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THE PERCEPTION AND BENEFITS OF BUILDING INFORMATION MODELLING IN CONSTRUCTION INDUSTRY CASE STUDY OF PETALING JAYA, SELANGOR.

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ABSTRACT

This paper explores the benefits of implementing Building Information Modelling (BIM) in the construction industry. Building Information Modelling (BIM) is a promising and widely discussed methodology aimed at tackling the issue of construction waste generation, particularly during the design and preconstruction stages. It offers sustainable evaluation methods, life cycle simulations, cost-effective engineering, improved collaboration, and the assessment of alternative ideas in the construction industry. In Malaysia, implementing BIM faces challenges due to the lack of a strong consensus on its application and usage. There is no unified BIM manual for implementation, and cultural barriers and unclear fee structures further hinder progress. BIM adoption rate remains relatively low in Malaysia, with cost being the primary challenge. This research aims to investigate the perception and benefits gained by architects in implementing Building Information Modeling (BIM) in construction projects in Petaling Jaya, Selangor. The study was conducted among 88 architects in Petaling Jaya using quantitative method. Fortunately, all the questionnaire was distributed to respondents through Google Forms using purposive sampling. The findings demonstrate that the majority of the respondents are agreed that there is fewer demand in using building information modelling. Furthermore, the study show that the respondent mostly agreed by implement building information modelling can integrate cost elimination.

Keywords: *building information modelling, construction industry, benefits*

INTRODUCTION

Building Information Modelling (BIM) is a promising and widely discussed methodology aimed at tackling the issue of construction waste generation, particularly during the design and preconstruction stages (Vasudevan, 2019). It offers sustainable evaluation methods, life cycle simulations, cost-effective engineering, improved collaboration, and the assessment of alternative ideas in the construction industry. Previous research confirms that BIM facilitates information exchange during construction operations, reducing costs associated with 2D drawings and enabling more efficient data transmission (Enegbuma et al., 2014). BIM's usage in project programming allows teams to evaluate space, comply with regulations, and focus on value-added activities. Globally, many countries are recognizing and investing in BIM's potential to enhance the construction industry, with some already mandating its implementation. In Malaysia, BIM is viewed as a transformative technology to digitize data and information, replacing outdated paper-based approaches. Therefore, conducting further research on the impact of BIM implementation in the construction industry in Petaling Jaya, is essential. The study will also assess the satisfaction levels of the Architecture, Engineering, and Construction (AEC) industry with BIM implementation.

Problem Statement

There are a few problems with implementing BIM in Malaysia, first, no strong consensus exists about how BIM should be applied or used. There is no single BIM manual offering instructions on its implementation and use, unlike many other building activities (Azhar et al., 2012). Organisational and process-related obstacles are also present, such as cultural barriers to the introduction of a new technology, unclear fee structures for extra reach (Ilter & Ergen, 2015).

BIM adoption rate is relatively low in Malaysia and cost issue is ranked first place as challenges to adopting BIM (Ang et al., 2020) BIM adoption is at an early stage. From the perspective of the Bew-Richards BIM Maturity Model and Succar models, Malaysia’s construction industry still falls between stages 1 and 2 and pre- BIM Modelling 1, respectively. (Enegbuma et al., 2014).

It is because many construction players declined to accept BIM because, in the management of construction projects, they are more comfortable with traditional processes (Akob et al., 2019), and owing to the lack of case study evidence of the financial value of BIM, they are not ready to invest in BIM (Han & Damian, 2008). Also, lack of interoperability, a misunderstanding of information handover specifications (Dixit et al., 2019, Mcauley et al., 2015), and approval denial of BIM for cost-saving (Naghshbandi, 2016). BIM also faced restrictions, for example, when it comes to creating irregular architectural elements that are often found in old and

historic buildings, BIM- based software packages are often constrained (Usmani et al., 2019).

The study also found that two major problems in the adoption of BIM are assisted by machine self-efficiency and top management (Aljarman et al., 2020). The author pointed out that among the main obstacles were technology such as hardware and software. Due to issues related to risks in hardware and software and the investment required to train and retain technologically trained workers, businesses typically resist technological change. And usually, the design, development, and commissioning of projects precede the use of life-cycle BIM for project execution in the event of the implementation of contractual mechanisms to regulate them (Abd Jamil & Fathi, 2018).

