study to the construction industry is that contractors can be better understand and implement the Fourth Industrial Revolution (IR 4.0), This study can provide some knowledge and give awareness to contractors about the benefits of IBS and to learn more about IBS by participating in courses provided by CIDB. The programs provided by CIDB can provide more knowledge and knowledge about IBS to the construction industry. This can be used in the future and applied in the next construction project. This research study has contributed the academic reference that related to the potential, influencing factors and steps to promote the Fourth Industrial Revolution (IR 4.0) implementation for improving Industrial Building System (IBS) construction project. This research contributed knowledge input to the academic reference of the potential of IR 4.0 implementation. IR 4.0 implementation may become an alternative to conventional technology system methods. Moreover, this research study also contributed knowledge input to the academic reference of the influencing factors IR 4.0 implementation for improving Industrial Building System (IBS) construction project. Readers can have a deeper understanding of the steps to promote the IR 4.0 implementation for improving Industrial Building System (IBS) construction project. It can indirectly improve the knowledge of IBS among the parties involved. With this research can share the experience in making it a success.

The recommendations for construction industry of IR 4.0 implementation are not only need a high-quality product, but it also can reduction cost from the projects. The usage of IBS may improve the architecture of a building and make it more conducive and safe building. It is possible to enhance design and construction requirements. The usage of IBS may decrease construction time, waste, and provide a clean and safe project site environment, as well as generate excellent goods. Building maintenance may be made more efficient and cost-effective. Moreover, this may be shown by predicting maintenance cost costs at the beginning of building maintenance planning. Maintenance employees' wages can be cut, and maintenance time saved. Damage to the building space is readily and quickly repaired. On the basis of the findings of this paper, recommendations for further research are made. In order for this research on automated equipment identification in the construction industry to continue, the following suggestion should be viewed and considered as a guide for future research. This study employs a quantitative technique in this analysis, in which respondents are requested to fill out a research questionnaire by picking the best response for each question to concentrate on their perspectives on each issue. In the future, for any researcher who wishes to do research in this area of study will be able to combine the two research techniques that are quantitative and capable of providing a qualitative approach. This will provide a clear insight into the report of the findings.

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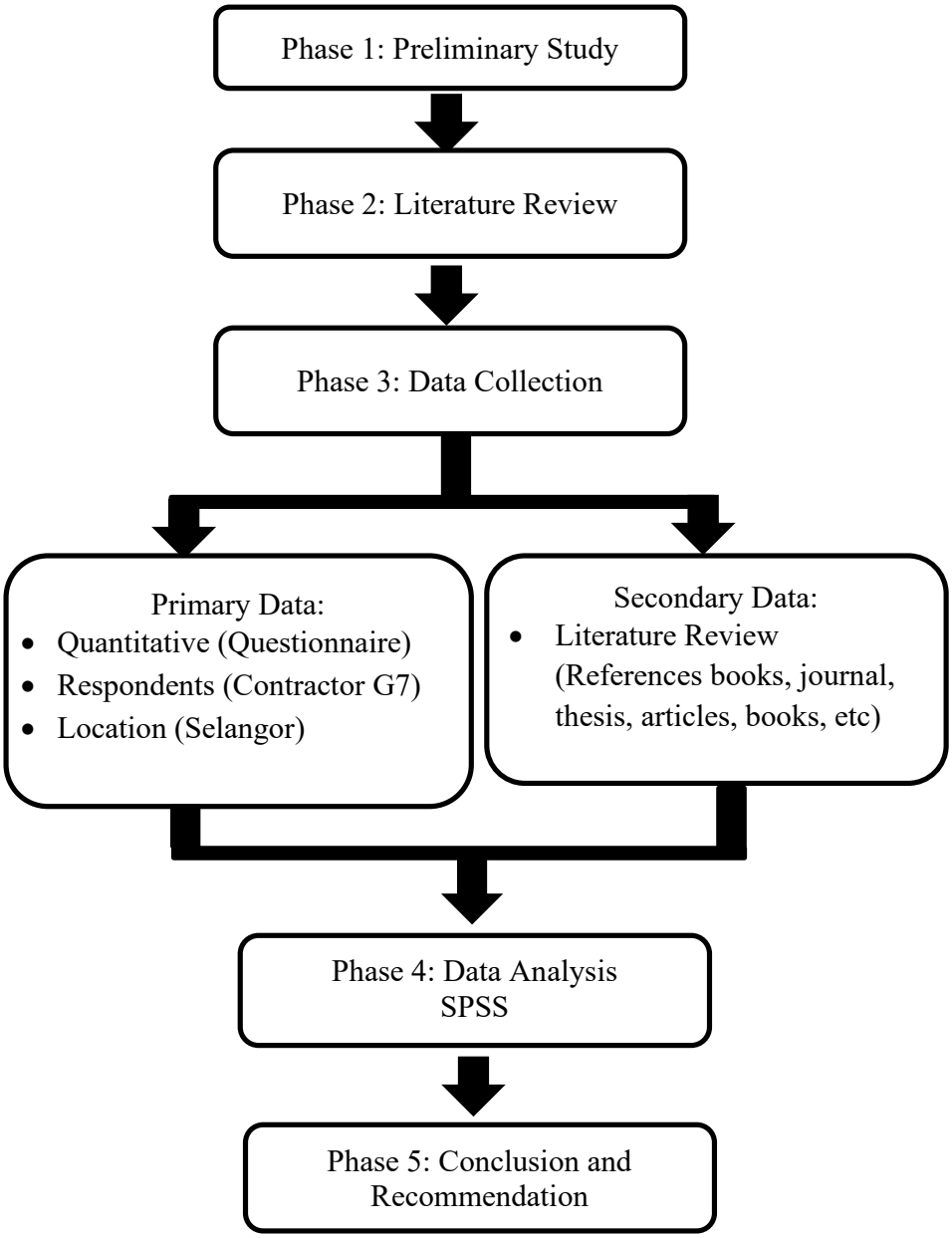
Appendix A


Phase 1: Preliminary Study
Phase 2: Literature Review
Phase 3: Data Collection
Primary Data:
Quantitative (Questionnaire)
Respondents (Contractor G7)
Location (Selangor)
Secondary Data:
Literature Review (References books, journal, thesis, articles, books, etc)
Phase 4: Data Analysis SPSS
Phase 5: Conclusion and Recommendation