Adoption of Building Information Modelling (BIM) Technology among G7 Contractors in Penang

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DOI: https://doi.org/10.47772/IJRISS.2026.100500458

Received: 11 May 2026; Accepted: 16 May 2026; Published: 04 June 2026

ABSTRACT

Building Information Modelling (BIM) is described as model-based technology for creates, exchanges, and analyzes the whole cycle of construction project. Even though there are numerous advantages to use BIM, the local construction sector is still hesitant to use the technology to deliver its services. This study aims to investigate the response from selected G7 contractors in Penang on the adopting BIM in projects. This study is focusing on discovering barriers and determining the effectiveness and success keys in adopting BIM among contractors. Data were analyzed using descriptive analysis in IBM SPSS software. It was found that the primary barrier in adopting BIM is purchasing software and hardware yet need to be upgraded regularly as indicated by mean value of 4.54. The determined effectiveness of BIM adoption is increasing the accuracy of visualizations of project which the value of 4.41, as indicated the most apply. The research was determined the success key which majority of respondents were agreed that BIM adoption program (4.44) can be developed as supporting the implementation in construction industry. This paper presents the current drivers of BIM adoption contractor in Penang construction project.

Keywords: Building Information Modelling, barriers, effectiveness, success keys

INTRODUCTION

The advancement of technologies in today's communication, many technologies have been introduced and are currently used in the construction industry globally and locally. Building Information Modelling (BIM) technology is the intelligent object-oriented medium that are integrating information while interconnecting with a relational database (Shaqour, 2022). These technologies provide two-dimensional (2D) and three-dimensional(3D) Computer-Aided Design (CAD) formats for common use that will enhance the performance of the visualization of the project. In the beginning, 2D drawings and text is used then, CAD evolved where a 3D model is able in the design process (Kong et al., 2020). Other than that, BIM also has other dimension such as 4D (scheduling), 5D (cost estimating), 6D (sustainable design), and 7D (facility management). All of these dimensions play the important role in the construction flow. In a simple word, BIM is the prime step to achieve the goals in the construction works. However, many construction firms have not fully reaped the benefits of using BIM due to insufficient individual BIM use (Ma et al., 2020) and BIM adoption by construction clients, both public and private, has received little attention (Gurevich & Sacks, 2020). As a result, the construction project is quite low inefficiencies and low labour productivity (Stojanovska-Georgievska et al., 2022).

The last couple of years, the construction industry is in unstable state which facing with lot of challenges due to Corona Virus Disease (COVID-19). As a result, most construction companies reconsidered about implementing and adopting digital technology in their design and build project. Since BIM technology has been introduced, the construction workflows able to be digitise and replace the on-site manual data entry with digital one. Furthermore, these technologies also dominant with others dimension (4D, 5D, 6D and 7D) that works together to achieve success of the construction project. However, adoption of BIM has not received much attention through event management. Therefore, BIM implementation will effectively break through the business and development dilemma caused by the pandemic (Ismail, 2023; Wang et al., 2021).

In Malaysia, BIM technology is currently in trends among construction companies that will transform the process of design and build in this industry from the conventional one to the advanced technologies usage. It will modernize the Malaysia construction industry by enhance the methods of communication and collaborating among construction stakeholders to achieved the construction goals (Rahim et al., 2021). Based on Construction 4.0 Strategic Plan (CR4.0) that has been launched by Construction Industry Development Board (CIDB), it stated that the goal of this plan is constructing more building that smart and more sustainable and also expecting Malaysia being a market leader in future in Southeast Asia. In this CR4.0, BIM is one of the disruptive technologies that able to change the future in construction sector. That means BIM adoption and implementation in Malaysia will rise over year due to the attraction of the technologies that can change the future in the construction process onwards.

In a nutshell, BIM technologies adoption in Malaysia require more attention by the involve parties in construction industry. In order to establish the implementation, this research will find out the factors of BIM adoption especially in contractor profession.

LITERATURE REVIEW

In order to integrate information, the Building Information Modelling (BIM) technology interfaces to a relational database (Shaqour, 2022). It is a technology has various function which in terms of scheduling, cost estimation, design and management. All of the functions play important role in construction flow. Recently, the construction industry faced difficulties during Corona Virus Disease (Covid-19) pandemic hit the world. As a result, the ongoing projects delayed and less productive in terms of time, cost and wastage. However, BIM technology provides the effective ways to enhance the project workflow from the design to post-construction stage. In other words, it can break through the business and development dilemma caused by unpredictable condition.

