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CHALLENGES AND STRATEGIES FOR LASER SCANNING ADOPTION IN HBIM FOR HERITAGE ASSET AND PROJECT MANAGEMENT IN MALAYSIA

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Abstract

This study examines the adoption of laser scanning technology within Historic Building Information Modelling (HBIM) workflows for heritage asset management in Malaysia. Although laser scanning and HBIM have the potential to improve documentation accuracy, information integration, and lifecycle-oriented management, their practical application in Malaysian heritage projects remains limited and fragmented. A qualitative research approach was adopted through semi-structured interviews with seven stakeholders involved in heritage asset management, including conservators, architects, HBIM specialists, laser scanning practitioners, quantity surveyors, and government representatives. The interview data were analysed using thematic analysis to identify key adoption challenges and strategic responses. The findings reveal that adoption is constrained by high implementation costs, limited technical expertise, fragmented organisational workflows, weak stakeholder coordination, and insufficient policy or contractual support. In response, the study highlights the need for financial support mechanisms, capacity-building programmes, standardised scan-to-HBIM workflows, clearer project requirements, and stronger institutional support. The study contributes to planning and heritage-management practice by demonstrating how laser scanning and HBIM can support conservation documentation, maintenance planning, condition monitoring, adaptive reuse assessment, and more evidence-based decision-making for heritage assets. The findings provide practical insights for planners, policymakers, local authorities, and industry practitioners seeking to strengthen digital adoption in Malaysian heritage asset management.

Keywords: Heritage asset management, Historic Building Information Modelling (HBIM), Laser scanning technology, Digital adoption, Malaysia

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INTRODUCTION

Heritage buildings represent an essential component of a nation's cultural identity, reflecting historical, architectural, and socio-cultural values that shape the character of cities and communities. In Malaysia, the management of heritage assets has become increasingly important in the context of rapid urbanisation and development pressures, which place heritage assets at risk of deterioration or redevelopment (Baharuddin et al., 2022; Ismail et al., 2021). From a heritage asset management perspective, these buildings should be treated as long-term assets that require systematic documentation, monitoring, and maintenance throughout their lifecycle.

Effective heritage asset management relies heavily on accurate and reliable documentation to support decision-making, maintenance planning, and long-term monitoring. However, current practices in Malaysia remain largely dependent on conventional documentation methods, such as manual measurements, photographic records, and written reports, which are often time-consuming, fragmented, and prone to inconsistencies (Ismail et al., 2026; López et al., 2018). These limitations restrict the ability of stakeholders to manage heritage assets efficiently and to implement data-driven asset management strategies.

To address these limitations, digital technologies have been increasingly introduced into the built environment. Building Information Modelling (BIM) enables the integration of geometric and non-geometric data within a unified digital environment, supporting improved information management and lifecycle coordination (Abugu, 2025; López et al., 2018; Lovell et al., 2023). In the context of heritage assets, Historic Building Information Modelling (HBIM) extends BIM capabilities by incorporating historical, material, and condition-related information into structured digital models (López et al., 2018; Godinho et al., 2019). A key enabler of HBIM is laser scanning technology, particularly Terrestrial Laser Scanning (TLS), which allows accurate capture of complex geometries and supports the development of high-quality digital representations (Alshawabkeh et al., 2021).

Beyond documentation accuracy, the integration of laser scanning and HBIM can support heritage planning and asset management decisions. Laser scanning provides reliable geometric and spatial data for assessing existing building conditions, proposed interventions, and conservation requirements (Alshawabkeh et al., 2021). When integrated into HBIM models, this information can be linked with material, defect, and maintenance records to support lifecycle asset management, preventive maintenance, condition monitoring, and conservation planning (Lovell et al., 2023; Rocha et al., 2020). Such scan-to-HBIM workflows can also assist adaptive reuse assessment and local authority decision-making by enabling stakeholders to evaluate physical constraints and

potential intervention impacts before implementation (Salleh et al., 2022; Ismail et al., 2021).

Despite the recognised potential of these technologies, their adoption within the Malaysian context remains limited and uncoordinated (Ismail et al., 2021; Mustafa et al., 2020; Ali et al., 2018). Existing studies have largely focused on technological development and international applications, with limited attention given to the practical realities faced by stakeholders in Malaysia (Lovell et al., 2023; López et al., 2018; Dore & Murphy, 2017). In particular, there is insufficient empirical understanding of stakeholder perceptions, implementation challenges, and the strategies required to support wider adoption. This gap is critical, as successful digital integration depends not only on technological capabilities but also on organisational readiness, institutional capacity, and policy alignment (Ismail et al., 2026; Pärn & Edwards, 2019). The lack of systematic digital adoption further constrains lifecycle-oriented asset management practices, including maintenance planning and long-term monitoring.

