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BUILDING INFORMATION MODELLING (BIM) READINESS: COMPETENCY LEVELS AND STRATEGIC IMPROVEMENTS FOR GRADUATING QS STUDENTS

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Abstract: *Building Information Modelling (BIM) has become an essential catalyst for digital transformation within the modern construction sector, necessitating adequate preparation from entering professionals. Yet, adoption in Malaysia remains relatively slow, with overall implementation rates hovering between 13% and 17%. This study evaluates the BIM readiness and competency levels of graduating Bachelor of Quantity Surveying (Hons) students at Universiti Teknologi MARA (UiTM), specifically across the Seri Iskandar and Shah Alam campuses, and proposes strategic educational improvements. Adopting a quantitative research design, data were collected via a structured questionnaire using purposive sampling, yielding a total of 69 final-year respondents. Descriptive statistics and mean score analysis were employed to evaluate the students' conceptual knowledge and practical software proficiency.*

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The findings reveal a critical deficiency in practical BIM competencies among graduating students, with minimal proficiency recorded in essential tasks such as automated quantity take-offs and digital Bills of Quantities (BQ) production (mean scores ranging from 1.536 to 1.663). To bridge this technical gap, respondents strongly advocated for two primary interventions: the comprehensive integration of BIM concepts into core academic curricula (M = 3.94) and the provision of financial subsidies to improve resource accessibility (M = 3.90). Consequently, this study underscores the urgent need for higher education institutions to mandate hands-on software training within core syllabi and foster strategic industry partnerships to secure software funding. Implementing these strategies will ensure future quantity surveying graduates are equipped to meet the evolving digital demands of the construction industry.

Keywords: *BIM, Quantity Surveying, Fresh graduates, Competency level*

Introduction

Building Information Modelling (BIM) has emerged as a transformative technological paradigm within the built environment, optimizing project lifecycles from conceptualization to facility management. In Malaysia, the transition toward this digital frontier is heavily championed by the Construction Industry Development Board (CIDB) through the Construction 4.0 Strategic Plan (2021–2025), which positions BIM as a primary catalyst for enhancing industry productivity, sustainability, and competitiveness.

The Malaysian construction industry's acceptance of BIM gained significant momentum following government mandates requiring BIM implementation for public projects exceeding RM100 million (CIDB, 2020). However, despite these progressive top-down initiatives, widespread adoption across the private sector remains gradual. Current literature consistently identifies that implementation is hindered by the high initial costs of software and hardware investment, expensive training fees, and a pervasive shortage of highly skilled BIM professionals (Abd Hamid et al., 2018; Gamil & Rahman, 2019).

Building Information Modelling (BIM) adoption in Malaysia remains relatively slow, with overall implementation rates hovering between 13% and 17% (Naing et al., 2022; Tanko et al., 2024). While global integration accelerates, local adoption is primarily driven by the public sector and international firms handling mega-projects, heavily concentrating usage in central Peninsular Malaysia (Al-Ashmori et al., 2022; Naing et al., 2022).

Literature Review

As the industry pivots toward digitalization, the traditional role of the Quantity Surveyor (QS) is evolving beyond manual 2D measurement into multi-dimensional data management, specifically 5D BIM for cost estimation. Consequently, the industry demand for fresh graduates equipped with robust BIM capabilities has surged. However, a critical problem persists regarding the actual competency levels of graduating QS students. According to Zainon et al. (2018), a major contributing factor to the slow growth of BIM implementation in Malaysia is the fundamental lack of BIM knowledge and operational competencies among quantity surveyors.

While most fresh graduates possess basic software literacy and a conceptual awareness of 3D visualization, they frequently struggle with automated quantity take-offs and multidisciplinary collaboration within a native BIM environment. This competency gap is primarily attributed to

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superficial software exposure during academic training and the absence of a structured, standardized BIM competency framework tailored specifically for QS education (Saka et al., 2020; Yan & Cheng, 2021). To ensure that graduating QS students remain competitive and can actively contribute to Malaysia's Construction 4.0 agenda, strategic improvements in university curricula and targeted upskilling frameworks are urgently required.

