



ENHANCING BIM MANAGER PROFICIENCY: EXPLORING COMPETENCIES AND COMPETENCE LEVEL

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Abstract

In effective BIM project delivery, BIM Managers' roles and responsibilities are pivotal across the project lifecycle, significantly influencing project performance. Despite this, no empirical studies have assessed BIM Manager proficiency in Malaysia's construction industry. This study addresses this gap by investigating required competencies and competence levels for BIM Managers in BIM environments. A concurrent mixed-methods approach provided comprehensive insights. Qualitative data from interviews with 8 BIM Subject Matter Experts underwent content analysis. Quantitatively, 58 BIM Managers completed a questionnaire on 8 competency sets comprising 57 items, analyzed descriptively. Triangulation enabled robust comparison, contrast, and synthesis of results. Findings classified competencies into four tiers: essential for expert level, requisite for advanced, ancillary for intermediate, and complementary for basic. Notably, 5 of 8 competency sets were deemed important at intermediate-to-expert levels, while 3 were basic-to-intermediate. This research advanced BIM Manager proficiency understanding by identifying novel competency sets and delineating competence levels. It enhances requirements for competent BIM Managers and supports developing skilled BIM talent for future industry needs.

Keywords: Building Information Modelling, BIM Manager, Competency, Competence Level, Malaysia Construction Industry

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INTRODUCTION

The construction industry drives economic development by providing essential infrastructure (Cucos & Turcan, 2025). Construction 4.0 promotes digitalisation, with Building Information Modelling (BIM) enhancing project productivity. Malaysia introduced BIM in 2007, but adoption initially lagged behind Singapore, Hong Kong, and China (Ismail et al., 2017). Adoption rates rose from 17% in 2016 to 49% in 2019 and 55% in 2021 (CIDB, 2021), spurred by government initiatives such as the Construction Industry Transformation Programme (CITP 2016–2020), the Twelfth Malaysia Plan (12th MP), and the Construction 4.0 Strategic Plan 2021–2025. These plans mandate BIM for 50% of Public Works Department (PWD) projects worth RM10 million and above, increasing by 10% annually to 2030 (CIDB, 2024).

Despite progress, expertise shortages persist (Mamter et al., 2024). Achieving these targets requires BIM competence among professionals, particularly BIM Managers, Coordinators, and Modellers. BIM Managers coordinate across the project lifecycle, allocating approximately 80% of their effort to management (CIDB, 2024; Fuzi et al., 2024; Haron, 2021; Sampaio et al., 2023). Strong competencies are vital for performance (Abdulqader et al., 2025; Fuzi et al., 2024), yet shortages in skilled BIM Managers hinder adoption due to skill gaps (Abdulqader et al., 2025; Ariffin et al., 2023; Fuzi et al., 2024). Industry needs more BIM talent as deficiencies impede technology uptake (Abdulqader et al., 2025; Fuzi et al., 2024; Mamter et al., 2024; Ariffin et al., 2023; Mahazir et al., 2024; Tajuddin et al., 2025).

Limited studies address BIM Manager proficiency in Malaysia, especially for public projects (Abdulqader et al., 2025; Fuzi et al., 2024), forming this study's gap. This research identifies required competencies and levels to boost performance. Subsequent sections cover literature review, methodology, findings, discussion, and conclusions.

LITERATURE REVIEW

The Roles and Responsibilities of a BIM Manager

A BIM Manager oversees BIM-related processes by integrating BIM concept knowledge with project management expertise (Sampaio et al., 2023). Core responsibilities include leading BIM teams, managing BIM processes and information across the project lifecycle, implementing standards, resolving coordination issues, and facilitating training (Adekunle et al., 2022; Chernobay et al., 2021; Holzer, 2016; Succar et al., 2013). In Malaysia, the Public Works Department formalises these responsibilities, positioning the BIM Manager as Head of the Project Team, overseeing BIM strategies from inception to handover (Hashim et al., 2024). Key duties span three main functions: **strategy** (setting objectives, work processes, standards, implementation, and training);

management (BIM Execution Plan, model audit, coordination, and requirements); and **preparation** (model and drawing oversight). Unlike BIM Coordinators and Modellers who focus on technical execution, the BIM Manager concentrates on strategic leadership and project governance throughout the project lifecycle (Haron, 2021; Sampaio et al., 2023).

