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Benefits and Challenges of Implementing Building Information Technology (BIM) in Industrialised Building System (IBS) Construction Project in Malaysia

Woo Xian Yang[1], Peniel Ang Soon Ern[2]*

[1]Woo Xian Yang,
UTHM Kampus Pagoh, Hab Pendidikan Tinggi Pagoh,
KM1, Jalan Panchor, 84600, Panchor, Johor, MALAYSIA

[2]Peniel Ang Soon Ern,
UTHM Kampus Pagoh, Hab Pendidikan Tinggi Pagoh,
KM1, Jalan Panchor, 84600, Panchor, Johor, MALAYSIA

*Corresponding Author Designation

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Abstract: BIM offers new chances to improve the efficiency of IBS. BIM acts as a digital representation of constructed facility and offers an important line of 'integration' which is crucial in IBS. According to the recent research, researchers believe that BIM can lead to cost reduction and improve budgeting and cost estimating capabilities in IBS construction project. As an addition to its capabilities BIM has also has the potential to improve the designing process in IBS project. However, back to Malaysia, the development of construction industry in Malaysia are not looking up to expected which has the lowest contribution in economic productivity levels and adaption is needed in construction industry to make it up to expected. However, the implementation of BIM in IBS is relatively low since IBS contractors in Malaysia has difficulties such as technical problems, management, environmental issues, financial problems and legal issues in implementing BIM in IBS construction project. Hence, this research is aimed to identify the benefits of implementing BIM in IBS construction and investigate challenges of BIM implementation in IBS construction in Malaysia construction industry. A questionnaire survey was distributed to Grade 7 IBS contractors with BIM experience in Wilayah Kuala Lumpur and 44 respondents were received]. The data obtained was analyzed by frequency analysis by using SPSS software. Based on the results, the most agreed benefits are visualization of design, improve budgeting and cost estimating, monitoring and controlling cost and cash flow, installation process, and initial work process while the most agreed challenges of implementing BIM in IBS construction industry in Malaysia are high cost required for BIM training, high cost required for BIM experts and tools, lack of protection for intellectual property right, lack of insurance applicable to BIM implementation in IBS and lack of BIM standard.

Corresponding author: peniel@uthm.edu.my

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1. Introduction

Building Information Modelling (BIM) was one of the choices being discussed the most on construction industry as it brought in beneficial impact to construction industry. BIM is defined as the process supported by various tools, technologies and contracts involving the generation and management of digital representations of physical and functional characteristics of places [1]. The characteristic of BIM which are equipped with professional tool on architectural, engineering and construction field made it become one of the best choice for construction industry. The modern and developed countries such as United States of America (USA), Singapore and Canada are frequently using it in construction industry. However, the implementation of BIM in Malaysia is too low. Construction Industry Development Board (CIDB) had showed effort to stimulate the implementation of BIM. Public Works Department (PWD) also had its own effort on it.

Beside BIM, there is also a construction technology called Industrialised Building System (IBS). IBS is the term used in Malaysia, it is known as Pre-Fabricated or Pre-Fab Construction, Modern Method of Construction (MMC) and Off-Site construction [1]. It is a construction method where it's construction components are manufactured off site, then transported and positioned at site and assemble into structure at last for minimum unnecessary site work [2]. IBS is classified into five classifications which consists of precast concrete system (walls, slabs, column, 3D components), steel formwork system, steel framing system, prefabricated timber framing systems and block work systems [3]. The introduction of IBS is in the early 1960s and the first implementation in Malaysia was located at Jalan Pekeliling which consists of 4 blocks of 4-storey flats and 40 storey shops lots and 7 blocks of 17 storey flats [4]. However, in 2019, there was only 35% of the industry had took part in implementation of IBS [4].

