DIGITALISATION IN BUILT HERITAGE TOWARDS PROMOTING A CONSERVATION MANAGEMENT PLAN BY NATIONAL HERITAGE ACT 2005: ASSESSING THE DIFFICULTIES IN MANAGING DATA INFORMATION DURING CONSERVATION PROCESS OF HERITAGE BUILDING IN MALAYSIA

Mohd Nurfaisal Baharuddin[1], Nur Fadhilah Bahardin[2], Abdul Hadi Nawawi[3], Siti Norlizaiha Harun[4], Afifuddin Husairi Hussain[5]

[1,2] *Department of Built Environment Studies and Technology,*
College of Built Environment,
UNIVERSITI TEKNOLOGI MARA, PERAK BRANCH, MALAYSIA
[1,3,4] *College of Built Environment,*
UNIVERSITI TEKNOLOGI MARA, SHAH ALAM, MALAYSIA
[5] *School of Liberal Studies,*
UNIVERSITI KEBANGSAAN MALAYSIA, MALAYSIA

Abstract

Malaysia possesses a rich tangible cultural heritage, and efforts are underway to preserve and manage it through heritage data documentation and information systems. Built heritage data documentation plays a vital role in heritage conservation and management by recording and documenting information about existing buildings and heritage sites. Despite the importance of these heritage data systems for site management, conservation, and public mediation, their implementation faces challenges. To better understand these challenges, this paper presents a qualitative study conducted through focus group interviews with stakeholders and conservation experts on 14th to 15th June 2023. The primary objective is to investigate deficiencies in current heritage data documentation practices, particularly in the context of large data management and knowledge sharing among heritage conservation stakeholders. As a result, the study proposes a theme on issues related to heritage data documentation and information.

Keywords: Heritage Data Documentation, Heritage Data Information, Conservation, Conservation Stakeholders, Digitalisation

[1] Senior Lecturer at Universiti Teknologi MARA *Email: mohd468@uitm.edu.my

INTRODUCTION

Malaysia has a vast tangible cultural heritage. Various heritage data documentation and information systems have been created to safeguard and oversee this heritage. These systems are designed to manage and preserve cultural and built heritage data (Ahmed et al., 2015). Heritage information systems improve site management, conservation, dissemination of information, and public mediation. However greater effort is needed to fully comprehend such systems' potential benefits (Poux et al., 2020). In recent years, using technology has become crucial in the heritage conservation (Trillo et al., 2020), nevertheless, the current implementation of digital heritage information systems in Malaysia is encountering challenges. Despite previous digitization initiatives undertaken by certain institutions, the adoption and integration of these systems are still facing hurdles (Abd Manaf, 2007). According to (Salleh & Bushroa, 2022) Malaysian digital heritage data implementation is hindered by a lack of dissemination, transparency, data standards, and user-provider connectivity. Interoperability and standardisation complicate the processes. A Malaysian digitization case study found that while all institutions had begun digitisation, financing, infrastructure, and competence were persistent issues. Addressing these difficulties is essential for national digital heritage data information system integration (Mansor et al., 2005) (Abd Manaf & Ismail, 2010). This paper offers perspective of stakeholders, related parties and expertise in regards of current implementation and deficiencies of heritage data documentation or heritage information in Malaysia, by using qualitative approach, data collection are made based on perspective of (N=16) focus group interview sessions in order to achieve objective which is to investigate the deficiencies of current practice and implementation towards heritage information system in existing built heritage in Malaysia in addressing the issue of large data management in the context of social, historical, geographical, technological and knowledge sharing among heritage conservation stakeholders.

HERITAGE DATA DOCUMENTATION / HERITAGE DATA INFORMATION

Building heritage data documentation is essential for recording and documenting heritage sites and buildings. This practice is important to heritage conservation and management, providing accurate facts about heritage buildings and sites' conditions, materials, changes, physical characteristics, historical significance, and cultural value (Yang et al., 2020); (Mezzino et al., 2017); (WDBG Historic Preservation Subcommittee, 2023). Built heritage documentation involves digital tools and technology which enables complete documentation and strategic planning for heritage site conservation and preservation (Trillo et al., 2020).