In BEP management, the BIM Manager holds full responsibility for four key sections: Section D (Project Goals/BIM Uses), Section F (BIM Process Design), Section L (Model Structure), and Section M (Project Deliverables), ensuring all deliverables meet client requirements (CIDB, 2017). Although the BIM Manager has primary responsibility for these sections, they are also accountable for overseeing the remaining BEP sections to ensure compliance with PWD BIM guidelines, standards, and established workflows. The information contained in the BEP is essential to the success of a BIM project and serves as a benchmark for evaluating the BIM Manager's competence in project management (CIDB, 2017).

The Competencies of a BIM Manager

Competency is defined as a cluster of knowledge, personal attributes, and performance abilities that impact project success and can be improved through training (PMI, 2017). Various BIM competency frameworks exist, but many are outdated or region-specific. The Individual BIM Competency Hierarchy (IBCH) proposed by Succar et al. (2013) offers a comprehensive framework aligned with this study. It structures competencies into three tiers: core, domain, and execution (refer to Figure 1).

- **Core competencies** include foundation traits, situation enablers, qualifications, and experience.
- **Domain competencies** measure multi-task performance via primary sets (managerial, functional, technical, supportive) and secondary sets (administration, implementation, operation, research & development).
- **Execution competencies** distinguish roles by specialised tool/technique use (e.g., software, programming).

In this study, the core competency tier functions as an initial screening criterion, ensuring that participants meet the fundamental requirements common to all BIM roles (Olorunfemi et al., 2021; Succar et al., 2013). The domain competency tier comprises eight competency sets encompassing 57 items, reflecting the professional capabilities required for multi-task BIM execution (Olorunfemi et al., 2021; Succar et al., 2013). The execution competency tier further differentiates BIM Managers by evaluating advanced and specialized competencies that extend beyond standard BIM roles (Succar et al., 2013).

The Individual BIM Competency Hierarchy (IBCH) proposed by Succar et al. (2013), comprises eight domain competency set, namely Managerial, Functional, Technical, Supportive, Administration, Operation, Implementation, and Research and Development. All the associated items were reviewed, consolidated, and adapted to reflect Malaysian BIM Manager roles, public BIM project requirements, and MyBIM Centre and CREaTE JKR training modules. BIM Matter Expert review confirmed the relevance of the final 57 items.

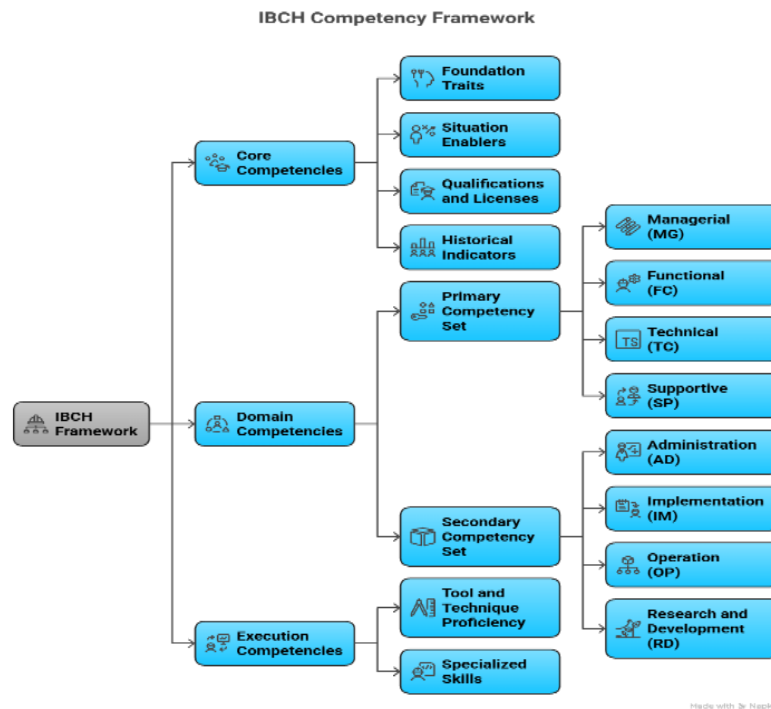


Figure 1: Individual BIM Competencies Hierarchy ([Succar et al.,\(2013\)](#))