However, IBS has a problem of lacking on the involvement on IT and technology. It would be a problem on searching engineering information or properties while designing the structure. However, on the global level, all the advanced countries which leads in the construction industry, BIM is normally implemented in IBS construction process such as decision making, project analysis, management, maintenance and so on [5]. From the selection of BIM implementation in IBS in foreign country, it can be concluded that there are benefits contributed by BIM implementation in IBS construction industry [6]. However, back to Malaysia, the development of construction industry in Malaysia are not looking up to expected which has the lowest contribution in economic productivity levels in 2019. Adaption is needed in construction industry to make it up to expected. However, adaption to BIM is the biggest challenges that restricting the implementation of BIM in IBS construction project [7]. This is due to BIM tool might not suit the IBS construction in Malaysia yet although it fit the development process in foreign country [8] and it resulted the stakeholders in the current market faced difficulties in effectively reengineering the existing process into BIM implementation. Apart from that, there are five categories of challenges that restricting the BIM implementation in IBS construction project which include technical problems, management, environmental issues, financial problems and legal issues [9]. Therefore, the finding of this research discuss the current situation in the Malaysia construction industry on the aspect of BIM implementation in IBS, specifically in the benefits and challenges to increase the rate of implementation of BIM in IBS to improve the construction industry in Malaysia.

1.2 Aim and Objective

The aim of this research project is to study the BIM implementation in IBS construction in Malaysia. The specific objectives of the research include:

- To identify the benefits of integrating BIM in IBS construction project in Malaysia
- To determine challenges of BIM implementation in IBS construction in Malaysia

1.3 Scope of study

This research focused on projects that used BIM in IBS as part of the construction project in Malaysia. This was aimed to study and find out the differences due to the presence of BIM in IBS project to reach the objective of this research which is to study the benefits and challenges of implementing BIM in IBS in Malaysia construction industry. This research was conducted in Wilayah Persekutuan Kuala Lumpur which is the capital city of Malaysia. The capital city of a country usually contributes more on construction industry. The reason of choosing Kuala Lumpur to conduct this research is due to Kuala Lumpur having many high grade contractors and big size of companies. Meanwhile, implementation of BIM in IBS in construction industry usually can be afford by the main contractor and big company towards their construction projects. Thus, Kuala Lumpur is the best area to study this research. The research will scope down to Grade 7 IBS contractors (pre-cast concrete framing, panel and box system) with BIM experience. This is due to Grade 7 contractors are more well-verse to technology usage whether directly or indirectly involved with BIM projects.

2. Literature Reviews

2.1 Implementation of BIM in IBS

BIM and IBS are two paradigms that have been claimed to potentially address the long-standing issues such as lower efficiency and productivity in construction industry and profoundly innovate the construction industry. The implementation of BIM in IBS is to improve the construction industry. As BIM implementation in IBS brings in advantages, there are more studies are being devoted in this area. Implementation of BIM in IBS is known as a methodology to utilize the advantages and minimize the weakness of from both site. With the implementation of BIM in IBS, it does bring in numerous benefits in the construction industry. However, with the high level of technology of BIM, it will be challenges or barriers to be adopted by the construction industry in Malaysia.

2.2 Benefits of implementing BIM in IBS

BIM has potential to helps in IBS work process which consist of initial work, component production, transportation, installation and finishing process [10]. Also, in designing process, BIM can improve IBS designing process with the visualization of design which can bring in benefits such as smoothen communication on design team, better delivery of details of design, and better sharing and storing of data and design. These not only reduce rework and execution time in all phases of design but also reduce the modification needs that rise during the construction phase, on site [11]. BIM's technical capabilities give users the chance to not only reduce building costs but also monitor and control the costs and the cash flows related to them through all lifecycle of a construction project. According to the recent research, contractors believe that BIM can lead to cost reduction and improve budgeting and cost estimating capabilities. As an addition to its capabilities BIM has also has the potential to reduce costs by facilitating training and improving experience of the workforce [12].

2.3 Challenges of implementing BIM in IBS

The biggest challenges that restricting the implementation in IBS project is the adaption to BIM. The stakeholders in the current market are having difficulties in effectively reengineering the existing process into BIM implementation. Since BIM is a model development tool, it will increase the amount of model developing work for extra time, cost and effort on the BIM developing. Thus, extra work will be added on the development team [13]. The BIM implementation needed professional interactivity throughout a project. However, the lack of BIM profession interaction in Malaysia is the main challenge in the environmental issues. BIM requires large amount of cost and time for the training for profession. Meanwhile, there is overestimation of the cost needed for BIM profession training [7]. As well as

training, the BIM experts and tools are expensive too. The medium size developing companies are not affordable to hire BIM experts and tools since there is financial problem. Numerous researchers stress over the issues related with intellectual property rights more than BIM execution, for example, BIM model possession and information proprietorship contained inside the model. Appropriate legislation defending the IP rights is not yet available [5]. Absence of standardization from authorities is regularly experienced challenges on BIM usage. The implementation of BIM depends on standards for overseeing its' procedure, activities, and deliverables. There is no standard currently available for implementing BIM in IBS.