This study focuses specifically on the adoption of laser scanning technology within scan-to-HBIM workflows, rather than examining HBIM adoption or digital heritage management as broad standalone concepts. Laser scanning is treated as the data acquisition method used to capture accurate geometric and spatial information, while HBIM is viewed as the digital platform through which this information can be organised, interpreted, and used for heritage asset management. The discussion mainly refers to terrestrial laser scanning and scan-to-HBIM workflows, while acknowledging that other digital documentation methods such as photogrammetry may complement laser scanning in heritage projects.

Therefore, this study aims to explore the adoption of laser scanning technology within HBIM workflows for heritage asset management in Malaysia by examining stakeholder perceptions, identifying key challenges, and proposing strategic recommendations. Using a qualitative approach based on semi-structured interviews, this study provides empirical insights into the current state of digital adoption. The findings contribute to a more structured and coordinated approach to integrating digital technologies into heritage asset management, supporting more effective, data-driven, and sustainable management of heritage assets.

LITERATURE REVIEW

Heritage Asset Management and Documentation Practices in Malaysia

Heritage asset management in Malaysia plays a critical role in preserving cultural identity while ensuring the long-term functionality and value of historic buildings. The management of heritage assets is guided by legislative frameworks such as the National Heritage Act 2005 (Act 645), which emphasises systematic

documentation and conservation planning to support sustainable management (Baharuddin et al., 2024).

Despite these frameworks, current practices remain largely dependent on conventional documentation methods, including manual measurements, photographic records, and written reports. While these approaches provide essential baseline information, they are often time-consuming, fragmented, and prone to inconsistencies, limiting their effectiveness in supporting integrated asset management processes (Baharuddin et al., 2024; Ali et al., 2018). In particular, traditional documentation methods are inadequate in capturing complex geometries and detailed architectural features, which are critical for the accurate representation and management of heritage assets.

From a heritage asset management perspective, these limitations restrict the ability to support lifecycle-oriented activities such as maintenance planning, condition monitoring, and data-driven decision-making. The lack of structured and integrated information systems further hinders coordination among stakeholders and reduces the efficiency of managing heritage assets over time (Salleh et al., 2022; López et al., 2018). These challenges highlight the need for more advanced digital approaches to enhance documentation, integration, and long-term management of heritage assets in Malaysia.

Digital Technologies in Heritage Asset Management: BIM and HBIM

The advancement of digital technologies has significantly transformed information management practices in the built environment, particularly through the adoption of Building Information Modelling (BIM). BIM enables the integration of geometric and non-geometric data within a unified digital platform, supporting improved collaboration, information sharing, and lifecycle management of built assets (Lovell et al., 2023; López et al., 2018).

In the context of heritage assets, BIM has evolved into Historic Building Information Modelling (HBIM), which adapts BIM principles to accommodate the unique characteristics of historic structures. HBIM facilitates the development of information-rich digital models that incorporate historical, material, and condition-related data, enabling more systematic documentation and management of heritage assets (Lovell et al., 2023; Dore & Murphy, 2017). This capability is particularly important for supporting long-term asset management processes, including maintenance planning, condition assessment, and data-driven decision-making.

Despite its potential, the adoption of HBIM in Malaysia remains limited. Existing Malaysian HBIM studies have also proposed BIM-based processes for heritage documentation and data management, but wider implementation remains constrained by technical, organisational, and expertise-related challenges (Agwa & Celik, 2025; Mustafa et al., 2020). As a result, the

benefits of HBIM in enhancing coordinated and lifecycle-oriented heritage asset management have yet to be fully realised within the Malaysian context.

Laser Scanning Technology in HBIM Workflows

Laser scanning technology plays a critical role in HBIM workflows, particularly in the data acquisition stage where accurate geometric information is required. Technologies such as Terrestrial Laser Scanning (TLS) enable the rapid capture of high-density point cloud data, allowing precise three-dimensional representation of heritage assets (Alshawabkeh & Baik, 2023). Compared to conventional survey methods, laser scanning offers significant advantages in terms of accuracy, efficiency, and the ability to capture complex and irregular geometries.