The Competency Measurement Level

To accurately measure individual competencies, an appropriate measurement level must be selected to ensure consistency. Established construction frameworks include the ICB-IPMA Competence Baseline Version 3.0, Project Manager Competency Development framework, and Individual Competency Index ([Rustam et al., 2024](#)). These differ in components and readiness across knowledge, skills, and behaviors for project success ([Abebe & Tsehayae, 2024](#); [Rustam et al., 2024](#)). However, [Succar et al. \(2013\)](#), recommend the Banner's Individual Competency Index, suited to the IBCH framework is ideal for BIM from an individual perspective due to new technology adoption. Its five indexes with robust indicators are more accessible than IPMA's 10-scale, especially given

immature BIM knowledge and skills in Malaysia. Table 1 shows the ICI features levels from learning divide (levels 0-1) and time/repetition divide (3-4) ([Gillies & Howard, 2003](#)).

Table 1: The Description of Five Distinct Levels

LEVELS	COMPETENCY	DESCRIPTIONS
LEVEL 0	None	Lack of competence in a specific area or topic
LEVEL 1	Basic	Have some understanding and practical application
LEVEL 2	Intermediate	Comprehensive conceptual understanding and practical application.
LEVEL 3	Advanced	Significant knowledge and consistent high-standard performance
LEVEL 4	Expert	Extensive knowledge, refined skill, and prolonged experience

METHODOLOGY

Data Collection

A concurrent mixed-methods approach combined semi-structured interviews (qualitative) and a questionnaire survey (quantitative) to explore BIM Manager competencies. This design provides breadth and depth, enabling corroboration of industry needs and existing competencies (Wing et al., 1998). The interview examined the competencies and competence levels required for the BIM Manager role, whereas the questionnaire measured the current self-assessed competence of certified BIM Manager across the eight competency sets. Interviews were conducted with eight BIM Subject Matter Experts (SMEs) from PWD and MyBIM Centre, selected based on their involvement in BIM guideline development and BIM Manager training. The questionnaire was distributed via Google Forms to 58 certified BIM Managers for self-assessment, drawn from PWD and MyBIM Centre records.

Participant Selection

A purposive sampling was used. There are several criteria that have been provided for the selected participants. Inclusion criteria are;

- **Interviews:** For qualitative component, the accessible population comprised 16 BIM Subject Matter Experts (BIM-SMEs) from the Public Works Department (PWD) and the Construction Industry Development Board (CIDB). Eight BIM-SMEs participated, comprising four representatives from each organisation. The participants have more than 5 years BIM experience, directly involved in BIM Manager assessment and syllabus or training-module development at the MyBIM Centre and CREaTE JKR. They were purposively selected based on their relevant experience and willingness to participate. The

sample of eight experts was considered appropriate for an in-depth qualitative study and provided insights from the two principal organisations involved in BIM Manager competency development and certification for Malaysian public projects. Table 2 shows the background of the participants.

Table 2: Background of BIM Matter Experts

ID	Position	BIM Experiences
J1	BIM-SME	10 years
J2	BIM-SME	15 years
J3	Unit BIM, PWD	6 years
J4	Unit BIM, PWD	6 years
C1	BIM - CIDB	12 years
C2	BIM - CIDB	9 years
C3	BIM - CIDB	10 years
C4	BIM - CIDB	8 years

- **Survey:** For the quantitative component, the defined population comprised 65 BIM Managers certified by MyBIM-CIDB or CREaTE JKR. These certifications were selected because they are highly recognised for participation in Malaysian public BIM projects. An a priori G*Power analysis, using a statistical power of 0.80, an effect size of 0.35, an alpha level of 0.05, and a maximum of nine predictors, indicated a minimum sample of 54 respondents. The study targeted 60 respondents to accommodate potential non-response, and 58 completed questionnaires were obtained. Thus, the achieved sample exceeded the minimum requirement and represented 89.2% of the defined population, providing strong coverage of the eligible certified BIM Manager population. All the participants were certified BIM Manager completed BIM Manager training (Part 1 & 2) under MyBIM Centre and currently involved in public BIM projects. Table 3 shows the tabulation of the participants.