3. Methodology

The flow of this methodology starts from the study of benefits and challenges of integrating BIM in IBS construction industry in Malaysia. Since this study is based of quantitative method, the data collections were made specifically on population which are related to construction industry. A sampling of population involved in construction industry were targeted in this study. A questionnaire was used as the medium to collect the data from the respondent population. Meanwhile, literature reviews based on journal, articles and researches were done to obtain the ideas as well as data. Figure 1 shows the flow of the study.

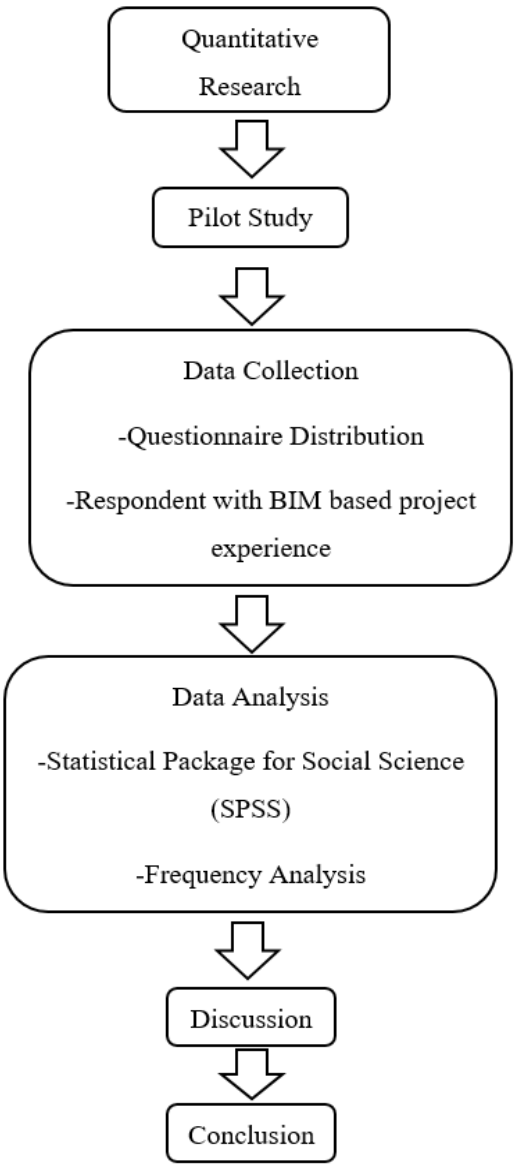

Figure 1: Flowchart of Methodology

3.1 Population and Sampling

A sample is a subgroup of population which includes in representing the selected population that is responsible for providing data as research information. A sample is any part of a fully defined population which the members of the population have an equal and mutually exclusive chance of being selected.

This study focused on the population on Grade 7 contractors who have experience in IBS construction which used pre-cast concrete framing, panel and box system. Also, the respondents must have BIM experience in IBS project. In addition, the population are targeted from main cities in Malaysia, Kuala Lumpur. The city consists of more construction companies. There are 93 IBS contractors available, therefore, a minimum of 40 respondents are needed for the sample size. The responded rate was 47.3% where 44 responds were received.

$$Sample\ size = \frac{\frac{p(1-p)(z)^2}{e^2}}{1+\frac{p(1-p)z^2}{Ne^2}}$$

$$= \frac{\frac{0.5(1-0.5)(1.645)^2}{0.1^2}}{1+\frac{0.5(1-0.5)1.645^2}{93(0.1)^2}}$$

$$= 40$$

3.2 Questionnaire Survey

A questionnaire survey was developed based on the findings from the variable elements identified in the literature review. The survey questions were established to determine the benefits and challenges of BIM implementation in the IBS projects. The findings from the questionnaire survey will contribute in achieving the objectives. The questionnaires done are based on the 5-point Likert scale rating. The scale ranges from strongly agree to strongly disagree with a score rating of 1 to 5 respectively. The format of a 5-point Likert scale is shown in table 2.