The integration of laser scanning with HBIM, commonly referred to as Scan-to-BIM, enables point cloud data to be processed into structured digital models that contain both geometric and semantic information (Rocha et al., 2020). This integration enhances the quality and reliability of documentation, supporting key asset management functions such as condition assessment, maintenance planning, and long-term monitoring of heritage assets.

Despite these advantages, the application of laser scanning in heritage asset management remains limited in practice. Challenges related to data processing complexity, large data volumes, and interoperability issues continue to affect the efficiency of integrating point cloud data into HBIM platforms (Rocha et al., 2020). These limitations highlight the need for improved workflows and technical capabilities to support the effective use of laser scanning within asset management processes.

Challenges in Adopting Laser Scanning and HBIM

Despite the recognised benefits of laser scanning and HBIM, their adoption in practice remains constrained by several challenges. One of the primary barriers is the high initial cost associated with equipment, software, and training, which limits accessibility, particularly for small and medium-sized organisations (Agwa & Celik, 2025). In cost-driven environments, such investments are often difficult to justify without clear short-term returns.

In addition to financial constraints, the lack of technical expertise has been widely identified as a significant challenge. The operation of laser scanning equipment and the processing of point cloud data require specialised skills that are not commonly available among industry practitioners, thereby limiting effective implementation (Ismail et al., 2021; Ali et al., 2018).

Organisational and institutional factors further affect adoption. The absence of standardised workflows, guidelines, and best practices contributes to inconsistencies in implementation and reduces stakeholder confidence in

adopting these technologies (Ismail et al., 2026; López et al., 2018). Moreover, limited coordination among stakeholders hinders effective data sharing and integration within digital environments.

Technical challenges related to data processing, interoperability, and model accuracy also persist. Issues such as large data volumes, processing complexity, and software limitations continue to affect the usability of HBIM models (Rocha et al., 2020). These challenges indicate that the adoption of laser scanning and HBIM is not solely a technological issue but involves broader organisational and institutional considerations.

To guide the interpretation of these adoption barriers, this study draws on the Technology–Organisation–Environment (TOE) perspective. The TOE perspective explains technology adoption through three interrelated contexts: technological conditions, organisational readiness, and external environmental factors. In this study, technical and data-related challenges are interpreted under the technological context, skill-related and organisational challenges under the organisational context, and financial, regulatory, and policy-related challenges under the environmental context.

RESEARCH METHODOLOGY

This study adopts a qualitative research approach to explore the adoption of laser scanning technology within Historic Building Information Modelling (HBIM) workflows for heritage asset management in Malaysia. A qualitative approach is appropriate as the study seeks to obtain in-depth insights into stakeholders' perceptions, experiences, and challenges that cannot be effectively captured through quantitative methods (Creswell, 2014).

Data were collected through semi-structured interviews with key stakeholders involved in heritage-related projects. This method allows flexibility in exploring participants' perspectives while maintaining consistency across interviews, ensuring comparability of responses (Bryman, 2016).

A purposive sampling strategy was employed to select participants with relevant expertise in heritage conservation, laser scanning, HBIM, or heritage asset management. Participants were required to have at least five years of professional experience and prior involvement in heritage-related projects. Seven participants were interviewed, representing conservators, conservation architects, HBIM specialists, laser scanning practitioners, quantity surveyors, and government representatives. Although the sample size was small, it was considered suitable for this qualitative study due to the specialised nature of the topic, the focused research scope, and the recurrence of similar themes across the interviews, indicating thematic saturation (Hennink & Kaiser, 2022).

The interviews were conducted between 10 November and 16 December 2025. The participants represented key professional roles related to

heritage conservation, laser scanning, HBIM, quantity surveying, and public-sector heritage management. Their profiles, including professional role, organisation or sector, years of experience, and relevance to heritage or digital documentation projects, are summarised in Table 1.

Table 1: Profile of Interview Participants.

Interviewee	Professional Role	Organisation / Sector	Years of Experience	Relevant Expertise / Heritage Project Involvement
R1	Laser scanning specialist	Digital surveying / geospatial service provider	7	Laser scanning and digital documentation of existing buildings; involved in 3D data capture and point cloud processing for building documentation projects
R2	HBIM expert	BIM / digital construction consultancy	8	HBIM modelling and scan-to-HBIM workflow integration; involved in converting survey data into structured digital models for existing and heritage-related buildings
R3	Quantity surveyor	Construction cost consultancy / project management	5	Cost, procurement, and project implementation considerations; involved in assessing project cost implications and digital technology adoption in building projects
R4	Conservation architect	Architectural / heritage conservation practice	14	Heritage conservation planning and design coordination; involved in conservation design, documentation review, and coordination with project stakeholders
R5	Conservator	Heritage conservation practice	15	Conservation practice and heritage documentation; involved in site documentation, condition observation, and conservation-related recording of heritage assets
R6	Government heritage officer	Public-sector heritage administration / local authority	10	Heritage administration, approval procedures, and policy implementation; involved in reviewing heritage-related