Table 3: Background of Certified BIM Manager

BIM Manager Criteria	Population
Certified BIM Manager	29
Complete BIM Manager Training Part 1 & 2 from MyBIM CIDB	16
BIM Manager Competency Certification by CREaTE JKR	8
BIM Manager involved in 16 public BIM project	12
TOTAL	65

Data Analysis

Interview recordings were transcribed and analysed using content analysis. Quantitative data were analysed using SPSS for descriptive statistics (mean, standard deviation). Triangulation involved comparing qualitative and

quantitative results in a matrix table to compare, contrast, and synthesise findings systematically.

RESULTS AND DISCUSSION

Qualitative Findings

Throughout the comprehensive discussion with the BIM-SME in the qualitative section, the competencies and levels of competence required for a BIM Manager were categorized into four categories, representing the most required competencies to the least required competencies with the competence level. The categories are also applied by [Uhm et al., \(2017\)](#) in their research to classify the competencies. Table 4 describes the key terms for those four categories of competencies that are being used in this study.

Table 4: Categories and the Competence Level Required for a BIM Manager

Categories	Descriptions	Level of Competencies Required
Essential competencies	The competencies that are highly required for a competent BIM Manager.	Expert
Requisite Competencies	The competencies that are required for a competent BIM Manager.	Advanced
Ancillary competencies	This competency is encouraged for a BIM Manager to possess as it can enhance the ability of a BIM Manager	Intermediate
Complementary competencies	This competency is not essential for a BIM Manager but still required as the value added.	Basic

The qualitative findings identified eight competency sets comprising 57 items, of which 27 were classified as essential, 9 as requisite, 9 as ancillary, and 12 as complementary. The Management (MG) and Administration (AD) competency sets were deemed essential for expert-level BIM Managers, particularly in areas related to leadership, strategic planning, project management, and BIM Execution Plan development. Client management, business development, and partnership-related competencies were classified as requisite, as they extend beyond core BIM responsibilities.

The Functional (FC) competency set was also essential, as it underpins BIM collaboration, workflow coordination, and effective project delivery. In contrast, the Operational (OP) set was largely non-essential, since it focuses on modelling and simulation tasks typically undertaken by BIM Modellers and Coordinators; only general modelling oversight and monitoring were considered essential.

The Technical (TC) set showed a mixed classification, with core BIM system, documentation, and data management knowledge identified as essential,

while modelling, hardware, presentation, and model management were classified as complementary. The Implementation (IM) set included essential, requisite, and complementary competencies: fundamental implementation knowledge was essential, standardisation and training-related competencies were requisite, and component development and library management were complementary.

Supportive (SP) competencies were mostly ancillary or complementary, except for general IT support, which was essential for troubleshooting. Finally, the Research and Development (RD) set was primarily ancillary, with essential competencies in BIM research and strategic planning and requisite competencies in training and knowledge management, while other RD activities were considered optional.

Quantitative Findings

Descriptive analysis, using mean and standard deviation, was employed to determine the current self-assessed competence of the BIM Manager participants. The questionnaire used a five-point competence scale ranging from None to Expert. Mean scores were categorised using the ICI scale: None (1.00–1.80), Basic (1.90–2.60), Intermediate (2.70–3.40), Advanced (3.50–4.20), Expert (4.30–5.00). The results of the descriptive analysis for current BIM Managers in MCI across the eight competency sets are presented in Table 5.

Table 5: Overall Mean, Std. Deviation, Scale Range, and Cronbach's Alpha for the BIM Manager Competency Set

	Variables	Mean	Std. Deviation	Scale Range	Cronbach's alpha
Domain Competencies	MG	4.44	.32	Expert	0.721
	FC	4.57	.37	Expert	0.872
	TC	3.29	.64	Intermediate	0.908
	SP	2.50	.42	Basic	0.806
	AD	4.65	.36	Expert	0.956
	OP	3.07	.66	Intermediate	0.957
	IM	3.77	.53	Advanced	0.862
	RD	3.24	.56	Intermediate	0.899

Table 5 shows the overall mean score, std. deviation, scale range, and Cronbach's alpha for each competency set consisting of Managerial (MG), Functional (FC), Technical (TC), Supportive (SP), Administration (AD), Operation (OP), Implementation (IM), and Research and Development (RD). According to the mean score, AD has the highest mean scorer at 4.65, followed by FC (4.57), MG (4.44), IM (3.77), TC (3.29), RD (3.24), and OP (3.07), while SP was the lowest at 2.50. Thus, Table 5 indicates that the participants reported expert-level competence in MG, FC, and AD; advanced competence in IM; intermediate competence in TC, OP, and RD; and basic competence in SP. The

Cronbach's alpha values ranged from 0.721 to 0.957, indicating acceptable to excellent internal consistency across all eight competency sets.