Table 2: Likert Scale

Rating	1	2	3	4	5
Likert Scale	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3.3 Pilot Study

Pilot study is the small-scale version of proposed research study that run earlier on the major event with the purpose of spotting and revising any overlook problems. It is crucial as to ensure that the elimination of misunderstanding, misleading, confusing or offensive regarding the questions provided as pilot study provided a reliability on the questions as the process required to pass through the representative people [14]. Few result could be obtained from pilot study which included the long-time taken to answer the question, unclear instruction as well as the length of item asked. After the pilot study, few adjustments were needed in order to produce a simpler and precise manner in helping the respondents to have a better understanding regard to the question distributed. Due to the Covid pandemic, five contractors nearby the researcher, who were from Kuala Kangsar were interviewed for the pilot study.

Cronbach's Alpha test is selected to run the reliability test of the data. Cronbach's Alpha is an estimation of the score reliability based on the internal consistency among the items. The Cronbach's Alpha has a coefficient ranged from 0 to 1 where 0.8 are the acceptable value for the score's reliability. In other words, the higher the coefficient of Cronbach's Alpha, the higher the reliability. The Cronbach's Alpha test was conducted using SPSS and 0.847 was obtained and shown in table 3.1. In others words, the questionnaire was reliable for this research since the coefficient is higher than 0.8.

Table 3: Cronbach's Alpha

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.847	0.844	37

3.4 Data Analysis

The data obtained in questionnaire survey was analyzed by using Window version 27.0 Statistical Package for Social Science (SPSS). It is a Windows based program that can be used to perform data entry and analysis and to create tables and graphs. SPSS is capable of handling large amounts of data and can perform all of the analyses covered in the text and much more. SPSS is commonly used in the Social Sciences. Statistical analysis of the frequency of benefits and barriers will be conducted using SPSS to get the findings of the study. The types of analysis were consisted of frequency analysis. This ensures data obtained is organized to ease the analysis and discussion process.

4.0 Results and Discussion

The data obtained from the questionnaire survey were obtained and analyzed using SPSS to show the agreement of respondents on the benefits and challenges of implementing BIM in IBS. There were total 44 respondents. The data analysis was shown below.

4.1 Demography of Respondents

The demography part contains three items of the respondents' background which are the position, experience in IBS construction project, experience of implementation of BIM in IBS and number of full time staffs in company. All items are analyzed and presented by using IBM SPSS and Microsoft Excel software.

Table 4 and Figure 2 showed the position of the respondents and their percentages over the total number of respondents which were 44 people. The positions that ranked the most are general manager and engineer which are 12 respondents (27.3 %) for both positions. Then, it followed by 9 project managers which recorded 20.5 % of the total respondents. Quantity surveyor trailed by recording 7 out of 44 respondents which contributed 15.9 % of the respondents. There was only one architect involved in this questionnaire survey while the remaining 3 respondents are made up of BIM engineer, assistant BIM manager and site supervisor.

Table 4: Position of Respondents

Position	Frequency	Percent (%)
General Manager	12	27.3
Project Manager	9	20.5
Architect	1	2.3
Engineer	12	27.3
Quantity Surveyor	7	15.9
Other	3	6.8