Heritage data documentation stands as a fundamental by influencing and facilitating necessary procedures to conserve heritage buildings. Moreover, it also serves to improve their performance and future functions effectively by systematically collecting and archiving both tangible and intangible elements of heritage structures (Khalil et al., 2021). These records are instrumental in supporting historical research and contributing to a deeper understanding of the building's significance and historical context (Poux et al., 2020). Nowadays, digital tools have become increasingly important for capturing built heritage data. Some examples of digital tools used for capturing built heritage data include GIS (Geographic Information System) (Wan-Mohamad & Abdul-Ghani, 2011), laser scanning (Marzouk, 2020), photogrammetry (Santana Quintero et al., 2020), 3D Modelling (Laing, 2020), point cloud data (Poux et al., 2020), total station and voice and video recording (Santana Quintero et al., 2020). Previously, handwritten notes, sketches, measured drawings, and film photos are used to collect manual heritage data, it is laborious, time-consuming, and prone to human mistake, making organisation and management difficult as well as promoting seldom interaction between stakeholders (Letellier, 2007); (Ali et al., 2018). Digitization of heritage building data provides remote storage, sharing, and access without physical storage or transit. Moreover, it is easy to store, organise, and share, whenever physical access to heritage sites is limited, it simplifies data analysis and interaction with other digital systems, enabling easy updates and remote access (Wang et al., 2020); (Santana Quintero et al., 2020); (Münster et al., 2021)

NEEDS OF HERITAGE DATA DOCUMENTATION THROUGHOUT CONSERVATION PROCESS

Documentation is an essential part of the conservation process, as it allows conservation professionals to record current conditions, consider appropriate conservation options, plan, and monitor the implementation of the plan (Leblanc & Eppich, 2005); (Bahardin et al., 2022); (Baharuddin et al., 2020). According to Ahmad (2021), heritage documentation is important in conservation projects to preserve these historical sites for future generations. According to Laws of Malaysia National Heritage Act 645, (2005), Section 46 stipulate that a commissioner shall prepare a conservation management plan for the purpose of promoting the conservation activities of the heritage site as well as preparing a systematic data documentation to encourage multi-collaboration effort among heritage stakeholders. This legal provision emphasises the importance of working collaboratively and preparing strategically to effectively manage and protect cultural and historical heritage. In Malaysia, according to Harun (2011);

Baharuddin et al., (2022) conservation projects include vast quantities of documentation and heritage information at many phases as shown below:

- *Pre-conservation* – Pre-conservation is divided into three stage which includes preliminary stages, dilapidation survey and preparation of tender documents (Harun, 2023), history and background of the building or site that are intended for conservation such as historical background, construction details, architectural features, and the surrounding context of the building are documented (Zuraidi, 2014). In addition, dilapidation surveys are conducted to detect historical building defects and conditions, along with measured drawings and conservation proposals. Assessing the building's condition and preparing for conservation is essential. Preparation of a document tender includes creating a scope of conservation work, bills of quantities, and measurement drawings for the nominated contractor. Apart from that, preparation of HABS 1 report also included documenting the building's fabric in its original state at the commencement of the conservation contract (Jabatan Warisan Negara, 2017); (Harun, 2023).

- *Execution of conservation* – Both conservators and contractors are responsible for preparing several essential documents such as work method statements consisting of scope of work, methodology, and techniques to be employed for each specific task. This statement also includes risk assessment and safety measures including environmental considerations to mitigate any potential impacts on the environment during the conservation activities (Mezzino et al., 2017); (Ahmad, 2021). HABS II is a central role as the primary documentation and data during conservation, according to Jabatan Warisan Negara (2017), HABS II is compilation of the conservation works' progress throughout the project execution which takes the form of monthly reports, incorporating photography or other suitable recording means. It serves the purpose of gathering information from both HABS I and HABS II, facilitating an understanding of the working sequences, methods, and processes employed during the conservation project. Moreover, numerous additional reports are prepared to cater to the specific project needs such as scientific and technical details, as well as weekly and monthly progress reports. Additionally, site meeting reports are compiled to document discussions and decisions made during on-site meetings (Ahmad, 2021); (Harun S. N., 2020).