Interviewee	Professional Role	Organisation / Sector	Years of Experience	Relevant Expertise / Heritage Project Involvement
				submissions and coordinating conservation requirements
R7	Conservator	Heritage conservation practice	17	Conservation practice, site issues, and long-term maintenance considerations; involved in heritage building conservation, maintenance observation, and post-conservation monitoring
				Source: Author's own work

Source: Author's own work

The interviews were conducted face-to-face or online, depending on participant availability, and each session lasted between 30 and 60 minutes. All interviews were recorded with consent. The interview guide was developed based on the research objectives and covered three main areas: current adoption of laser scanning in HBIM workflows, implementation challenges, and strategies to enhance its application in heritage asset management. Ethical considerations were observed through voluntary participation, informed consent, and anonymisation of participant identities.

The interview data were analysed using thematic analysis based on Braun and Clarke's (2006) procedure. The process involved familiarisation with the data, initial coding, theme generation, theme review, theme definition, and reporting. Codes were first generated from recurring ideas in the interview data and then grouped into broader themes such as financial constraints, technical and data-related challenges, skill-related gaps, organisational challenges, and regulatory or policy-related issues. To improve credibility, the themes were reviewed against the interview data and discussed among the research team before being finalised.

RESULTS AND DISCUSSION

Challenges in Implementing Laser Scanning Technology in HBIM

The findings indicate that the adoption of laser scanning technology in HBIM is constrained by multiple interrelated factors, including financial, technical, skill-related, organisational, and regulatory challenges.

Financial constraints remain a primary barrier, as the high cost of equipment, software, and training limits adoption, particularly in cost-sensitive projects (Ismail et al., 2021; Pärn & Edwards, 2019). In addition, the lack of

technical expertise further restricts implementation, as specialised skills are required for operating laser scanning systems and processing point cloud data (Baharuddin et al., 2024; Ismail et al., 2021).

Organisational challenges, including fragmented workflows and limited stakeholder coordination, hinder effective data integration and reduce the efficiency of digital implementation (López et al., 2018). At the institutional level, the absence of clear policies and regulatory requirements reduces the urgency for adoption and limits the integration of digital technologies into heritage asset management practices. Technical issues related to data processing complexity, large data volumes, and interoperability further complicate implementation (Rocha et al., 2020).

Table 2: Thematic Analysis of Challenges in Implementing Laser Scanning Technology in HBIM.

Themes	Codes	Interviewees
Financial Constraints	High implementation cost	All respondents
	Lack of dedicated funding or incentives for digital heritage documentation	R5, R6
Technical and Data-Related Challenges	Difficulty integrating point cloud data into HBIM models	R1, R2, R4
	Large data size and complexity of point cloud processing	R1, R2
Skill-Related Gaps	Shortage of professionals skilled in both heritage conservation and HBIM	R2, R3, R4, R5, R6
	Low digital literacy among conservators and site personnel	R4, R7
	Limited hands-on training opportunities in laser scanning and HBIM	R5, R7
Organisational Challenges	Fragmented workflows between consultants, contractors, and conservators	R2, R3, R4, R6
	Resistance to change and reliance on conventional documentation methods	R3, R4, R6
Regulatory and Policy-Related Challenges	Lack of contractual requirements mandating laser scanning or HBIM usage	R3, R7
	Unclear approval requirements for digital documentation submissions	R1, R2, R5

Source: Author's own work

Table 2 presents the key challenges identified from the thematic analysis. The findings indicate that the adoption of laser scanning in HBIM workflows is constrained by financial, technical, skill-related, organisational, and regulatory barriers. These findings are consistent with previous studies that highlighted high implementation cost, technical complexity, limited expertise, and weak institutional support as common barriers to digital adoption in heritage and construction contexts (Agwa & Celik, 2025; Baharuddin et al., 2024; Rocha

et al., 2020). However, the interview findings further show that, in Malaysian heritage projects, these barriers are closely connected to project delivery and heritage-management practice.