BIM technology adoption relatively gives the overall project be more efficient from resolving emergency situations, enhancing construction works, and bolstering pandemic prevention (Lu et al., 2020). According to Stojanovska-Georgievska et al. (2022), BIM technology more relevant for each stage of the construction project compared to traditional method. The project details and information integrated in the software which able to access easily by others. Examining the whole project process is producing the strong and valid of management (Liu & Zub, 2020).

Currently, BIM adoption is rising up either developed or developing countries which has being center of attention in latest studies. The innovation has been created to treat the weakness of traditional method in construction process. However, BIM adoption in Malaysia is still in trends which not fully used in projects. The issue to implement BIM in construction project is to understand BIM systems because technology is the medium that constantly evolving (Olanrewaju et al., 2022). Hence, BIM adoption need to be supporting by all parties related to construction fields.

Notably, BIM adoption surely limited by some reasons such as financial issue, educational issue and environmental issue which un-growing the number of users. Exposing the effectiveness of BIM technology in huge community and getting supporters by all main parties can improve all of the issues that blocking the implementation of BIM construction industry.

Problem Statement

This research proposes to study the BIM technology adoption among G7 contractors in Penang. BIM technology is medium that use for collaboration among construction organisation in processing the data across the construction lifecycle. However, most of the contractor's organisations are still hesitant to execute the technology in their project (Fountain & Langar, 2018; Mahazir & Kar Ros, 2020; Mohammad et al., 2018). Evidence already in existence suggests that BIM's anticipated advantages were not completely achieved throughout implementation (Ahn et al., 2016; Gurevich & Sacks, 2020). Because of that, the chance to adopt BIM technology in their works is quite slim due to the power in decision making (Calderon-Hernandez, 2018). They also barely to express their opinion about the advanced technologies that possible to use and run in the

construction works. Consequently, they are not being exposed to the technologies that has been used in this era (Al-Ashmori et al., 2022).

Success and BIM development aren't quite where they should be yet. BIM has not yet achieved complete agglomeration in the construction industry (Gurevich & Sacks, 2020). In terms of technology and design, BIM represents a considerable advancement. Despite this, users in the construction sector still do not fully utilise BIM implementation (Raja Mohd Noor et al., 2021). In addition to this, BIM is not widely used and is associated with risks and issues that could undermine its usefulness (Ibrahim et al., 2019). A structure, a factory floor layout, or any other interconnected complex system in BIM requires careful modelling on many different levels (Othman et al., 2021a).

Besides, for many years, the construction industry has also dealt with difficulties related to fragmentation, complexity, risk, and unpredictability. Despites that, the construction organisations need to improve their management and collaboration by introducing BIM to limit the issues (Mohammad et al., 2018). However, there are some barriers adopting BIM in the project that will reduce the number of organisations to execute it. The majority of local companies view BIM implementation in construction projects as an uncertain technology due to the unpredictability of process changes and the high cost of the BIM system's digital project management process (Al-Ashmori et al., 2022). The biggest issue is understanding BIM systems because the technology is constantly evolving. Particularly in developing world, where BIM adoption is still in its infancy, there is a sizable market that has not yet been fully penetrated (Olanrewaju et al., 2022a). BIM has been extensively promoted in China over the past ten years by the government and technology vendors, but compared to many industrialised nations, the adoption rate and application maturity of BIM are still quite low. Furthermore, because BIM has not been widely adopted, the traditional construction sector has not been significantly altered. Therefore, it is crucial to investigate effective strategies to encourage BIM use in the construction industry in light of the exceptional COVID-19 problem (Wang et al., 2021).

Additionally, during the COVID-19 crisis, the benefits of implementing BIM in areas like resolving emergency situations, enhancing construction efficiency, and bolstering pandemic prevention have become more apparent (Lu et al., 2020). Based on Mahazir and Kar Ros (2020), in the construction sector, BIM technology is automatically delivering and supplying a wide range of solutions and effectiveness that serve to enhance and boost the productivity and efficiency of the project management.

Consequently, choosing BIM over the traditional building method has distinct benefits at each stage of the construction process (Stojanovska-Georgievska et al., 2022). Construction project management will be constrained by a number of issues by the turn of the century, which will significantly slow down the project management cycle and have a negative impact on the speed and calibre of the entire construction project. The efficiency and efficacy of project management continuously increase with the use of BIM technology, which has evolved into the primary instrument for project coordination and cooperation (Liu, Y., and Zub, 2020).

METHODOLOGY

Research Instrumentation

Research instrumentation is a tool for gathering, measuring and analysing data associated with the study interest. Basically, this study aims to discover the adoption of BIM technology among contractor, a set of questionnaires to conduct a survey was employed. This survey method was used in this study as it fit for quantitative method (Nardi, 2015).