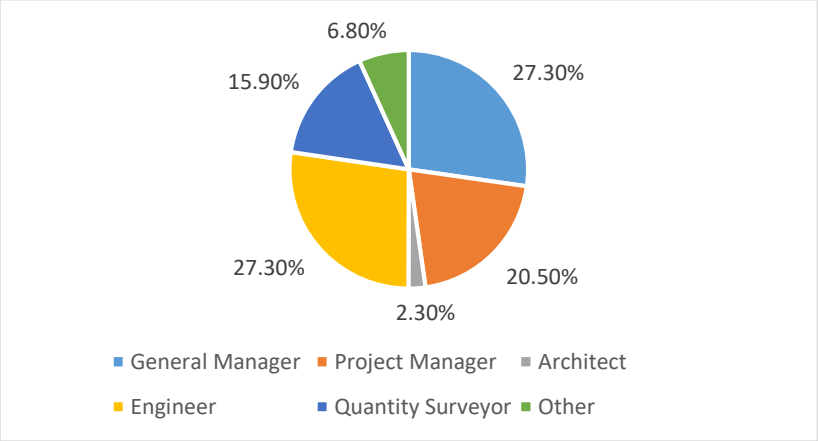

Figure 2: Percentages of the respondent's position

Table 5 and Figure 3 showed the years of experience of IBS of the respondents. Most of the respondents are from 6-10 years of experience in IBS category (27 respondents) which recorded 61.4 %. The second most are from 1-5 years of experience in IBS which recorded 12 respondents (27.3 %). Then, it followed by 4 respondents which has 11-15 years of experience in IBS. There is only one respondent who has more than 16 years of experience in IBS.

Table 5: Years of Experience

Years	Frequency	Percent (%)
1-5 years	12	27.3
6-10 years	27	61.4
11-15 years	4	9.1
More than 16 years	1	2.3

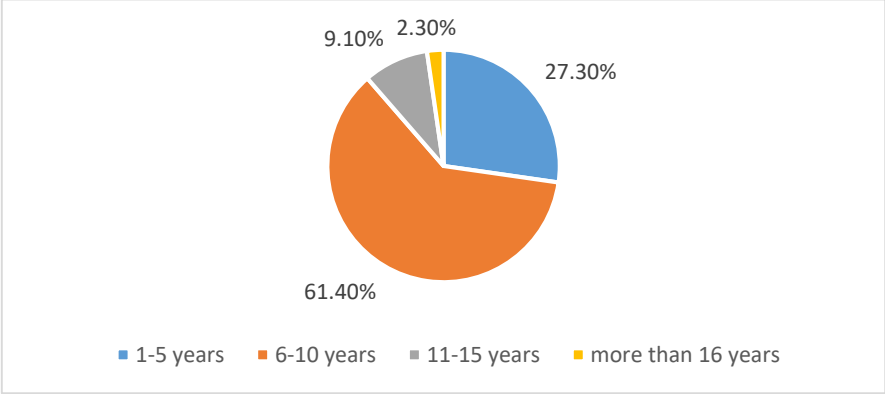

Figure 3: Percentages of Years of Experience in IBS

From Table 6 and Figure 4, there are 30 respondents (68.2 %) are from company that have 11-50 people of full time staff. Then followed by 8 respondents in company that have 51-100 people, 5 respondents from company has less than 11 people while only one is in company that has 101-250 full time staff.

Table 6: Number of Full Time Staff in Company

Size	Frequency	Percent (%)
1-10 people	5	11.4
11-50 people	30	68.2
51-100 people	8	18.2
101-250 people	1	2.3

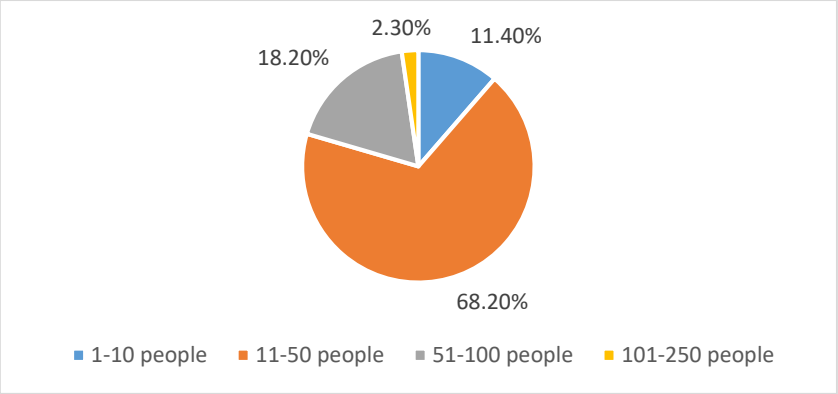

Figure 4: Percentages of Number of Full Time Staff in Company

3.1 Benefits of implementing BIM in IBS construction project

This section discussed the respondents' level of agreement on the benefits brought by implementation of BIM in IBS construction project in Malaysia. there were total 4 sections which consisted of BIM improve the workflow process on IBS project, BIM is beneficial in IBS designing process, BIM can save cost in IBS project and BIM can save time in IBS project. The tables provided in this section contain information such as frequency, percentages and mean of the respondents' score.