- *Completion of conservation* – The final stage in the conservation process involves the preparation of the final report. This comprehensive record

encompasses the entirety of the building conservation journey, serving as a vital point of reference for future endeavors in heritage preservation and maintenance. It is considered as valuables record of National Heritage property and serves as an essential archival resource for future reference (Harun, 2011). Furthermore, video recordings represent another essential requirement in the conservation of built heritage. These recordings hold significant importance as they visually capture the entire conservation process undertaken on the heritage building. By showcasing the various stages and actions implemented, video recordings become invaluable data for documentation and analysis. Moreover, they highlight critical tasks that necessitate specialized skills and expertise in specific conservation works. Video recordings also emphasize jobs that involve handling parts and elements of the building that carry substantial heritage value (Jabatan Warisan Negara, 2017).

- ***Operation and maintenance of heritage buildin*g** – Upon the completion of a conservation project, a maintenance plan is typically provided to the owner, maintenance team, or even the heritage building occupants to ensure the continuous monitoring, management, and proper maintenance of the building over time, employing appropriate methods and techniques. The maintenance plan serves as a guideline, outlining scheduled maintenance activities (Jabatan Warisan Negara, 2017), an accurate building assessment and condition evaluation through regular condition surveys, as well as reports from previous conservation projects, constitute additional essential documentation that should be maintained and handed over to the maintenance team or owners. This is crucial in formulating an effective maintenance strategy, ensuring that future maintenance efforts are well-informed and designed to prevent the recurrence of similar issues (Mohd-Isa et al., 2011). Scheduled maintenance data and reports need to involve routine or ongoing maintenance to protect and observe a heritage building. It addresses building operation issues and obstructions. Periodical and ongoing maintenance follow a well-planned schedule that prioritizes control measures to anticipate and resolve future issues. This systematic approach protects and preserves the building, reducing risks while encouraging sustainability (Rahman et al., n.d.), information and data integration system through maintenance manual and logbook also need to be regularly updated to ensure that all the maintenance works are delivered accordingly to the level of significance and vulnerability of the building's fabric (Mohd-Isa et al., 2011).

INVOLVEMENT OF MANAGING HERITAGE DATA DOCUMENTATION BY CONSERVATION EXPERTISE AND STAKEHOLDERS: A FOCUS GROUP

A successful heritage building conservation project is the outcome of a collaborative endeavour that brings together experts from diverse disciplines, united in their commitment to preserving the heritage's historical and cultural significance for posterity. Key stakeholders in heritage conservation, including conservator consultants, conservator contractors, contractors, architects, engineers, and government agencies, collectively drive the project's success. Their collective expertise, knowledge, and dedication contribute to preserving and restoring the building's heritage value, ensuring its enduring legacy for future generations to cherish and appreciate (Jabatan Warisan Negara, 2017. The inclusion of maintenance activities after the completion of the conservation project is a vital continuation in preservation practice, aiming to minimize inconvenience and risks in the building's operation (Rahman et al., n.d.), this continuation entails the involvement of multiple experts and stakeholders, including owners, maintenance teams, and building occupants. The conservation project typically follows four distinct stages: pre-conservation, execution, completion, and operation and maintenance. Each of these stages necessitates collaborative efforts and contributions from diverse expertise and stakeholders (Gulotta & Toniolo, 2019); (WDBG Historic Preservation Subcommittee, 2023); (Jabatan Warisan Negara, 2017). Based on the above literature study, it highlights that the identified expertise and stakeholders are well-suited participants for a focus group interview, as they possess valuable insights and perspectives regarding the implementation of the conservation process in Malaysia. Their involvement, extensive experience, and in-depth knowledge in documenting data and information throughout the conservation process make them ideal contributors to the discussion.