The question of the survey from was designed by dividing intro four main sections; Section A: respondent's demographic information, Section B: barriers of BIM adoption, Section C: Effectiveness of BIM adoption and Section D: success keys of BIM adoption among contractor. All items in section B to D used a 5point Likert scale. Thus, the respondents have to indicate their level of agreement on the item ranging from 1= Strongly Disagree to 5= Strongly Agree.

Population and Targeted Respondents

Research population relates to a group shares the common behaviour and traits. In addition, a sample is subset from the population which determining the conclusion of the study (Eisele et al., 2022). In the study, the contractor G7 that has been listed in Construction Industry Development Board (CIDB) as construction organisation has been chosen to contribute in the survey. They were chosen as respondents because of the biggest and highest organisation that developing the mega-related projects (Razi et al., 2020). Take into the account, the organization of G7 normally involve in handling project with highest cost and may use the technology as controller of overall projects.

The study focuses on discovering the barriers of BIM adoption among G7 contractors at Seberang Perai, Pulau Pinang. The determination of BIM effectiveness and success keys of contractors adopting BIM also the highlighted objectives in this research study. The scope area is in the Seberang Perai, Pulau Pinang, which performing construction work related. This research was carried out using quantitative technique which the 43 companies in Seberang Perai that registered with CIDB according to the website. Regarding to the method of Krejcie and Morgan to measure the number of respondents for a certain population source in the appendix A, the targeted number of samples to use for the respondent is about 40 samples.

Data Collection

This study adopted convenience type which is one of the non-probability samplings. It is a sample where the primary data source will be used for the research without additional requirements. The survey forms developed were distributed to the respondents as it can be fill anytime means without timeframe and collected after reaching the responses target.

The respondents were briefly introduced the objectives of the conducted research. The objectives determined the main point of the survey which enable the respondents know the flow. The questionnaire has been completed by respondents after reviewing the explained objectives.

The conducted survey required 40 sets out of 43 set of questionnaires according to Krejci and Morgan. This study has distributed exactly 40 sets of survey form to the listed organization of contractor G7 in CIDB. However, the respond rate of this study only 90.7% which indicated the required sample was not fully getting respond. After that, descriptive analysis was being executed for each objective of the study. The data also has been tested on reliability to ensure the data were valid according to the research objectives.

RESULT AND DISCUSSION

Demographic Information

Table 1 showed the responses of 39 respondents from the survey. The demographic information of respondents classified into seven categories as listed. According to percentage, there 89.7% of respondents are male. The age of respondents mostly in range of 36-40 years old (23.1%). Furthermore, PhD (33.3%) is the higher percentage for educational level. The working experience based on the survey, the majority in 7-9 years working in construction industry. However, there are many of them did not have BIM certificate (97.45%). Half of them mostly involved with BIM in the project for 4-6 years only (51.28%). As a result, they were moderately aware with BIM implementation in construction industry.

Table 1: Demographic Information of Respondents

Item	Frequency, n	Percentage, %
Gender		
Male	35	89.74
Female	4	10.26

Age		
21-25 years old	4	10.26
26-30 years old	5	12.82
31-35 years old	6	15.38
36-40 years old	9	23.08
41-45 years old	7	17.95
46-50 years old	5	12.82
51-54 years old	2	5.13
55 and above	1	2.56
Education Level		
SPM	2	5.13
STPM	1	2.56 0
Certificate	0	5.13
Diploma	2	30.77
Bachelor's Degree	12 9	23.08
Master	13	33.33
PhD		
Working Experience		
Less than 1 year	1	2.56
1-3 years	7	17.95
4-6 years	6	15.38
7-9 years	16	41.03
More than 10 years	9	23.08
BIM Certificate		
Yes	1	2.56
No	38	97.44
Period of BIM Involvement		
Less than 1 year	1	2.56
1-3 years	6	15.38
4-6 years	20	51.28
7-9 years	8	20.51
More than 10 years	4	10.26
Awareness of BIM Implementation		
Lowly aware	2	5.13
Moderately aware	36	92.31
Highly aware	1	2.56

Barriers of BIM adoption

Table 2 displayed the barriers of BIM adoption with the highest mean value for each element: behavior, knowledge, software and hardware, finance and others. This resonates with the findings by Al-Ashmori et al. (2022); Durdyev et al. (2021); Enshassi et al. (2019); Jia et al. (2022); (Mohammad et al., 2018); (Olanrewaju et al., 2022). The primary barrier in the study is software and hardware need to be upgraded regularly (4.54). Purchasing a good software and high-end software are expensive as well as when to upgrade it. This statement is included another related barrier which the return on investment influenced by the cost and benefits of technology implementation. Thus, the cost is major challenges which also depending on selecting and purchasing software and hardware that can affected on the return investment.