Triangulation Analysis

Triangulation was conducted by comparing qualitative and quantitative findings, which were synthesised into four competency categories: essential, requisite, ancillary, and complementary. Both qualitative and quantitative findings consistently identified Administration (AD), Functional Competency (FC), and Management (MG) as the most essential competency sets for BIM Managers in the Malaysian construction industry (MCI). Qualitatively, AD was ranked highest, with 8 out of 9 items classified as essential, followed by FC (all items) and MG (4 out of 6 items). Quantitatively, AD recorded the highest mean score (4.65), followed by FC (4.57) and MG (4.44), indicating expert-level competency characterised by advanced knowledge, refined skills, and extensive experience (Benner, 1994). AD emerged as the most critical competency, complementing MG by translating strategic objectives into effective project management practices, particularly in developing and maintaining the BIM Execution Plan and controlling BIM processes and information (Succar et al., 2013). FC was identified as the second most essential competency, encompassing collaboration, facilitation, and workflow management, which are vital for effective BIM project delivery and risk reduction.

AD emerged as the most critical competency, complementing MG by translating strategic objectives into effective day-to-day project management practices. While MG focuses on project goals, strategic planning, and organisational management at the early stages of a project (Succar et al., 2013), AD supports implementation through operational control, project coordination, and BIM information management. Together, AD and MG enable BIM Managers to develop and maintain the BIM Execution Plan (BEP), manage BIM processes, and control BIM information, consistent with prior studies ([Olorunfemi et al., 2021](#); [Sampaio et al., 2023](#)). These competencies have also been shown to significantly influence overall project performance and success.

FC was identified as the second most essential competency set at the expert level, encompassing collaboration, facilitation, project management, and team and workflow coordination. Triangulation results confirmed that all FC items are essential, reflecting the importance of non-technical competencies in initiating, managing, and delivering BIM projects effectively. FC competencies enhance collaboration among project stakeholders, reduce project risks, and improve communication, thereby contributing to improved BIM project performance. This statement was supported by Ariyachandra et al., (2020).

The Information Management (IM) competency set was classified as requisite at the advanced level, particularly for standardisation, system and

process testing, and the development of BIM guides and manuals. These competencies are critical for ensuring interoperability, consistency, and improved BIM project outcomes, as supported by existing literature by (Ariyachandra et al., 2020; Haron, 2021; Kassem et al., 2018). Also, the IM competency set is crucial for improving BIM project performance (Ariyachandra et al., 2020). Research and Development (RD) was identified as an ancillary competency at the intermediate level, supporting knowledge management, organisational change, and continuous improvement. This results reflected the findings by Mahamadu (2016), which research and development are important to support learning and continuous improvement in BIM. Similarly, Simulation and Production (SP), Technical Coordination (TC), and Operation and Maintenance (OP) were classified as ancillary or complementary competencies, typically required at basic to intermediate levels and more closely aligned with BIM Coordinator responsibilities (Sampaio et al., 2023). The syntheses of the triangulation findings demonstrates in Table 6.

Table 6: Triangulation Matrix of BIM Manager Competencies

Category	Qualitative Findings	Quantitative Findings	Synthesised Outcome	Relationship
Essential (Expert)	MG (4 items), FC (all), AD (8 items)	MG (4.44), FC (4.57), AD (4.65)	MG, FC, AD: Essential at Expert level	Strong Agreement
Requisite (Advanced)	IM (4 items), RD (2 items)	IM (3.77), RD (3.24)	IM: Requisite at Advanced. RD: Ancillary at Intermediate	Agreement
Ancillary (Intermediate)	SP (3 items), RD (3 items), OP (3 items)	TC (3.29), OP (3.07), RD (3.24)	RD: Ancillary TC, OP: Complementary	Partial Agreement
Complementary (Basic)	TC (5 items), OP (4 items), SP (1 item)	SP (2.50)	SP, TC, OP: Complementary at Basic/Intermediate	Differences

Overall, triangulation findings indicate strong agreement between BIM Subject Matter Experts and BIM Managers regarding competency priorities. AD, FC, and MG were confirmed as essential expert-level competencies, followed by IM at the advanced level, while RD, SP, TC, and OP were considered supportive competencies. These findings provide clear guidance for the Malaysian construction industry in defining appropriate competency requirements and proficiency levels for BIM Managers.