According to CIDB (2017), from the survey conducted in 2016, only 17 percent of the 570 respondents in the construction industry have experience using BIM. 12.8 percent have 1 to 5 years of experience, 3.9 percent with 6 to 10 years of experience, and 0.8 percent with more than 10 years, out of 17 percent of respondents with BIM experience. In order to understand the challenges to the adoption of BIM, the diffusion of BIM within construction organisations is a vital consideration.

Research Aim

To investigate the benefits gained by architects in implementing Building Information Modelling (BIM) in construction projects in Petaling Jaya, Selangor.

Research Question

- What are the barriers of Building Information Modeling implementation in Malaysia?
- What are the benefits of Building Information Modeling implementation in the construction industry?

Research Objectives

- To identify the barriers of Building Information Modelling implementation from the stakeholder perception.
- To determine benefits the stakeholder receives from the implementation of Building Information Modelling.

Scope of Study

The benefits of Building Information Modeling implementation in the construction industry will be the primary focus of the investigation's scope. The Petaling Jaya is the only area of interest in this study, and all the respondents are Malaysian citizens

who are currently working as architect within this region. This study will be carried out in some of Malaysia's major architect firms that have existed since 2000.

LITERATURE REVIEW

The literature review chapter provides an overview of Building Information Modelling (BIM) in the construction industry, discussing its benefits, barriers to adoption, and the perception of professionals towards BIM. The reviews of studies that other researchers have undertaken in a similar manner are presented next.

Building Information Modelling

Building Information Modelling (BIM) offers a sustainable evaluation method for life cycle simulations, productive costing, improved engineering quality, collaboration, and assessing alternative ideas in construction Gerrish et al., 2017). According to Vasudevan (2019), its effectiveness in providing design information during construction, efficient data transmission, and cost reduction in 2D project drawings. BIM also aids project teams in space evaluation, compliance with standards, and time-saving for value-added activities during the programming process.

Original Design

Building Information Modelling (BIM) has revolutionized the construction industry in the past decade, significantly enhancing productivity. BIM enables a digital depiction of projects before construction, allowing efficient resource sharing and collaboration among project stakeholders. The transition from 2D CAD to 3D modelling marked a paradigm shift from visualization to simulation in design thinking. BIM's 3D digital model includes intrinsic features, providing a more dynamic and efficient environment compared to traditional static 2D CAD. The AEC industry has embraced BIM's rise, bringing forth a new era of design and construction. BIM proficiency is categorized into four stages: level 0, level 1, level 2, and level 3, as described by Akob et al (2015).

Stakeholder’s Perception on Building Information Modelling

Over time, the perception of Building Information Modelling (BIM) within the architecture, engineering, and construction (AEC) industry has evolved positively. Initially met with resistance and scepticism, BIM is now widely recognized for its benefits. It facilitates enhanced coordination and collaboration among project stakeholders, leading to reduced errors and conflicts. BIM's 3D modelling and visualization capabilities enhance design comprehension and communication with clients and teams. The platform's productivity tools, automated quantity take-offs, and precise cost estimation streamline workflows and save time and resources. BIM's

support throughout the project lifecycle, integration of building data, and compliance with industry standards and regulations have contributed to its popularity. Despite the positive perception, challenges like initial investment costs, training requirements, and interoperability issues persist. Nonetheless, AEC professionals increasingly view BIM as a valuable asset for the construction industry.

Over time, perceptions of Building Information Modelling (BIM) in the architecture, engineering, and construction (AEC) industry have changed significantly. BIM is a digital representation of a building or infrastructure project's physical and functional characteristics, involving information creation, administration, and sharing throughout the project lifecycle. Initially, there was resistance and scepticism toward BIM as professionals were accustomed to traditional 2D design methods. However, as the benefits became evident, attitudes shifted. Presently, AEC professionals have a predominantly positive view of BIM, with the following key perspectives:

- BIM enhances coordination and collaboration among project stakeholders, reducing errors and conflicts.
- BIM enables 3D modeling and visualization, improving design comprehension and communication.
- BIM offers productivity tools, streamlining workflows, and saving time and resources.
- BIM supports the entire project lifecycle, aiding facility management and future renovations.
- BIM's popularity is influenced by industry standards and regulations, driving its adoption.
- Despite the favorable view, challenges remain, such as initial costs, training, and interoperability issues.

Overall, AEC professionals increasingly recognize the benefits of BIM and its growing adoption in the construction industry.