QS graduating students' competencies in utilizing BIM

This subtopic evaluates the practical Building Information Modelling (BIM) competencies of graduating UiTM quantity surveying students, which are critical for contemporary industry practices. It delineates technical proficiency across key operational areas, focusing specifically on their ability to utilize industry-standard software for automated quantity take-offs, structural data extraction, and the precise generation of digital bills of quantities.

Technical skills

Developing robust technical skills is an essential prerequisite for modern quantity surveying graduates facing the ongoing digital paradigm shift. Integrating comprehensive BIM software training in higher education ensures students master critical digital competencies, including cost estimation and 3D modelling, ensuring their readiness for highly collaborative modern construction environments (Tanko & Mbugua, 2021).

Taking off skills (substructure and superstructure works)

Accurate automated quantification of complex substructure and superstructure elements forms a fundamental industry competency. Utilizing advanced BIM capabilities allows quantity surveying students to precisely extract volume and area parameters directly from integrated digital elements, severely minimizing the profound measurement discrepancies commonly encountered during foundational cost planning (Soon et al., 2024).

Taking off skills (reinforcement works)

Executing accurate quantity take-offs for reinforcement works using 5D BIM technologies drastically optimizes complex rebar configurations. Graduating students must accurately calculate intricate bar parameters, such as bending and splicing, which enhances overall structural estimation precision and mitigates the substantial human errors routinely found in conventional calculation methods (Soon et al., 2024).

Taking off skills (mechanical & electrical services using TME)

Accurately measuring complex mechanical and electrical services via digital platforms requires sophisticated technical modelling competencies. Specialized applications like Cubicost TME facilitate the automated calculation of intricate service layouts. This proficiency ensures graduates correctly estimate advanced installations while consistently avoiding the severe documentation discrepancies associated with manual drafting interpretations (Mokhtar Azizi et al., 2021).

Taking off skills (finishes works)

The ability to conduct quantity take-offs for structural finishing works via BIM ensures high measurement accuracy. Extracting geometric properties directly from 3D models eliminates tedious, error-prone manual interpretations traditionally required for finishes, ultimately empowering quantity surveyors to generate highly reliable and rapid cost estimations directly within modern digital environments (Soon et al., 2024).

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Ability to extract quantities from BIM software into BQ

The specialized ability to seamlessly extract quantities from an integrated BIM model directly into a BQ effectively overcomes traditional data integration challenges. These automated extraction functions significantly expedite comprehensive cost estimation processes, effectively bypassing tedious manual take-offs and fundamentally reducing the inherent human errors in construction documentation (Soon et al., 2024).

Ability to produce BQ using Cubi cost TBQ

Mastering the ability to produce Bills of Quantities (BQ) using specialized costing software like Glodon Cubicost TBQ directly streamlines the estimation of finishes. This specific software proficiency prevents critical interoperability issues, minimizing potential data loss while ensuring accurate, rapid pricing without reverting to outdated manual calculation procedures (Mokhtar Azizi et al., 2021).

Table 1: Matrix Table - QS graduating students' competencies in utilizing BIM

Theme / Competency Area	Key Findings / Required Competencies	Software / Technology Highlighted	Citation
Technical Skills	Developing robust technical skills is an essential prerequisite for modern QS graduates due to the digital paradigm shift. Integrating comprehensive training ensures mastery of digital competencies like cost estimation and 3D modelling, preparing them for collaborative environments.	Comprehensive BIM software	Tanko & Mbugua, 2021
Taking Off Skills (Substructure and Superstructure Works)	Accurate automated quantification of complex elements is a fundamental competency. Students must precisely extract volume and area parameters directly from integrated digital elements to minimize profound measurement discrepancies.	Advanced BIM capabilities	Soon et al., 2024
Taking Off Skills (Reinforcement Works)	Executing accurate take-offs optimizes complex rebar configurations. Graduating students must accurately calculate intricate parameters (bending, splicing) to enhance estimation precision and mitigate substantial human errors found in conventional methods.	5D BIM technologies	Soon et al., 2024
Taking Off Skills (Mechanical & Electrical Services)	Requires sophisticated technical modelling competencies to measure complex M&E services. Facilitates automated calculation of intricate service layouts to correctly estimate installations and avoid severe documentation discrepancies from manual drafting.	Cubicost TME	Mokhtar Azizi et al., 2021
Taking Off Skills (Finishes Works)	Extracting geometric properties directly from 3D models eliminates tedious, error-prone manual interpretations. Empowers quantity surveyors to generate highly reliable and rapid cost estimations directly within digital environments.	3D models / BIM	Soon et al., 2024