CONCLUSION

The objective of this paper was achieved by identifying the most required competencies to the least required competencies, and the level of competencies needed for each of the competency sets through the triangulation of the qualitative and quantitative results. As anticipated, the AD, FC, and MG competency sets were the essential competencies required for a BIM Manager at the expert level, followed by the IM competency set at the requisite competency and the level of competencies was at the advanced level. These four competency sets were critically important in developing the objective and goal of the BIM project, developing a BIM execution plan, managing the BIM process and procedure, managing the BIM information, monitoring and controlling the entire BIM project lifecycle, and managing collaboration among the project team and the stakeholders. Subsequently, the RD competency set are required at an intermediate level for the ancillary competencies and should be based on the BIM Manager's interest and the willingness to participate in knowledge sharing with industry, education, and research fields. Finally, for the TC, OP, and SP competency set, these three competencies are required for a BIM Manager at the basic to intermediate level as those competencies were categorized as ancillary and complementary competencies. Furthermore, as mentioned in the literature based on the roles and the responsibilities of a BIM Manager, these three competencies' sets were taken from the roles and the responsibilities of a BIM Manager and perfectly suit the roles of BIM Coordinator and BIM Modeller. The findings from both methods have been validated. The validation is done through three steps to ensure all the information is relevant to the current BIM requirement for a BIM Manager in MCI contexts. In the first step, the data were triangulated by gathering all the data into a table, then, the data were compared, contrasted, and synthesized for the outcome. Then, peer-differing was conducted to check the findings of the triangulation. Finally, the data is then validated using member-checking, and the results have been reviewed by three experts, in which the same experts participate in the interview session. The validation was done by checking the content of the findings from both results twice. From the validation, the three of them were given positive comments to the researcher and agreed with the findings.

Moreover, this study provides a clear definition of the relevant competencies and the competence level required for the BIM Manager in line with their roles and responsibilities in a BIM project. Overall, this study has contributed to the theoretical, methodological, and practical dimensions of the competencies of a BIM Manager. This study facilitates CIDB, MyBIM Centre, and PWD in strengthening BIM Manager certification and assessment criteria. Universities and training provider can use the identified competencies to improve BIM curricula and professional training, while construction firms can apply them

in recruitment, performance assessment, and staff development. These finding can strengthen the construction and the educational sector by supporting the development of competent BIM Manager in the future.

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REFERENCES

- Abdelalim, A. M., Shawky, K., Alnaser, A. A., Shibeika, A., & Шериф, А. (2024). Developing Standard BIM Execution Plans for Complex Construction Projects. *Preprints.Org*. <https://doi.org/10.20944/preprints202405.1858.v1>
- Abdulqader, M., Alias, A. H. B., Haron, N. A., & Zuhri, M. Y. M. (2025). Advancing BIM Adoption in Malaysia's Construction Industry: Overcoming Barriers and Enhancing Operations and Facility Management. *International Journal of Sustainable Development and Planning*, 20(9), 3673. <https://doi.org/10.18280/ijstdp.200904>
- Abebe, K. D., & Tsehayae, A. A. (2024). Assessment of the Role of Project Management Technical and Behavioral Competencies in the Success of Construction Projects. *International Journal for Research in Applied Science and Engineering Technology*, 12(2), 1448. <https://doi.org/10.22214/ijraset.2024.58518>
- Adekunle, S. A., Aigbavboa, C., & Ejohwomu, O. (2022). Understanding the BIM actor role: a study of employer and employee preference and availability in the construction industry. *Engineering Construction & Architectural Management*, 31(13), 160. <https://doi.org/10.1108/ecam-08-2021-0714>
- Ariffin, E. Y., Mustafa, N. E., & Sapri, M. (2023). Perspective towards the Perceived Benefits and Challenges on Building Information Modelling - Facility Management (BIM-FM) Integration at an Early Stage of BIM Projects. *Malaysian Journal of Real Estate/International Journal of Real Estate Studies*, 17(1), 70. <https://doi.org/10.11113/intrest.v17n1.198>
- Ariyachandra, M. R. M. F., Jayasena, H. S., & Perera, B. A. K. S. (2020). Competencies Expected from an Information Manager Working in BIM Based Projects. *International Journal of Construction Education and Research*, 18(1), 49. <https://doi.org/10.1080/15578771.2020.1808123>
- Barison, M. B., & Santos, E. T. (2014). A Tool for Assisting Teachers in Planning BIM Courses. *Computing in Civil and Building Engineering (2014)*, 2159. <https://doi.org/10.1061/9780784413616.268>
- Benner, P. (1982). From Novice to Expert. *AJN American Journal of Nursing*, 82(3), 402. <https://doi.org/10.2307/3462928>
- Charef, R., Emmitt, S., Alaka, H., & Fouchal, F. (2019). Building Information Modelling adoption in the European Union: An overview. *Journal of Building Engineering*, 25, 100777. <https://doi.org/10.1016/j.jobbe.2019.100777>