For financial constraints, R3 noted that “the initial cost of laser scanning equipment and specialised services is relatively high, especially for heritage projects with limited budgets.” This reflects the difficulty of justifying laser scanning investment in projects where conservation budgets are already limited. For technical and data-related challenges, R1 and R2 indicated that point cloud data can be difficult to process and integrate into HBIM models when clear workflows, software compatibility, and technical expertise are lacking. For skill-related gaps, R4, R5, and R7 highlighted that many heritage practitioners are still more familiar with conventional documentation methods, such as photographs, manual measurements, and written reports, than with laser scanning and HBIM-based workflows. Organisationally, R2, R3, R4, and R6 indicated that fragmented coordination between consultants, conservators, contractors, and government agencies can reduce the continuity of digital information across documentation, conservation planning, implementation, and maintenance stages. At the regulatory level, R6 highlighted that “the approval process for digital documentation is not clearly defined,” creating uncertainty when laser scanning or HBIM outputs are submitted for project use.

From a planning and heritage-management perspective, these challenges suggest that laser scanning adoption should not be treated as a purely technical issue. Financial constraints affect the willingness of asset owners and project teams to invest in accurate digital documentation, while skill gaps limit the conversion of point cloud data into useful HBIM information. Organisational fragmentation also weakens continuity between documentation, conservation planning, implementation, and post-conservation maintenance. Therefore, effective adoption requires not only access to technology, but also clearer project requirements, professional capacity, coordinated workflows, and institutional recognition of digital documentation within heritage conservation processes.

Strategies to Enhance the Adoption of Laser Scanning Technology in HBIM

In response to the identified challenges, several strategies are proposed to support the adoption of laser scanning technology within HBIM workflows for heritage asset management.

Financial support mechanisms are essential to reduce cost barriers and encourage initial adoption. The provision of government incentives, subsidies, or cost-sharing schemes can help organisations manage the high upfront investment associated with laser scanning technologies. Such measures enable a shift from short-term cost-driven practices towards long-term value-oriented asset management (Alshawabkeh & Baik, 2023).

Capacity development is equally critical in addressing the lack of technical expertise. Training programmes, professional workshops, and academic integration can enhance stakeholders' competencies in operating laser scanning systems and processing point cloud data. Strengthening human capital not only improves implementation efficiency but also increases confidence in adopting digital technologies.

At the organisational level, the development of standardised workflows and guidelines can improve consistency and reduce uncertainties in implementation. Clear procedures for data acquisition, processing, and integration within HBIM platforms are essential to ensure reliable and structured information management. These standardisation efforts support better interoperability and facilitate more effective asset management practices.

From an institutional perspective, stronger policy frameworks and regulatory support are necessary to drive large-scale adoption. The integration of digital requirements into national heritage guidelines can formalise the use of laser scanning and HBIM, encouraging broader industry uptake (Alshawabkeh & Baik, 2023). Policy intervention plays a key role in institutionalising digital practices within heritage asset management systems.

Table 3: Thematic Analysis of Strategies to Enhance the Adoption of Laser Scanning Technology in HBIM.

Themes	Codes	Interviewees
Financial Support and Cost Mitigation Strategies	Government grants or subsidies to offset high initial cost of laser scanning services	R3, R4, R5, R7
	Cost-sharing arrangement among project stakeholders for laser scanning and HBIM	R1, R2
	Phased adoption strategy instead of directly full integration	R3, R6
Technical Strategies	Clear definition of expected deliverables for laser scanning and HBIM outputs	R1, R2, R3
	Improved integration of laser scanning data beyond 2D drawings into HBIM models	R1, R2, R4
Skill and Knowledge Enhancement	Structured training programmes on laser scanning and HBIM for industry practitioners	R1, R2, R4, R6, R7
	Integration of HBIM and laser scanning modules into higher education curricula	R5, R6, R7
	Continuous professional development programmes on laser scanning and HBIM	R5
Organisational Coordination and Collaboration	Improved collaboration on data-sharing among stakeholders	R2, R3, R6
	Early involvement of digital specialists in conservation project planning	R1, R4, R5
	Establishment of clear roles and responsibilities managing digital heritage data	R1, R4

Themes	Codes	Interviewees
Regulatory and Policy Enhancement	Development of national guidelines or standards for laser scanning in heritage conservation	R1, R2, R4, R6, R7
	Inclusion of laser scanning or HBIM requirements in conservation project contracts	R3, R7

Source: Author's own work

Table 3 summarises the strategies proposed by interview participants to enhance laser scanning adoption in HBIM workflows. The findings suggest that adoption should be supported through a staged and coordinated approach rather than isolated technology investment. Financial support, including grants, subsidies, cost-sharing arrangements, and phased implementation, can reduce the initial cost burden and allow project teams to demonstrate value before wider adoption. At the technical level, respondents emphasised the need to define expected deliverables, including point cloud accuracy, HBIM model outputs, data formats, ownership, and update responsibilities, so that laser scanning data can be used beyond 2D documentation.