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Data Integration: Extracting Quantities into BQ	Seamless extraction of quantities from an integrated BIM model directly into a BQ overcomes traditional data integration challenges. This significantly expedites cost estimation, bypasses manual take-offs, and reduces inherent human errors.	Integrated BIM software	Soon et al., 2024
Producing BQ using Specialized Software	Mastering the ability to produce Bills of Quantities (BQ) directly streamlines estimation, prevents critical interoperability issues, minimizes potential data loss, and ensures accurate, rapid pricing without outdated manual procedures.	Glodon Cubicost TBQ	Mokhtar Azizi et al., 2021

Strategic approaches to enhance the competency of graduating UiTM quantity surveying students

This subtopic reviews strategic interventions for enhancing Building Information Modelling (BIM) competency among graduating quantity surveying students. By analyzing curriculum integration, financial subsidies, and industry collaborations, this review establishes solutions to align academic preparation with digital industry demands.

Integrate BIM concepts and practices into academic courses

Integrating Building Information Modelling (BIM) into academic courses bridges the gap between educational frameworks and industry requirements. Embedding these core concepts directly into curricula ensures that quantity surveying graduates develop the vital digital competencies necessary for collaborative modern construction processes (Sun et al., 2024).

Advocate for subsidies or funding

Advocating for financial subsidies severely mitigates economic barriers associated with software acquisition. This targeted funding allows higher education institutions to provide well-equipped technological infrastructure, ensuring students gain unimpeded access to vital learning resources without the constraints of prohibitive operational costs (Saka & Chan, 2019).

Offer targeted training sessions and hands-on workshops for BIM skills

Offering targeted training sessions and practical hands-on workshops is essential for developing technical proficiency. Practical software instruction empowers quantity surveying students to master critical competencies, such as conducting automated quantity take-offs and precisely managing complex data during cost calculations (Soon et al., 2024).

Apply BIM in real-world scenarios (Eg: internships or projects)

Providing opportunities to apply BIM through collaborative real-world scenarios directly aligns educational outcomes with industry expectations. This practical application allows students to fully grasp the complexities of information flow, thereby highlighting the explicit role of quantity surveyors during project development (Mayouf et al., 2019).

Awareness campaigns on the benefits and importance of BIM

Conducting targeted awareness campaigns is crucial for emphasizing BIM's extensive industry benefits. Highlighting these vast advantages effectively counters the widespread resistance to change and encourages a necessary paradigm shift, ensuring future professionals actively

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support technology-driven construction and integrated project management (Saka & Chan, 2019).

Teaching advanced BIM software skills for confidence and competence

Focusing specifically on advanced software skills equips quantity surveying graduates for complex specialized operations. Focused instruction on 5D BIM capabilities ensures students confidently navigate inherent interoperability challenges and effectively perform highly accurate cost estimates directly extracted from digital architectural models (Sun et al., 2024).

Having access to up-to-date BIM software for learning and practice

Ensuring continuous access to up-to-date BIM software guarantees that students practice using the exact technological tools required by current industry standards. Resolving this critical infrastructure deficit empowers graduates to effectively execute highly accurate automated cost analyses directly within modern digital environments (Soon et al., 2024).

Create standardized procedures and best practices for effective BIM use

Creating standardized procedures and clear best practices ensures structured digital methodologies for students. Establishing these standardized protocols reduces technical complexities and data ambiguities, ultimately leading to highly reliable cost estimations and more seamless integration of quantity surveyors into the BIM workflow (Mayouf et al., 2019).

Educate clients about BIM advantage to increase its adoption

Educating clients regarding the long-term operational and cost-saving advantages of BIM increases crucial industry adoption. Empowering graduating students to articulate these substantial benefits actively addresses the significant barrier of low client demand, thereby promoting widespread technological integration and reliable construction investments (Saka & Chan, 2019).