Table 7 showed the mean score on BIM can improve the workflow of IBS project. From table 7, the highest mean is 4.39 on installation process of IBS project. Then followed by finishing process, initial work process, component production process and transportation process. Transportation process recorded the lowest mean which is only 3.16 while other processes are exceeding mean score of 4.00. BIM has potential to helps in IBS work process which consist of initial work, component production, transportation, installation and finishing [10]. Generally, the overall mean from the respondents has more than 4.00 mean score. However, from the respondents, the transportation process recorded the mean scores of 3.16. Hence, it can be said that the implementation of BIM can improve the workflow of IBS project.

Table 7: BIM improve the workflow of IBS project

	Mean Score
Initial Work Process	4.30
Component Production Process	4.16
Transportation Process	3.16
Installation Process	4.39
Finishing Process	4.27
Overall	4.02

Table 8 showed the mean score on BIM can improve the design process of IBS project. From table 8, the highest mean is 4.59 on visualization of design. Then followed by better delivery of details, data sharing, acquiring and storing and lastly smoothen communication while designing. The lowest mean was 3.84 which is smoothen communication while designing. From table 8, 41 respondents agreed or strongly agreed on visualization of design by BIM which resulted a mean score of 4.59 since the visualization by BIM are the most significant benefits brought by BIM [15]. He further added that with the visualization by BIM, the delivery of details from design team to construction team is better. From table 8, the respondents agreed that the delivery of details was better and the delivery of details also recorded a high mean score of 4.20. For better data sharing, acquiring and storing, the respondents agreed and recorded mean score of 4.07.

Table 8: BIM can Improve Designing Process in IBS Project

	Mean Score
Smoothen communication while designing	3.84
Visualization of design	4.59
Better delivery of details	4.20
Better data sharing, acquiring and storing	4.07
Overall	4.18

Table 9 showed the mean score on BIM can save cost in IBS project. From table 9, the highest mean is 4.59 on improving budgeting and cost estimation. Then followed by monitoring and control cost and cash flow with mean of 4.57. The lowest mean was 3.50 which is reduce cost while designing. For reducing manpower cost, it recorded 3.55 mean. Generally, the overall mean was 4.05. The respondents agreed most on BIM can improve budgeting and cost estimating in IBS project. BIM's technical capabilities give users the chance to not only reduce building costs but also budgeting and estimating the cost to reduce the overall cost of an IBS project [11]. Cost monitoring and controlling also mentioned and the respondents recorded a mean of 4.57. BIM's technical capabilities can also give users the chance to not only reduce building costs but also monitor and control the costs and the cash flows related to them through all lifecycle of a construction project [12].

Table 9: BIM can Save Cost in IBS Project

	Mean Score
Reduce design cost	3.50
Reduce manpower cost	3.55
Monitor and control cost and cash flow	4.57
Improve budgeting and cost estimating	4.59
Overall	4.05

Table 10 showed the mean score on BIM can shorten duration in IBS project. From table 10, the highest mean was 4.14 on reducing time for production process. Then followed by reducing time for designing with mean of 4.05. The third highest was avoiding unnecessary logistic which was 3.80. The lowest mean was 3.64 which is reduce time for all phase of execution process. Also, it recorded an overall mean of 3.90. From table 10, respondents agreed most on the reduce time for production process. BIM was able to create or generate 3D views from the base model with high accuracy of data and information that is needed for prefabrication of building components [11]. Hence, facilitating the automated production and the production process will be much quicker. BIM was key principle that can easily lead to the success of overcoming the issue of lack of integration existing in current Malaysian IBS projects [16]. This will result in shortening of duration of designing phase of IBS projects. From the respondents, a 4.05 mean score was recorded from table 10.