Barriers in Adopting BIM

The implementation of Building Information Modelling (BIM) in Malaysia faces several obstacles. Lack of awareness and understanding among industry users, coupled with concerns over costs, national standards, and the shortage of qualified employees, hinder BIM adoption. Resistance to change, especially among architects accustomed to traditional methods, further slows down progress. Additionally, software incompatibility and the need for clear standards contribute to the challenges in integrating BIM into construction processes. Successful BIM adoption requires collaborative efforts from government agencies, educational institutions, and all construction stakeholders. Addressing process-related, social, technological, and cost-related hurdles is essential for the widespread success of BIM deployment in the industry.

- **Lack of awareness and understanding**

  Limited awareness and comprehension of BIM among construction professionals hinder its widespread implementation.

- **Cost of implementation**

  Initial costs for BIM implementation, including software, hardware, and training, can be a significant barrier for smaller businesses and initiatives with limited budgets. Upgrading IT infrastructure to support BIM can also increase costs.

- **Resistance to change**

  Change resistance is a common challenge in the construction industry when adopting BIM. Stakeholders may be hesitant to shift from conventional workflows and processes. Effective change management and clear communication about BIM's benefits are necessary to overcome this resistance.

- **Interoperability issues**

  BIM collaboration involves multiple stakeholders using different software platforms and file formats, leading to interoperability issues. Ensuring smooth data exchange and collaboration can be challenging. 2.5.5 Skills and Training Gaps:

  Shortage of skilled professionals in BIM software and processes requires adequate training and upskilling for successful implementation.

- **Legal and contractual challenges**

  Adapting legal and contractual frameworks to suit BIM's collaborative and data-driven nature may be necessary.

- **Data management and security**

  Managing vast BIM data requires robust systems and protocols to ensure integrity, security, and access control.

- **Industry fragmentation**

  Construction industry fragmentation poses challenges for achieving BIM standardization.

Benefits of BIM

According to Alshawi et al., (2015), BIM implementation in the construction industry brings a range of benefits, including enhanced collaboration, improved visualization, clash detection, and risk mitigation. It enables cost and time efficiency through accurate quantity take-offs and project scheduling, leading to cost savings and improved timelines. BIM also promotes sustainability and energy efficiency by facilitating sustainable design and energy analysis. It supports effective facilities management and maintenance by providing detailed building information. Furthermore, BIM assists in regulatory compliance, ensures long-term value by utilizing data throughout the building's lifecycle, and drives industry advancement through the adoption of advanced technologies and digital workflows. Overall, BIM enhances construction processes, project outcomes, and digital transformation in the Malaysian construction industry (Chan et al., 2019).

- **Enhanced collaboration**

  BIM fosters collaboration among stakeholders, reducing errors and conflicts through real-time information exchange.

- **Improved visualization**

  BIM enables 3D visualization and virtual walkthroughs, enhancing communication and informed decision-making.

- **Clash detection and risk mitigation**

  BIM allows early clash detection, reducing construction delays and costs through risk mitigation.

- **Cost and time efficiency**

  BIM enables accurate quantity take-offs, cost estimation, and project scheduling, leading to cost savings and improved timelines.

- **Sustainability and energy efficiency**

  BIM aids sustainable design and energy analysis, reducing the carbon footprint of buildings.

- **Facilities management and maintenance**

  BIM provides valuable information for effective facility management and maintenance decisions.

- **Regulatory compliance**

  BIM ensures compliance with building codes and regulations, minimizing non-compliance risks.

- **Long-term value**

  BIM data supports the building's lifecycle, enhancing long-term value through future renovations and facility management.

- **Industry advancement**

  BIM drives the adoption of advanced technologies and digital workflows, advancing and modernizing the construction industry.

  Overall, BIM implementation in the Malaysian construction industry offers benefits such as improved collaboration, visualization, cost savings, sustainability, and industry advancement. It streamlines processes and enhances project outcomes, driving digital transformation in the sector.

METHODOLOGY

This study adopted a quantitative method. An online questionnaire was used in order to achieve the objective. The survey was conducted in architecture firms in Petaling Jaya, and the respondents were architects, landscape architects, and interior designer that working in architecture firms. The data obtained from the questionnaire survey were analysed for the research evaluation to rank the most agreeable benefits of building information modelling implementation. The questionnaires consist of three sections. Section A includes demographic questions about respondents. Section B covers the perception of barriers to BIM implementation, and Section C focuses on the benefits of BIM implementation in the construction industry. 88 sets of questionnaires were distributed to the architecture firms in Petaling Jaya district, and 88 sets of questionnaires were fulfilled and returned to the researcher. The collected data was analysed using SPSS Version 27.