Facilitate partnerships with industry experts

Facilitating robust partnerships with industry experts provides essential mentorship and necessary technical guidance. These strategic collaborations effectively bridge the gap between academic theory and practical execution, ensuring students grasp critical performance indicators, essential multidisciplinary coordination, and complex real-world project applications (Sun et al., 2024).

Table 2: Matrix Table - Strategic approaches to enhance the competency of graduating UiTM quantity surveying students

Strategic Approach	Key Interventions & Expected Outcomes	Citation
Integrate BIM concepts and practices into academic courses	Embedding core concepts bridges the gap between educational frameworks and industry requirements, ensuring graduates develop vital digital competencies for collaborative modern construction.	Sun et al., 2024
Advocate for subsidies or funding	Mitigates economic barriers for software acquisition, allowing higher education institutions to provide well-equipped technological infrastructure without prohibitive operational costs.	Saka & Chan, 2019
Offer targeted training sessions	Develops technical proficiency through practical software instruction, empowering students to master	Soon et al., 2024

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and hands-on workshops	critical competencies like automated quantity take-offs and complex data management.	
Apply BIM in real-world scenarios (e.g., internships or projects)	Aligns educational outcomes with industry expectations. Helps students grasp information flow complexities and explicitly defines the role of quantity surveyors during project development.	Mayouf et al., 2019
Awareness campaigns on the benefits and importance of BIM	Counters resistance to change and encourages a paradigm shift, ensuring future professionals actively support technology-driven construction and integrated project management.	Saka & Chan, 2019
Teaching advanced BIM software skills	Equips graduates for complex specialized operations (e.g., 5D BIM). Allows them to confidently navigate interoperability challenges and perform highly accurate cost estimates directly extracted from digital models.	Sun et al., 2024
Access to up-to-date BIM software for learning and practice	Guarantees practice using current industry-standard tools. Resolving infrastructure deficits empowers graduates to execute highly accurate automated cost analyses within digital environments.	Soon et al., 2024
Create standardized procedures and best practices	Provides structured digital methodologies. Reduces technical complexities and data ambiguities for reliable estimations and more seamless integration of quantity surveyors into the BIM workflow.	Mayouf et al., 2019
Educate clients about BIM advantage to increase adoption	Addresses the barrier of low client demand. Empowers students to articulate long-term operational and cost-saving advantages of BIM, promoting widespread technological integration.	Saka & Chan, 2019
Facilitate partnerships with industry experts	Provides mentorship and technical guidance. Strategically bridges the gap between academic theory and practical execution, ensuring students grasp multidisciplinary coordination and real-world project applications.	Sun et al., 2024

Methodology

This study adopts a quantitative research design utilizing a structured survey to evaluate the Building Information Modelling (BIM) knowledge and competency of final-year Bachelor of Quantity Surveying (Hons) students. The target population consists of final-year students from three Universiti Teknologi MARA (UiTM) campuses: Seri Iskandar and Shah Alam. Purposive sampling ensures respondents have sufficient academic exposure to BIM. The questionnaire assesses their conceptual understanding and practical software skills to foster continuous digital learning. Data gathered were then analysed through descriptive statistics, including mean score analysis, to identify current readiness levels and formulate strategic educational improvements.

Table 3: Likert Scale system adopted in the questionnaire

Scale	Level of Agreement
5	Strongly Agree
4	Agree
3	Neutral
2	Disagree
1	Strongly Disagree

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Data was collected using a Google Forms online survey distributed via WhatsApp. The survey was disseminated through the Quantity Surveying student club (PERUBAHAN) at both the UiTM Seri Iskandar and Shah Alam campuses. "Because the exact number of the target population (final-semester students) was unavailable to the researcher, establishing a strict probability sampling method was not feasible. Therefore, this study employed a purposive sampling approach to gather data from accessible participants. At the conclusion of the data collection phase, a total of 69 respondents had participated, forming the final sample size ($n = 69$) for subsequent data analysis. For this descriptive study, a sample size of 69 is methodologically sufficient. Roscoe (1975) and Sekaran (2003) establish that samples between 30 and 500 are appropriate for most research. Exceeding the 30-participant baseline ensures a reliable, meaningful summarization of the collected data (Isaac & Michael, 1995).