- CIDB. (2017). BIM Guide 4: BIM Execution Plan (BEP). In *Construction Industry Development Board Malaysia*. Construction Industry Development Board (CIDB) Malaysia.
- CIDB, C. (2021). *Malaysia Building Information Modelling (Bim) Report 2021*.
- CIDB, C. (2024). *BIM Effectiveness Implementation in Construction Project*, CIDB Technical Report Publication No. 2112.
- Cucos, S., & Turcan, R. (2025). Role Of the Construction Industry in Economic Growth and Sustainable Development. *Journal of Social Sciences*, 8(1), 25. [https://doi.org/10.52326/jss.utm.2025.8\(1\).02](https://doi.org/10.52326/jss.utm.2025.8(1).02)
- Fuzi, M. F. N. M., Salleh, H., & Loo, S. C. (2024). Addressing The Competency Of Practitioners Within Bim E-Submission in Malaysian Local Authorities. *Planning Malaysia*, 22. <https://doi.org/10.21837/pm.v22i33.1560>
- Gillies, A., & Howard, J. (2003). Managing change in process and people: Combining a maturity model with a competency-based approach. *Total Quality Management & Business Excellence*, 14(7), 779. <https://doi.org/10.1080/1478336032000090996>
- Haron, A. (2021). *Role & Responsibilities of BIM Manager in Public Project*.
- Hashim, M. Z., Othman, I., Khalid, N. S. M., Hassan, S. H., & Musa, M. K. (2024). Construction Players' Awareness on the Use of Building Information Modelling (BIM) and Industrialized Building System (IBS) in Malaysian Construction Industry. In *Lecture notes in civil engineering* (p. 491). Springer Nature. https://doi.org/10.1007/978-981-99-1111-0_42
- Institute, P. M. (2017). Project manager competency development framework. In *CERN Document Server (European Organization for Nuclear Research)*. European Organization for Nuclear Research.
- Ismail, N. A. A., Chiozzi, M. A., & Drogemuller, R. (2017). An overview of BIM uptake in Asian developing countries. *AIP Conference Proceedings*, 1903, 80008. <https://doi.org/10.1063/1.5011596>
- Kassem, M., Raoff, N. L. A., & Ouahrani, D. (2018). Identifying and analyzing BIM specialist roles using a competency-based approach. *Creative Construction Conference 2018. Proceedings*, 1044. <https://doi.org/10.3311/cc2018-135>
- Mahamadu, A. M. (2016). *Development of a decision support framework to aid selection of construction supply chain organisations for BIM-enabled project* [University of the West of England, Bristol. <http://eprints.uwe.ac.uk/29997/>
- Mahazir, M., Rahman, R. A., Zainudin, N. M., & Salleh, S. (2024). Construction Project Failure: Investigating Causes of Ineffective Building Information Modelling Execution Plans. *Planning Malaysia*, 22. <https://doi.org/10.21837/pm.v22i32.1492>
- Mamter, S., Nasruddin, N. S., Salleh, N. M., & Mamat, M. E. (2024). Adoption and Impact of Digital Transformation Tools among Fresh Graduate Quantity Surveyors in Malaysia. *International Journal of Research and Innovation in Social Science*, 762. <https://doi.org/10.47772/ijriss.2024.809067>
- Noor, R. N. H. R. M., Ibrahim, C. K. I. C., & Belayutham, S. (2021). Making Sense of Multi-Actor Social Collaboration in Building Information Modelling Level 2 Projects: A Case in Malaysia. *Construction Economics and Building*, 21(4). <https://doi.org/10.5130/ajceb.v21i4.7829>