Study Limitations

The primary focus of this paper lies in investigating the utilization of Building Information Modeling (BIM) in the construction industry, specifically concentrating on the Petaling Jaya region in Malaysia. It is crucial to acknowledge that the findings of this study may not be universally applicable to other regions or countries due to the potential influence of varying circumstances and factors on the adoption of BIM.

The study's data collection primarily revolves around stakeholders within the construction domain, such as architects, landscape architects, and interior designers. However, it should be noted that this approach omits perspectives from clients, government agencies, and end-users. This omission could potentially limit the comprehensiveness of the insights generated by the study.

ANALYSIS AND FINDINGS

The collected data was analyzed using various variables, including demographic profiles, stakeholder's perception on barriers and benefits of building information modelling. SPSS version 27 was used for the analysis, and the results were presented through tables, frequency counts, and mean values for better comprehension and conclusion demonstration. Frequency analysis, a descriptive statistical technique, was employed to display the frequency of each response chosen by the respondents. The findings were then presented in terms of frequency numbers and percentages of all participants.

Stakeholder's Perception on Barriers in Using Building Information Modelling

Table 1: Descriptive Statistic for the Mean Values of Selected Variables

Variables	Mean	Rank
Demand	4.23	1
New technology	4.17	2
Specification information	4.17	3
Setup cost	4.12	4
Software compatibility	4.08	5
Benefits awareness	4.08	6
Time for experimentation	3.99	7
References	3.93	8

Table 1 shows the ranking of mean scores on the stakeholder's perception on barriers in implementing building information modelling. It was determined by the mean score for each element based on the survey done on the online questionnaire that has been analyzed by SPSS version 27. As a result, based on Table 1, the highest mean is the demand with 4.23 mean value. Next, it is followed by resistance to change for new technology, and lack of specification information in bim models with 4.17 mean value. The fourth rank is setup cost, followed by software compatibility, and benefits awareness. The seventh rank is time for experinmentation, and the least is references. According to the interpretation of the mean, all the elements ranked are at a medium level.

Based on the analysis of 88 respondents, the findings highlight the obstacles faced by the construction industry in adopting Building Information Modeling (BIM). Respondents rated these barriers on a scale of 1 to 4, with an average score of 4 indicating significance. The most prominent hindrance identified was 'No client

demand,' suggesting that many respondents perceive the lack of client demand as a critical factor inhibiting BIM adoption (Mean = 4.23, S.D = 0.84046). This aligns with prior research by Kunz & Gilligan (2007) and Chan (2014), both of which underline the lack of client demand as a primary impediment to BIM adoption.

The second and third highest-rated barriers were 'Resistance to change for new technology' and 'Lack of protocols for coding objects within BIM models by designers through development of cost modeling using BIM such as lack of complete specification information in BIM models' (Mean = 4.17, S.D = 0.91961). These results underscore the industry's general tendency to stick with traditional methods due to reluctance toward technological change. Othman et al. (2021) also reported similar findings regarding the challenges faced by organizations in transitioning from traditional practices to new technologies.

Other barriers such as 'Setup cost inhibits its use, i.e., software, training, and hardware cost,' 'Lack of software compatibility restricts its use,' and 'Lack of awareness of BIM benefits' ranked lower in the analysis (Mean = 4.13, S.D = 0.79960; Mean = 4.08, S.D = 0.83352). These barriers reflect common reasons organizations in Malaysia cite for resisting new technologies like BIM. This aligns with previous studies by Hosseini et al. (2011) and Masood et al. (2014), which highlighted a lack of awareness and understanding of BIM benefits among Malaysian users.

Lastly, 'Lack of time for experimentation and implementation in fast-paced projects' (Mean = 3.99, S.D = 0.71910) and 'Lack of references to assist in implementing BIM' (Mean = 3.93, S.D = 0.86828) received the lowest scores, indicating respondents' relatively lower concern about these barriers.

In conclusion, the integration and adoption of BIM in the construction industry encounter various obstacles. Although the industry recognizes the advantages of BIM, overcoming these challenges requires coordinated efforts. By doing so, the construction industry can harness the potential of BIM to enhance productivity, efficiency, and collaboration in projects, thereby shaping a more promising future.