Table 2: Descriptive Analysis (Barriers of BIM Adoption)

Variables	Mean	Std. Deviation	Rank
Behavior Resistance to learn new technology	4.36	.486	**3**
Knowledge Insufficient knowledge	4.13	.522	**4**
Software and Hardware Upgraded software yearly	4.54	.644	**1**
Finance High-end hardware	4.38	.711	**2**
Others Absence of proper standards	3.95	.643	**5**

Effectiveness of BIM adoption

Table 3 indicated the highest value of agreement in each construction phase; design, preconstruction to fabrication and overall facilities. The adoption of BIM technology in construction project increases the accuracy of visualizations of designs as well as synchronizes the procurement with design and construction (4.41). Notably, the data information of project can be allocated and arranged in various application. The actual situation of construction project can analyze accurately in BIM technology of 5D mode (Liu & Zub, 2020). All in all, according to Kong et al. (2020), the BIM technology enhances most of the construction works with the smooth workflow. Scope, schedule and cost balance, which is a project management goal, are all achieved with BIM technology.

Table 3: Descriptive Analysis (Effectiveness of BIM Adoption)

Variables	Mean	Std. Deviation	Rank
Design Phase Accuracy in visualization	4.41	.595	**1**
Pre-construction, Construction and Fabrication Procurement synchronized with design and construction	4.41	.595	**2**
Facilities, Operations and Maintenance Decision-makers supporter	4.21	.615	**3**

Success keys of contractor adopting BIM

Table 4 summarized the most influenced keys in BIM adoption among contractor in local industry. The local authorities must take initiative to support the construction organization in adopting BIM in projects. Both government and private parties educate companies regarding the policies and decision-making in adopting BIM (Nisa Lau et al., 2018; Wan Mohammad et al., 2018; Wang et al., 2021). The BIM software includes many direct and indirect cost in terms of making decisions such as upgrading license and hardware also cost of BIM training. In addition, the technical factor involves the most important aspect in adopting BIM in construction industry such as software functionality, BIM protocols and compatibility with existing hardware. It can be interpreted that respondents agreed with the listed success keys to adopt BIM in projects. Table 4: Descriptive Analysis (Success key of BIM Adoption)

Variables	Mean	Std. Deviation	Rank
Organization's Financial Resources Initial investment	4.23	.656	**5**
Workflow Transformation Strategies BIM model based on 2D drawings	4.41	.721	**2**
Policies, Capabilities and Support BIM adoption programs	4.44	.502	**1**
Technical Level of data security and privacy	4.38	.590	**3**
Management Stakeholders strategies of BIM	4.33	.469	**4**

CONCLUSION

This study discovered the barriers in adopting BIM technology in local construction industry which affecting the number of users. The findings justify the previous researchers which are relating toward the implementation. The barriers such as staff resistance, insufficient knowledge of technology, software and hardware uses, economy status and lack of specific standard or policies regarding BIM implementation in construction industry.

BIM adoption provides most effective workflow of construction project from early stage to the final stage. The benefits influence the project lifecycle to be extra efficient compared to traditional method. Some of them are increase the accuracy in visualization and simulation, time management and decision-making process in overall construction works.

Following the research, BIM technology requires strong initiatives from all parties either government or private. The biggest support is the main factor to implement BIM technology in wide range in local construction industry.