Questionnaire Structure

The survey instrument was systematically designed and divided into three distinct sections to address the specific objectives of the study. The distribution of the questions across the core research themes is outlined in Table 4.

Table 4: Distribution of Questionnaire Items

Section	Focus Area / Construct	Number of Items
Section A	Demographic Information	4
Section B	QS Graduating Students' Competencies in Utilizing BIM	7
Section C	Strategic Approaches to Enhance the Competency of Graduating UiTM QS Students	10
	Total Items	**21**

Findings and Data Analysis

This section presents the primary findings and discussion of the research. It comprehensively evaluates the current Building Information Modelling (BIM) competency levels of graduating UiTM quantity surveying students and discusses proposed strategies to effectively enhance their technical proficiency.

QS graduating students' competencies in utilizing BIM

This section utilizes descriptive statistics, specifically mean scores, to evaluate the practical Building Information Modelling (BIM) competency levels of graduating UiTM quantity surveying students. Table 5 summarizes these findings for further analysis.

Table 5: Students' personal opinion on their BIM competency

Variables	Mean Score	Rank
Ability to do taking off structural works (finishes work)	1.663	1
Technical skills	1.658	2
Ability to produce BQ using Cubi cost TBQ (finishes work)	1.652	3
Ability to do taking off structural works (substructure and superstructure work)	1.625	4
Ability to do taking off reinforcement works	1.583	5
Ability to extract quantities from BIM software into BQ	1.536	6
Ability to do taking off mechanical & electrical services using TME	1.536	7

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According to the tabulated results, the respondents' mean scores ranged from 1.536 to 1.663, indicating a very minimal understanding of Building Information Modelling (BIM). This limited proficiency applies not only to the preparation of taking off works but also to the production of Bills of Quantities (BQ), the extraction of quantities from BIM into BQs, and overall technical skills. Ultimately, the mean scores reported for this entire section reflect a significantly low level of comprehension among the respondents. This supports previous authors which stated that competency gap is primarily attributed to superficial software exposure during academic training and the absence of a structured, standardized BIM competency framework tailored specifically for QS education (Saka et al., 2020; Yan & Cheng, 2021).

Strategic approaches to enhance the competency of graduating UiTM quantity surveying students

This section explores proposed strategies to enhance the Building Information Modelling (BIM) competencies of graduating UiTM quantity surveying students. Utilizing mean score analysis, the perceived effectiveness of these strategic interventions is evaluated and summarized in Table 6.

Table 6: Strategies to improve BIM Competency of graduating UiTM QS Students

Variables	Mean Score	Rank
Integrate BIM concepts and practices into academic courses to ensure comprehensive education.	3.94	1
Advocate for subsidies or funding to help students and institutions access BIM resources.	3.9	2
Offer targeted training sessions and hands-on workshops to develop practical BIM skills	3.88	3
Provide opportunities for students to apply BIM in real-world scenarios, such as internships or projects.	3.87	4
Conduct awareness campaigns to highlight the benefits and importance of BIM in the construction industry.	3.87	5
Focus on teaching advanced software skills to improve student confidence and competence in BIM tools.	3.87	6
Ensure that students have access to up-to-date BIM software for learning and practice.	3.84	7
Create standardized procedures and best practices for effective BIM use.	3.84	8
Educate clients about the advantages of BIM to increase its adoption in industry projects.	3.84	9
Facilitate partnerships with industry experts to provide insights and mentorship on BIM applications.	3.7	10

The survey results indicate that integrating Building Information Modelling (BIM) concepts into academic curricula (M = 3.94) and advocating for financial subsidies to improve resource accessibility (M = 3.90) received the highest mean scores. Respondents identified these two approaches as the most effective strategies for improving BIM competency among fresh quantity surveying graduates.

These results supports authors that stated BIM core concepts should be embedded directly into curricula to ensure quantity surveying graduates develop the vital digital competencies for

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collaborative modern construction processes (Sun et al., 2024) and the need to advocate financial subsidies which will help mitigates economic barriers associated with software acquisition for vital learning resources without the constraints of prohibitive operational costs (Saka & Chan, 2019).