The Benefits of Building Information Modelling Implementation

Table 2: Descriptive Statistic for the Mean Values of Selected Variables

Variables	Mean	Rank
Cost elimination	4.44	1
Energy efficiency	4.40	2
Site analysis and planning	4.40	3
Collaborates with other teams	4.40	4
Success interoperability	4.40	5

Review design process	4.40	6
Monitor and track progress	4.40	7
Improve multi-party communication and synchronization	4.31	8
Identify time-based clashes	4.25	9
Eliminates clashes	4.19	10
Assess time and cost	4.19	11
Integrate construction scheduling and planning	4.17	12
Increase productivity and efficiency design	4.01	13

Table 2 shows the ranking of mean scores on benefits in implementing building information modelling. It was determined by the mean score for each element based on the survey done on the online questionnaire that has been analyzed by SPSS version 27. As a result, based on Table 2, the highest mean is the cost elimination with 4.44 mean value. The least is increasing in productivity and efficiency design with 4.01 mean value. According to the interpretation of the mean, all the elements ranked are at a medium level.

Based on the information in Table 2, it's clear that most of the respondents favored 'Integrate cost elimination' as the top benefit, with the highest score of mean (M=4.44, S.D=0.70886). This benefit gained the highest score because the respondents observed positive impacts and advantages in their field through BIM implementation. Building Information Modeling (BIM) can achieve cost elimination by incorporating features like detecting clashes, optimizing designs, planning construction sequences, and scheduling. These BIM benefits collectively reduce waste, enhance cost predictability, and improve project efficiency. A study by McGraw-Hill (2008) on BIM's role in the AEC industry also highlighted its potential to lower costs and enhance productivity and work quality.

The following six benefits all received the same mean score (M=4.3977, S.D=0.70368): 'Facilitate energy efficiency analysis,' 'Facilitate site analysis and planning,' 'Effective collaboration with other teams,' 'Maintain interoperability of building components,' 'Review design process,' and 'Monitor and track construction progress.' These benefits ranked second to seventh and were widely agreed upon by respondents.

Moving on, the eighth-ranking benefit was improved multi-party communication and synchronization (M=4.30, S.D=0.684), followed by identifying time-based clashes (M=4.26, S.D= 0.66944) in ninth place, and eliminating clashes in design (M=4.19, S.D=0.69245) in the tenth spot. Additionally, assessing time and cost associated with design changes received the same mean score and standard deviation as the tenth-

ranked benefit. The two lowest-rated benefits by respondents were integrated construction scheduling and planning (M=4.17, S.D=0.761450) and increased productivity and efficiency in design (M=4.01, S.D=0.71910).

In summary, the analysis of the benefits of using BIM reveals a diverse range of advantages throughout various project phases. BIM acts as a powerful tool that transforms the architectural, engineering, and construction (AEC) sector by fostering collaboration, saving costs and time, enhancing productivity, and elevating project quality.

CONCLUSION AND RECOMMENDATIONS

In conclusion, the construction industry encounters barriers in implementing and adopting BIM but recognizes its numerous benefits. BIM transforms the AEC sector by enhancing collaboration, reducing costs and time, increasing productivity, and improving project quality. Addressing barriers like client demand, resistance to change, and lack of protocols is crucial. By raising awareness of BIM's advantages and overcoming these obstacles, the construction industry can fully harness BIM's potential to improve project efficiency, productivity, and collaboration.

Researchers are encouraged to conduct comparative studies, exploring BIM implementation alongside other construction methodologies or technologies to understand its benefits and limitations better. Inclusion of perspectives from various stakeholders in the construction industry, such as clients, government agencies, and end-users, can provide a comprehensive view of BIM's impact. Additionally, in-depth case studies of successful BIM projects in different regions can identify factors contributing to their success and serve as valuable references for future implementations. These recommendations aim to advance BIM understanding and implementation in the construction industry and contribute to its knowledge base.

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REFERENCES

Abd Jamil, A. H., & Fathi, M. S. (2018). *Contractual challenges for BIM-based construction projects: a systematic review*. Built Environment Project and Asset Management, *8*(4), 372–385. https: //doi.org/1 0.1108/BEPAM-12-2017- 0131

Akob, Z., Abang Hipni, M. Z., & Rosly, M. R. (2019). *Leveraging on building information modelling (BIM) for infrastructure projects: Pan Borneo Highway Sarawak Phase 1. I*OP Conference Series: Materials Science and Engineering, 512(1). https://doi.org/10.1088/1757 - 899X/512/1/012060