REFERENCES

1. Al-Ashmori, Y. Y., Othman, I., & Al-Aidrous, A. H. M. H. (2022). "Values, Challenges, and Critical Success Factors" of Building Information Modelling (BIM) in Malaysia: Experts Perspective. Sustainability (Switzerland), 14(6). https://doi.org/10.3390/su14063192
2. Durdyev, S., Mbachu, J., Thurnell, D., Zhao, L., & Reza Hosseini, M. (2021). BIM adoption in the cambodian construction industry: Key drivers and barriers. ISPRS International Journal of Geo-Information, 10(4). https://doi.org/10.3390/ijgi10040215
3. Eisele, G., Vachon, H., Lafit, G., Kuppens, P., Houben, M., Myin-Germeys, I., & Viechtbauer, W. (2022). The Effects of Sampling Frequency and Questionnaire Length on Perceived Burden, Compliance, and Careless Responding in Experience Sampling Data in a Student Population. Assessment, 29(2). https://doi.org/10.1177/1073191120957102
4. Enshassi, M. A., Al Hallaq, K. A., & Tayeh, B. A. (2019). Limitation Factors of Building Information Modeling (BIM) Implementation. The Open Construction & Building Technology Journal, 13(1). https://doi.org/10.2174/1874836801913010189
5. Ismail, Z. (2023). Integrating Maintenance Management System in IBS Building Projects: A Qualitative Study. Journal of Optimization in Industrial Engineering, 16(2). https://doi.org/10.22094/joie.2023.1986359.2067
6. Jia, J., Zhang, M., & Yang, G. (2022). Factors Influencing BIM Integration with Emerging Technologies: Knowledge Coupling Perspective. Journal of Management in Engineering, 38(2). https://doi.org/10.1061/(asce)me.1943-5479.0001018
7. Kong, S. W. R., Lau, L. T., Wong, S. Y., & Phan, D. T. (2020). A study on effectiveness of Building Information Modelling (BIM) on the Malaysian construction industry. IOP Conference Series: Materials Science and Engineering, 713(1). https://doi.org/10.1088/1757-899X/713/1/012035
8. Liu, Y., & Zub, A. T. (2020). Research on the Application of BIM Technology in the Efficiency and Effectiveness of Construction Project Management. Journal of Physics: Conference Series, 1574(1). https://doi.org/10.1088/1742-6596/1574/1/012081
9. Lu, W., Xu, J., & Söderlund, J. (2020). Exploring the Effects of Building Information Modeling on Projects: Longitudinal Social Network Analysis. Journal of Construction Engineering and Management, 146(5), 1–13. https://doi.org/10.1061/(asce)co.1943-7862.0001823

10. Mohammad, W. N. S. W., Abdullah, M. R., Ismail, S., & Takim, R. (2018). Building information modeling (BIM) adoption challenges for contractor's organisations in Malaysia. AIP Conference Proceedings, 2016(September), 020148. https://doi.org/10.1063/1.5055550
11. Nardi, P. M. (2015). Doing Survey Research. In Doing Survey Research. https://doi.org/10.4324/9781315635088
12. Nisa Lau, S. E., Zakaria, R., Aminudin, E., Saar, C. C., Yusof, A., & Hafifi Che Wahid, C. M. F. (2018). A Review of Application Building Information Modeling (BIM) during Pre-Construction Stage: Retrospective and Future Directions. IOP Conference Series: Earth and Environmental Science, 143(1). https://doi.org/10.1088/1755-1315/143/1/012050
13. Olanrewaju, O. I., Kineber, A. F., Chileshe, N., & Edwards, D. J. (2022). Modelling the relationship between Building Information Modelling (BIM) implementation barriers, usage and awareness on building project lifecycle. Building and Environment, 207(PB), 108556. https://doi.org/10.1016/j.buildenv.2021.108556
14. Razi, P. Z., Ramli, N. I., Ali, M. I., & Ramadhansyah, P. J. (2020). Selection of Method in Construction Industry by using Analytical Hierarchy Process (AHP). IOP Conference Series: Materials Science and Engineering, 712(1). https://doi.org/10.1088/1757-899X/712/1/012015
15. Shaqour, E. N. (2022). The role of implementing BIM applications in enhancing project management knowledge areas in Egypt. Ain Shams Engineering Journal, 13(1), 101509. https://doi.org/10.1016/J.ASEJ.2021.05.023
16. Stojanovska-Georgievska, L., Sandeva, I., Krleski, A., Spasevska, H., Ginovska, M., Panchevski, I., Ivanov, R., Arnal, I. P., Cerovsek, T., & Funtik, T. (2022). BIM in the Center of Digital Transformation of the Construction Sector—The Status of BIM Adoption in North Macedonia†. Buildings, 12(2). https://doi.org/10.3390/buildings12020218
17. Wan Mohammad, W. N. S., Abdullah, M. R., Ismail, S., & Takim, R. (2018). Overview of Building Information Modelling (BIM) adoption factors for construction organisations. IOP Conference Series: Earth and Environmental Science, 140(1). https://doi.org/10.1088/1755-1315/140/1/012107
18. Wang, W., Gao, S., Mi, L., Xing, J., Shang, K., Qiao, Y., Fu, Y., Ni, G., & Xu, N. (2021). Exploring the adoption of BIM amidst the COVID-19 crisis in China. Building Research & Information, 49(8), 930–947. https://doi.org/10.1080/09613218.2021.1921565