- Olorunfemi, E., Oyekunle, L., Olanrewaju, O. I., & Olorunfemi, R. (2021). *Competencies and the penetration status of building information modelling among built environment professionals in Nigeria*. <https://doi.org/10.26686/wgtn.14992089>
- Omer, M. M., Mohd-Ezazee, N. M. A., Lee, Y. S., Rajabi, M. S., & Rahman, R. A. (2022). Constructive and Destructive Leadership Behaviors, Skills, Styles and Traits in BIM-Based Construction Projects. *Buildings*, 12(12), 2068. <https://doi.org/10.3390/buildings12122068>
- PWD. (2014). *Garis Panduan BIM JKR*. Cawangan Pengurusan Projek Kompleks, JKR. <https://fliphtml5.com/robul/npvg/basic>
- Rustam, A., Yasin, M. N., Zainuddin, M., Yusoff, K. N., & Kamil, N. A. (2024). A Review on Dominant Factors of Project Manager Competency in Various Implementations for the Construction Industry. *IOP Conference Series Earth and Environmental Science*, 1347(1), 12044. IOP Publishing. <https://doi.org/10.1088/1755-1315/1347/1/012044>
- Sampaio, A. Z., Azevedo, G., & Gomes, A. (2023a). BIM Manager Role in the Integration and Coordination of Multidisciplinary Projects. *Preprints.Org*. <https://doi.org/10.20944/preprints202307.1287.v1>
- Sampaio, A. Z., Azevedo, G., & Gomes, A. (2023b). BIM Manager: Responsibility, Coordination and Data Exchange Regulator. *Preprints.Org*. <https://doi.org/10.20944/preprints202308.0994.v1>
- Succar, B., & Sher, W. (2014). A Competency Knowledge-base for BIM Learning. *Australasian Journal of Construction Economics and Building - Conference Series*, 2(2), 1. <https://doi.org/10.5130/ajceb-cs.v2i2.3883>
- Succar, B., Sher, W., & Williams, A. (2013). An integrated approach to BIM competency assessment, acquisition and application. *Automation in Construction*, 35, 174. <https://doi.org/10.1016/j.autcon.2013.05.016>
- Sujan, S. F., Jones, S., Kiviniemi, A., Wheatcroft, J. M., & Mwiya, B. (2020). Holistically assessing collaborative culture in the AEC industry. *Journal of Information Technology in Construction*, 25, 272. <https://doi.org/10.36680/j.itcon.2020.016>
- Tajuddin, M. A., Mohamed, M. R., Rashid, M. N. A., Nasir, N. A. M., & Mahdzir, M. (2025). Barriers And Solutions of Building Information Modelling (BIM) In Construction Site Safety in Malaysia. *Planning Malaysia*, 23. <https://doi.org/10.21837/pm.v23i36.1733>
- Toyin, J. O., & Mewomo, M. C. (2023). Assessing the innovative skills and competencies required of construction management graduates. *Organization Technology and Management in Construction an International Journal*, 15(1), 90. <https://doi.org/10.2478/otmcj-2023-0002>
- Uhm, M., Lee, G., & Jeon, B. (2017). An analysis of BIM jobs and competencies based on the use of terms in the industry. *Automation in Construction*, 81, 67. <https://doi.org/10.1016/j.autcon.2017.06.002>
- Wang, T., & Chen, H.-M. (2023). Integration of building information modeling and project management in construction project life cycle. *Automation in Construction*, 150, 104832. <https://doi.org/10.1016/j.autcon.2023.104832>

Wing, C. K., Raftery, J., & Walker, A. (1998). The baby and the bathwater: research methods in construction management. *Construction Management and Economics*, 16(1), 99. <https://doi.org/10.1080/014461998372637>

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