RESEARCH METHODOLOGY

The main objective of this research is to investigate the deficiencies of current practice and implementation towards Heritage Information System in existing built heritage in Malaysia in addressing the issues of large data management. An interview structure was developed by selecting conservation industry experts and stakeholders for this interview session who have experience and engagement in managing heritage data in conservation. The interview sessions were divided into of the four groups, each group has four participants, totalling 16. All groups are categorised by conservation stages: ***pre-conservation, commencement, completion, and operation and maintenance.*** The focus group interviews were held in a circle and voice recorded. Each session lasted 45 minutes to an hour and

Mohd Nurfaisal Baharuddin, Nur Fadhilah Bahardin, Abdul Hadi Nawawi, Siti Norlizaiha Harun, Afifuddin Husairi Hussain
Digitalisation In Built Heritage Towards Promoting a Conservation Management Plan by National Heritage Act 2005: Assessing the Difficulties in Managing Data Information During Conservation Process of Heritage Building in Malaysia

took two days to complete from 14th to 15th June, 2023. There are two moderators involved in this interview session.

RESULT AND DISCUSSION
Based on the interview sessions conducted, four main transcript analyses were carried out. These analyses included demographic information of the focus group respondents, understanding of definition of heritage documentation and heritage information, experience in heritage documentation data gathering for conservation process and lastly is issues in managing heritage data documentation and data information. The thematic analysis of the issues in managing heritage data documentation is presented in Table 3. This analysis provides valuable insights into the challenges and problems faced in the conservation industry concerning the recording and collection of data throughout the entire conservation process, up to the maintenance phase of heritage buildings.

Demographic Information of Respondents

Table 1: Demographic Information

Group	Position	Years of experience in Heritage Conservation Project	Numbers of involvement in Heritage Conservation Project
Group 1	Consultant (2) Conservator (1) Government Agency (1)	5 to 10 (2) 20 to 25 (2)	< 10 (2) > 10 (2)
Group 2	Contractor (3) Conservator (1)	10 to 15 (3) 20 to 25 (1)	< 10 (3) > 10 (1)
Group 3	Contractor (1) Government Agency (3)	5 to 10 (2) 15 to 20 (2)	< 10 (2) > 10 (2)
Group 4	Government Agency (4)	10 to 15 (4)	< 10 (4)

Source: Author (2024)

According to Table 1, the participants were conservators (n=2), consultants (n=2), contractors (n=4), and government agency (n=8). Most participants (7 in total) have 10–15 years of heritage conservation experience. Only 3 participants had more than 20 years of conservation experience, whereas 4 had 5 to 10 years' experience. 11 individuals had worked on fewer than 10

heritage conservation projects in their careers, while 5 had worked on more than 10.

Definition of Heritage Documentation and Heritage Information
According to the four micro focus group interviews, most respondents define heritage documents and information similarly. According to Group 1, heritage information and documentation means ***"recording and documenting all data and information related to heritage buildings for use in conservation projects."*** Group 2 says it includes ***"any knowledge or information that is recorded and documented for conservation purposes."*** Group 3 describes heritage information and documentation as ***"information or data collected from the preliminary stages to the completion of conservation, including audio, oral history, photographs, drawings, and reports spanning the entire project."*** According to Group 4, this is the ***"collection of information gathered from oral interview, written records, audio, and pictures... it is systematically collected and retained during the conservation process and archived upon project completion."*** All four focus groups agree on the definition of heritage documentation and information.

Experience in Heritage Documentation Data Gathering for Conservation Process
Each of the group are given question regarding experience in the process of data gathering / collection of heritage documentation / heritage information based on four different stages of conservation. All the answers are simplified into short information using bullet point in table 2 below.

Table 2: Experience in Heritage Documentation Data Gathering

Group	Answer
Group 1	• Preliminary study – assessing heritage building's historical significance • Historical research – identify and collect information on features, characteristics, materials, architectural elements (documents, archives, oral histories, photograph, videos) • Dilapidation survey – record current condition, defects and preparing measured drawing, 3D drawing • Preparation of conservation proposal – scope of work and BQ
Group 2	• Preparation HABS 1, HABS 2 and HABS 3 • Preparation work method statement – clarify method of work for each element, provide photograph and information • CPM planning report • Report – weekly and monthly report including site meeting report • Photograph and video record all the work executed

Group	Answer
Group 3	• Handover – Final report including HABS 1,2 and 3 • Handover – as built drawing • Handover – video documentary in a CD or thumb drive • Preparation documentation for CCC/CPC
Group 4	• Maintenance operation and manual • Previous conservation report – for reference purpose • Preparation of schedule maintenance – daily, weekly, monthly, yearly

Source: Author (2024)

Issues in Managing Heritage Data Documentation/Information

All the respondents in four mini focus groups were answering questions regarding issues that are faced in managing heritage documentation/heritage information for conservation. All respondents agreed that there are issues in managing heritage data documentation and information. All the answer were recorded and analysed thematically as shown on table 3 below.