Table 10: BIM can Save Time in IBS Project

	Mean Score
Reduce time for designing	4.05
Reduce time for execution of all phase	3.64
Reduce time for production process	4.14
Avoid unnecessary logistic	3.80
Overall	3.90

The highest overall mean score for the benefits was BIM can improve designing process in IBS project with mean score 4.18. Then followed by mean score 4.05 on BIM can save cost in IBS project. The third highest was BIM can improve workflow of IBS project. The lowest was BIM can save time in IBS project which has only mean score 3.90. Also. The five highest mean score for each benefits were listed in table 11.

Table 11: Five Highest Ranked of Benefits

Benefits	Main Category	Mean Score
Visualization of design	Designing Process	4.59
Improve budgeting and cost estimating	Cost Saving	4.59
Monitor and control cost and cash flow	Cost Saving	4.57
Installation Process	Better Workflow	4.39
Initial work process	Better Workflow	4.30

3.2 Challenges of Implementing BIM in IBS Construction Project in Malaysia

This section discussed the respondents' level of agreement on the challenges faced on the implementation of BIM in IBS construction project in Malaysia. there were total 5 sections which technical problems faced by the industry, mind set of Malaysia contractors, lack of readiness of environment of Malaysia construction industry, financial problems and legal problems. The tables provided in this section contain information such as frequency, percentages and mean of the respondents' score.

Table 12 showed the mean score on technical problems faced to implement BIM in IBS project. From table 12, the highest mean was 3.95 on increased workload for model development. Then followed by lack of well-establish BIM-based workflow with mean of 3.75. The lowest mean was 3.45 which is difficulty in adapting BIM. From the respondents, it recorded an overall mean of 3.69. From the respondents, the most agreed topic was increased workload for model development. This showed that BIM as a model development tool, it will increase the amount of model developing work for the BIM developing in construction process [5].

Table 12: Technical Problems that Halt Implementation of BIM in IBS

	Mean Score
Difficulty in adapting BIM	3.45
Lack of domestic oriented BIM tool	3.64
Increased workload for model development	3.95
Lack of well-establish BIM-based workflow	3.75
Immature dispute resolution mechanism for BIM	3.66
Overall	3.69

Table 13 showed the mean score on mind set of local contractors on implementation of BIM in IBS project. From table 13, the highest mean was 3.89 on negative attitude toward working collaboratively. Then followed by misunderstanding of BIM with mean of 3.80. The lowest mean was 3.39 which is resistance to change. From the respondents, it recorded an overall mean of 3.70 and the most agreed

topic was negative attitude toward working collaboratively. In a BIM based IBS project, a collaboration and data integration is the key to success, however, the engineers tend to develop their design and model according to their preferred software and not work collaboratively [17] and it created the difficulties of transferring data and models which increase the difficulty of BIM implementation.

Table 13: Mind Set of Malaysia Contractors on Implementing BIM in IBS

	Mean Score
Resistance to change	3.39
Negative attitude toward data sharing	3.73
Misunderstanding of BIM	3.80
Negative attitude toward working collaboratively	3.89
Overall	3.70

Table 14 showed the mean score on lack of readiness of environment of Malaysia construction industry in implementing BIM in IBS project. From table 14, the highest mean was 3.86 on insufficient external motivation. Then followed by lack of professional interactivity with mean of 3.64. The lowest mean was 3.41 which lack of research of BIM. From table 14, it recorded an overall mean of 3.64. This is because low external motivation could inhibit BIM implementation [15]. External motivation can be an important stimulator that enhances the implementation of BIM. In fact, the local developers have no enough external encouragement.

Table 14: Lack or Readiness of Environment of Malaysia Construction Industry in Implementing BIM in IBS

	Mean Score
Lack of professional interactivity	3.64
Insufficient external motivation	3.86
Lack of research on BIM	3.41
Overall	3.64

Table 15 showed the mean score on financial problem on implementing BIM in IBS project. From table 15, the highest mean was 4.61 on cost required for BIM training. Then followed by cost required for BIM expert and tools with mean 4.55. The third highest was ambiguous economic benefits with mean 3.50. The lowest mean was 3.11 which was increase design cost. From the respondents, it recorded an overall mean of 3.94. From table 15, the respondents agreed the most on the cost required for BIM training which recorded 4.61 mean score. BIM requires large amount of cost as well as time for the training for profession [7]. Meanwhile the second most agreed topic was cost required for BIM experts and tools. This is due to medium size companies are not affordable to hire BIM experts and tools as it cost large amount of money [18].