Aljarman, M., Boussabaine, H., & Almarri, K. (2020). *Emerging technical risks from the application of building information modelling*. *J*ournal of Facilities Management, 18(3), 195–212. https://doi.org/10.1108/JFM-12-2019-0063

Ang, P. S. E., Pung, Y. L., Tsai, K. L., Zulkaply, M. N. A., Tey, J. S., Kasim, N. B., Osman, M. H., Musa, M. K., & Abdul Rahman, M. A. (2020). *BIM: The setback or solution to project cost issues in Malaysia construction industry? I*OP Conference Series: Earth and Environmental Science, 476(1). https://doi.org/10.1088/1755- 1315/476/1/012011

Ashcraft, H. W. (2008). *Building information modelling: a framework for collaboration*. Society of Construction Law International Conference, 28(June), 5.

Azhar, S. (2011). *Building information modelling (BIM): Trends, benefits, risks, and challenges for the AEC industry.* Leadership and Management in Engineering, 11(3), 241–252. https://doi.org/10.1061/(ASCE)LM.1943- 5630.0000127

Azhar, S., Khalfan, M., & Maqsood, T. (2012). *Building information modelling (BIM): Now and beyond.* Australasian Journal of Construction Economics and Building, 12(4), 15–28. https://doi.org/10.5130/ajceb.v12i4.3032

CIDB. (2017). Malaysia BIM Report 2016. In *CIDB Malaysia* (pp. 1–43). https://mybim.cidb.gov.my/download/ malaysia-bim-report-2016/

Chan, C. T. (2014). *Barriers of Implementing BIM in Construction Industry*. Retrieved fromJSMS_VOL4_NO2_003.doc: http://www.aasmr.org/jsms/Vol4/No.2/JSMS_VOL4_NO2_003.pdf

Dixit, M. K., Venkatraj, V., Ostadalimakhmalbaf, M., Pariafsai, F., & Lavy, S. (2019). I*ntegration of facility management and building information modelling (BIM): A review of key issues and challenges*. Facilities, 37(7–8), 455– 483. https://doi.org/10.1108/F-03-2018- 0043

Enegbuma, W. I., Aliagha, U. G., & Ali, K. N. (2014). *Preliminary building information modelling adoption model in Malaysia A strategic information technology perspective.* Construction Innovation, 14(4), 408–432. https://doi.org/10.1108/CI-01-2014-0012

Gerrish, T., Ruikar, K., Cook, M., Johnson, M., & Phillip, M. (2017). *Using BIM capabilities to improve existing building energy modelling practices.* Engineering, Construction and Architectural Management, 24(2), 190–208. https://doi.org/10.1108/ECAM-11-2015- 0181

Han, Y., & Damian, P. (2008). *Benefits and Barriers of Building Information Modelling. United Kingdom*. Proceedings of the 12th International Conference on Computing in Civil and Building Engineering (ICCCBE XII) & 2008 International Conference on Information Technology in Construction (INCITE 2008), 16–18. https://dspace.lboro.ac.uk/2134/23773%0A

Husain, A. H., Razali, M. N., & Eni, S. (2018). *Stakeholders' expectations on building information modelling (BIM) concept in Malaysia*. Property Management, 36(4), 400–422. https://doi.org/10.1108/PM-02- 2017-0013

Kunz, J., & Gilligan, B. (2007, November 6). Value from VDC / *BIM use: survey results - November 2007*. Presented at the CURT National Meeting,, Naples, FL. Retrieved from http://www.stanford.edu/group/CIFE/VDCSurvey.pdf

Othman, I., Yasser Yahya Al-Ashmori, Yani Rahmawati, Y.H. Mugahed Amran, & Ali, M. (2021). *The level of Building Information Modelling (BIM) Implementation in Malaysia*. *12*(1), 455–463. https://doi.org/10.1016/j.asej.2020.04.007

Sinoh, S. S., Othman, F., & Ibrahim, Z. (2020). *Critical success factors for BIM implementation: a Malaysian case study*. Engineering, Construction and Architectural Management, 27(9), 2737– 2765. https://doi.org/10.1108/ECAM-09- 2019-0475

Usmani, A. R. A., Elshafey, A., Gheisari, M., Chai, C., Aminudin, E. B., & Tan, C. S.

(2019). *A scan to as-built building information modeling workflow: a case study in Malaysia.* Journal of Engineering, Design and Technology, 18(4), 923–940. https://doi.org/10.1108/JEDT-07-2019- 0182

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Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar

Setuju.

27.1.2023

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