Table 3: Issues in Managing Heritage Data Documentation

Group	Answer	Themes (Based on Answer)
Group 1	R1 – *"issues in historical study…couldn't get much information from archive... uncertain information"*. R2 – *"need to ensure data collected is trustworthy and accurate…to determine suitable conservation approach"*. R3 – *"unavailability online or digital data. Physical data have high risk of missing, misplaced and damage"*. R4 – *"not much historical information in archive. Not much photograph, textual data, no human evidence"*	Lack of data reliability (high risk of inaccuracy and untrustworthy information) available in physical data (risk of misplaced, damage and missing)
Group 2	R1 - *"having difficulties in handling information which causing miscommunications. Information doesn't distribute. As if they are only working all by themselves"*. R2 – *"difficulty in managing big data… we might lose some data and have difficulty in tracking it back"*. R3 – *"difficulty in keeping information/record. Multiple duplication so everyone received latest information. Comes in hardcopy"*	Lack of multi-collaboration caused by workers/involved parties who worked in silo and lack of data sustainability which most of the data are missing, not up to date and loss track

Group	Answer	Themes (Based on Answer)
	R4 – *"every expert has their own understanding. Cause internal conflict and causing inefficiency… no systematic approach… cause segregation among the experts"*	
Group 3	R1 – *"missing recording, documentation and supporting document. Need to be submitted during the end of project"*. R2 – *"focusing more on physical documents instead of digital documents… have to re-access the information to complete the final documentation"*. R3 – *"no software, server or even specialist on IT to manage the heritage information using latest technology"*. R4 – *"quite hard to make a change if there are no policy, budget and knowledge…reluctant to change"*	Lack of data sustainability
Group 4	R1 – *"Manual and operation for maintenance not provided…no schedule, repairing and forecast maintenance"*. R2 – *"not receiving any documentations and information of the building… need to identify the issues and problems all by themselves… any reoccurring defect, the maintenance team does not have their references"*. R3 – *"building that have been conserved…may not found information and documentation of previous work…need to start over…repetitive work"*. R4 – *"Missing information…need to re-access historical data…drawings, M&E documentation, report…incomplete and missing…affecting process maintenance and operating"*	Reassess historical study and unstructured metadata

Source: Author (2024)

According to the presented Table 3, four primary challenges in the management of heritage documentation and information have been identified. These challenges predominantly arise from the issues in the context of social, historical, geographical, technological and knowledge sharing such as lack of data reliability, lack of multi-collaboration among involved parties due to working in silo, lack of data sustainability and lastly reassess historical study and unstructured metadata. Within social and historical data management issues, the lack of reliable data increases the risk of historical narratives and cultural

representations being inaccurate and untrustworthy, which could compromise cultural heritage preservation efforts. Geographical issues aggravate the situation, as spatial data errors can misread heritage site structure and context. Siloed working methods lead to incomplete, inconsistent, and redundant data sets, which can be worsened by outdated technology and incompatible formats, fragmenting knowledge exchange actions. Stakeholders' data sustainability issues also affecting geographical, social, and historical heritage data management. Old records need constant documenting and maintenance to avoid loss or degradation. Spatial data analysis and documentation track physical changes around heritage assets in sustainable data management. Technically, handling vast amounts of heritage data requires scalable and adaptive data storage solutions. Lastly, knowledge exchange difficulties and technology factors like interoperability by earlier working groups leads to unstructured metadata that needs to be reassessed for operation, maintenance, and conservation.