The findings also highlight the importance of capacity building and institutional support. Structured training, continuous professional development, and the integration of laser scanning and HBIM modules into higher education can help address the shortage of professionals with combined conservation and digital expertise. Organisationally, early involvement of digital specialists and clearer roles for managing digital heritage data can improve coordination between consultants, contractors, conservators, and public agencies. From a planning perspective, the inclusion of laser scanning or HBIM requirements in conservation project contracts and national guidelines can help formalise adoption and support more consistent use of digital documentation for conservation approval, maintenance planning, adaptive reuse assessment, and long-term monitoring.

Based on the identified challenges and proposed strategies, the staged roadmap in Table 4 is developed as a practical adoption readiness framework for laser scanning and HBIM in Malaysian heritage projects. The roadmap reflects the Technology–Organisation–Environment (TOE) perspective by linking technological readiness, organisational capacity, and institutional support to progressive stages of implementation. Technological readiness is addressed through digital documentation and scan-to-HBIM modelling, organisational readiness is addressed through asset management integration and coordinated information use, while environmental and institutional readiness is addressed through long-term monitoring, data ownership, and alignment with local authority or heritage-agency requirements.

Table 4: TOE-Based Staged Adoption Readiness Roadmap for Laser Scanning and HBIM in Malaysian Heritage Projects.

Stage	Focus	Key Actions	Expected Planning and Heritage-Management Outcome
Stage 1	Digital documentation	Conduct laser scanning of selected heritage buildings or critical building elements; prepare point cloud records and measured documentation.	More accurate baseline information for conservation planning and approval.
Stage 2	Scan-to-HBIM modelling	Convert point cloud data into HBIM models with geometric, material, defect, and condition-related information.	Improved information integration for consultants, conservators, and asset owners.
Stage 3	Asset management integration	Link HBIM outputs with maintenance schedules, repair records, facility information, and conservation project requirements.	Stronger support for maintenance planning, facility management, and adaptive reuse assessment.
Stage 4	Long-term monitoring and governance	Update HBIM records through periodic scanning, define data ownership, and align digital outputs with local authority or heritage-agency requirements.	More consistent condition monitoring, decision-making, and lifecycle-based heritage asset management.

Source: Author's own work

This staged roadmap suggests that laser scanning and HBIM adoption should begin with focused documentation before progressing towards modelling, asset management integration, and long-term monitoring. Such a phased approach is more suitable for Malaysian heritage projects because it allows stakeholders to manage cost, build technical capacity, and gradually formalise digital documentation within conservation and planning processes.

CONCLUSION

This study examined the adoption of laser scanning technology within Historic Building Information Modelling (HBIM) workflows for heritage asset management in Malaysia, focusing on stakeholder perspectives, implementation challenges, and strategic implications. The findings indicate that adoption remains limited despite increasing awareness, with current practices still relying heavily on conventional documentation methods that are inefficient in managing complex heritage assets.

The study identifies that the adoption of digital technologies is constrained by multiple interrelated factors, including high costs, limited technical expertise, organisational challenges, weak stakeholder coordination, and insufficient policy support. These findings suggest that the barriers are not

solely technological but are embedded within broader institutional and operational contexts.

From a heritage asset management perspective, the integration of laser scanning and HBIM offers significant potential to enhance documentation accuracy, support lifecycle management, and enable more informed decision-making. However, realising these benefits requires coordinated efforts, including financial support, capacity development, standardised workflows, and stronger policy frameworks.

As this study is based on qualitative interviews with seven participants, the findings should be interpreted as stakeholder-based insights rather than statistically generalisable conclusions for all Malaysian heritage projects. Nevertheless, the diversity of professional backgrounds among the participants provides useful indicative evidence on the practical challenges and strategic needs associated with laser scanning and HBIM adoption in heritage asset management. Future research may expand the sample size, include additional heritage agencies and local authorities, and examine specific pilot projects to further validate the proposed strategies.

Overall, this study contributes empirical insights into digital adoption within the Malaysian heritage asset management context. It highlights the need for a structured and strategic approach that links laser scanning and HBIM with conservation documentation, maintenance planning, adaptive reuse assessment, local authority decision-making, and long-term monitoring.

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