Table 15: Financial Problems on Implementing BIM in IBS

	Mean Score
Cost required for BIM training	4.61
Cost required for BIM expert and tools	4.55
Increase cost design	3.11
Ambiguous Economic Benefits	3.50
Overall	3.94

Table 16 showed the mean score on legal problem on implementing BIM in IBS project. From table 16, the highest mean was 4.25 on lack of protection for intellectual property right. Then followed by lack of insurance applicable to BIM implementation in IBS construction project with mean score 4.14.

Lack of BIM standard trailed by 4.11 mean score. The lowest mean was 3.95 which was lack of standard form of contract for BIM implementation. From table 16, it recorded an overall mean of 4.11. The highest mean was on lack of protection for intellectual properties rights with mean score of 4.25. This showed that appropriate legislation defending the intellectual property is not yet available [5]. In other words, BIM model possession and information proprietorship contained inside the model are not protected by any legislation. There is no standard and insurance currently available for implementing BIM in IBS and the usage of BIM can carry new dangers to the users [19].

Table 16: Legal Problems on Implementing BIM in IBS

	Mean Score
Lack of protection for intellectual property right	4.25
Lack of BIM standard	4.11
Lack of insurance applicable to BIM implementation in IBS	3.14
Lack of standard form of contract for BIM implementation	3.95
Overall	4.11

The highest overall mean score for the challenges was legal problems on implementing BIM in IBS with mean score 4.11. Then followed by mean score 3.94 on financial problems on implementing BIM in IBS project. The third highest was mind set of Malaysia contractors on implementing BIM in IBS project with mean score 3.70. The lowest was lack of readiness of environmental of Malaysia construction industry in implementing BIM in IBS project which has only mean score 3.64. Also. The five highest mean score for each challenge were listed in table 17.

Table 17: Highest Mean Score of Challenges

Benefits	Main Category	Mean Score
Cost required for BIM training	Financial Problems	4.61
Cost required for BIM experts and tools	Financial Problems	4.55
Lack of protection for intellectual property right	Legal Problems	4.25
Lack of insurance applicable to BIM implementation in IBS	Legal Problems	4.14
Lack of BIM standard	Legal Problems	4.11

4.0 Conclusion

The objectives of this study are to identify the perspective towards the benefits of integrating BIM in IBS construction project and to investigate challenges of BIM implementation in IBS construction in Malaysia. The benefits and challenges were obtained through the findings from professionals who were related to the IBS construction industry in Malaysia. The first objective was to identify the benefits of integrating BIM in IBS construction. From the respondents, the most agreed categories of benefit was BIM can improve designing process in IBS project while the most agreed benefits were visualization of design, improve budgeting and cost estimation, monitor and control cost and cash flow, installation process and initial work process. The second objective was to determine challenges of BIM implementation in IBS construction in Malaysia. From the respondent, the most agreed category of challenges was legal problems on implementing BIM in IBS with mean score 4.11 while the most agreed challenges were cost required for BIM training, cost required for BIM experts and tools, lack of protection for intellectual property right, lack of insurance applicable to BIM implementation in IBS and lack of BIM standard. It can be concluded that the implementation of BIM in IBS is beneficial to IBS construction project. However, the two most agreed challenges were cost required for BIM training and cost required for BIM experts and tools while the least agreed challenge was reducing design cost. It can be said that the initial investment on implementation of BIM in IBS was expensive, however, in long term, it will be a cost saving method compare to conventional methods. Hence, small size or even

medium size of contractors may not invest and not using BIM in IBS construction project as it need high amount of investment or capital. Also, from the challenges, the legal problems in implementing BIM in IBS were the most agreed challenges. It can be concluded that the legal environment was not ready or up to expected for the implementation of BIM in IBS.

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