Towards National Heritage Act 2005 (Act 645)
The entire four primary challenges found in the management of heritage documentation and information should be alleviated prudently particularly during planning permission to ensure systematic management plan for heritage sites. Referring to Section 46 (Conservation Management Plan - CMP), National Heritage Act 2005, the commissioner shall, in consultation with the council, prepare a conservation management plan for the purposes of:

Section 46 (1) stipulate that CMP should be prepare to:

i.   promoting the conservation, preservation, rehabilitation, restoration, or reconstruction of a heritage site.
ii. ensuring the proper management of a heritage site including the use and development of all buildings and lands in the heritage site and the preservation of the environment including measures for the improvement of the physical living environment, communications, socio-economic well-being, the management of traffic and the promotion of economic growth; and
iii. promoting schemes for the education of, or for practical and financial assistance to, owners and occupiers, and for community involvement in decision making.

This study has contributed to knowledge current issues and deficiencies of heritage data documentation that have been faced in Malaysia conservation

industry. As a result, the study reveals there are four main issues that in management of heritage data information systems are provided in Figure 1 below.
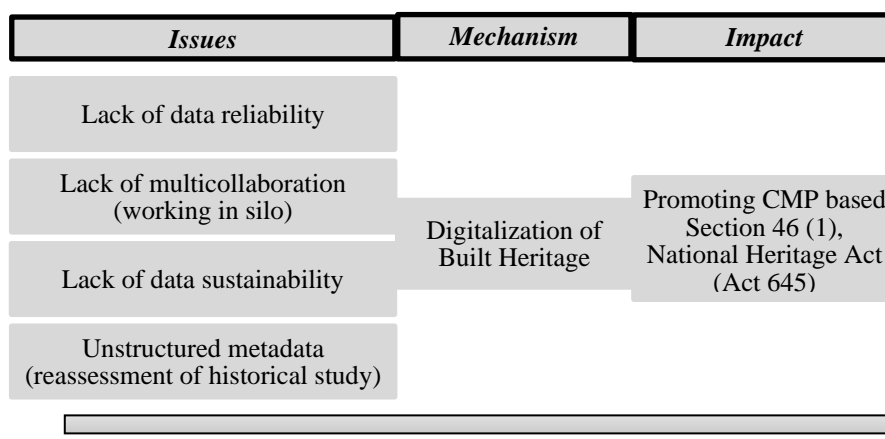

Figure 1: Issues and Deficiencies on Implementation of Heritage Data Documentation towards promoting CMP based on Section 46 (1) by transforming into digitalization approach.
Source: Author (2024)

CONCLUSION

In a nutshell, a comprehensive solution to transform the conventional practice into digitalization approach where it promotes a shared knowledge platform will emphasize the connectivity between stakeholders and data sustainability (Bahardin, 2022); (Karim, 2022); (Harun, 2020) towards systematic conservation management plan as stipulated in Section 46 (1), Act 645, National Heritage Act 2005.

ACKNOWLEDGEMENTS

REFERENCES

Abd Manaf Z., (2007). The state of digitisation initiatives by cultural institutions in Malaysia an exploratory survey. *Library Review, 56,* 45-60.

Abd Manaf, Z., & Ismail, A. (2010). Malaysian Cultural Heritage at Risk? A Case Study of Digitization Projects. *Library Review*, *59*(2), 107–116. https://doi.org/10.1108/00242531011023862

Ahmad, G. A. (2021). Documents in Heritage Conservation. In *School of Housing, Building and Planning*. Unpublished.

Ahmed, S., Syed Ariffin, I., Dodo, Y. A., Nafida, R., & Kamarulzaman, N. (2015). *A Conceptual Framework For Digitalizing Tangible Heritage In Malaysia* (Vol. 77). http://www.jurnalteknologi.utm.my/

Ali M., Ismail K. M., Hashim K. S. H., Suhaimi S., Mustafa M. H. (2018). *Heritage Building Preservation Through Building Information Modelling: Reviving Cultural Values Through Level of Development Exploration Journal of the Malaysian Institute of Planners*, Volume 16 Issue 2 (2022), Page 62–72

Baharuddin M. N, Bahardin N. F, Harun S. N, Manap M. D. A, Rashid M. S. A (2022). *Assessing Critical Risk Factors For Heritage Conservation Projects In Compliance With National Heritage Act 2005 (Act 645)* Journal of the Malaysian Institute of Planners, Volume 20 Issue 3 (2022), Page 50–62

Baharuddin M. N, M. S A. Rashid, M.K A. Bakhari, N. F. Bahardin, K. Alaudin. (2020). Expanding the Longevity of Traditional Malay's Architecture Identity: International Journal of Solid State Technology, ISSN: 0038-111X, Vol. 63, No. 3.