Conclusion and Recommendations

This study reveals a critical deficiency in the practical BIM competencies of graduating UiTM quantity surveying students. Findings indicate minimal proficiency (mean scores 1.536–1.663) across essential tasks, including automated take-offs and digital BQ production. To address this technical gap, respondents highlighted two primary strategies: integrating BIM concepts comprehensively into academic curricula (M = 3.94) and advocating for financial subsidies to enhance resource accessibility (M = 3.90). Consequently, universities must mandate hands-on software training within core syllabi and partner with industry stakeholders to secure software funding, ensuring future graduates meet the digital demands of the modern construction sector.

Conceptual Framework

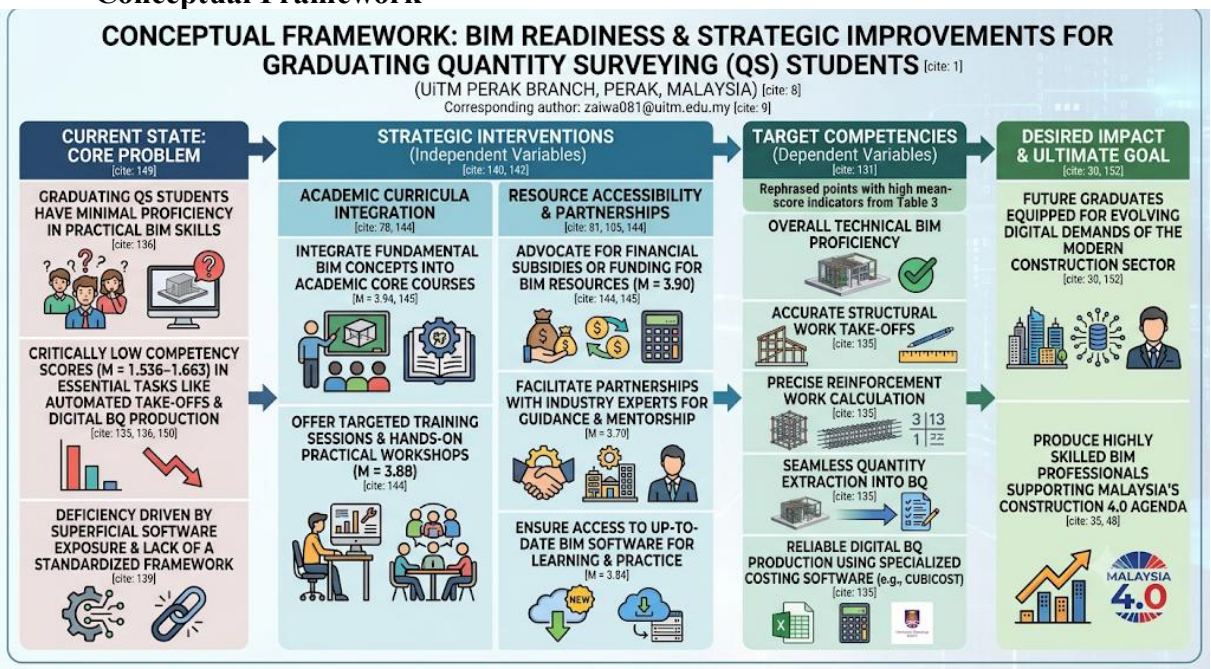

Figure 1: Conceptual Framework : BIM Readines & Strategic Improvements for Graduating QS Students

This conceptual framework addresses the critical deficiency in Building Information Modelling (BIM) proficiency among graduating Quantity Surveying (QS) students at Universiti Teknologi MARA (UiTM). Currently, students exhibit minimal skills in vital tasks like automated take-offs and digital Bill of Quantities (BQ) production due to superficial software exposure. To bridge this gap, the framework proposes embedding BIM concepts into core curricula and securing financial subsidies for software access. Alongside hands-on workshops and industry partnerships, these interventions cultivate essential technical competencies in digital quantification and 5D cost estimation. Ultimately, this ensures graduates can successfully meet modern digital construction demands and actively advance Malaysia's Construction 4.0 agenda.

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