N, Bahardin N. F, Baharuddin M.N, Azman M. A. A., Bakhari M. K. A. H., Rashid M. S. A (2022). *Assessing A Condition of Timber Defect for Perak Traditional Malay's Architecture: An Initial Step to Creating Entity Relationship (ER) Model in Databased Management System (DBMS) Journal of the Malaysian Institute of Planners*, Volume 20 Issue 3 (2022), Page 160–171.

Gulotta, D.; Toniolo, L. Conservation of the Built Heritage: Pilot Site Approach to Design a Sustainable Process. *Heritage* **2019**, *2*, 797-812. https://doi.org/10.3390/heritage2010052

Harun, S. N. (2011). Heritage building conservation in Malaysia: Experience and challenges. *Procedia Engineering*, *20*, 41–53. https://doi.org/10.1016/j.proeng.2011.11.137

Harun S. N. (2020). *Pemuliharaan Bangunan Warisan*. Dewan Bahasa Dan Pustaka .

Harun, S. N. (2023). Penetapan Kos Bagi Kerja-kerja Pemuliharaan Melalui Kajian Dilapidasi. In *Unpublished*. Jabatan Warisan Negara.

Jabatan Warisan Negara. (2017). *Garis Panduan Pemuliharaan Bangunan Warisan*.

Khalil, A., Stravoravdis, S., & Backes, D. (2021). *Categorisation of Building Data in the Digital Documentation of Heritage Buildings*. https://doi.org/10.1007/s12518-020-00322-7/Published

Laing, R. (2020). Built Heritage Modelling and Visualisation: The Potential to Engage with Issues of Heritage Value and Wider Participation. *Developments in the Built Environment*, *4*. https://doi.org/10.1016/j.dibe.2020.100017

Laws of Malaysia National Heritage Act 645. (2005).

Leblanc, F., & Eppich, R. (2005). *Documenting Our Past for the Future*. https://www.getty.edu/conservation/publications_resources/newsletters/20_3/feature.html

Letellier, R. (2007). *Recording, Documentation, and Information Management for the Conservation of Heritage Places: Guiding Principles*.

Mansor, Y., Banun, S., Zuraidah, J., & Manaf, A. (2005). *Developing A National Digital Cultural Heritage Repository Centre for Malaysia: Issues and Challenges*.

Marzouk, M. (2020). Using 3D Laser Scanning to Analyze Heritage Structures: The Case Study of Egyptian Palace. *Journal of Civil Engineering and Management*, *26*(1), 53–65. https://doi.org/10.3846/jcem.2020.11520

Mezzino, D., Chan, L., Santana Quintero, M., Esponda, M., Lee, S., Min, A., & Pwint, M. (2017). Built Heritage Documentation and Management: An Integrated Conservation Approach in Bagan. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *4*(2W2), 143–150. https://doi.org/10.5194/isprs-annals-IV-2-W2-143-2017

Mohd-Isa, A. F., Zainal-Abidin, Z., & Hashim, A. E. (2011). Built heritage maintenance: A Malaysian perspective. *Procedia Engineering*, *20*, 213–221. https://doi.org/10.1016/j.proeng.2011.11.158

Münster, S., Utescher, R., & Ulutas Aydogan, S. (2021). Digital Topics on Cultural Heritage Investigated: How can Data-Driven and Data-Guided Methods Support to Identify Current Topics and Trends in Digital Heritage? *Built Heritage*, *5*(1). https://doi.org/10.1186/s43238-021-00045-7

Poux, F., Billen, R., Kasprzyk, J. P., Lefebvre, P. H., & Hallot, P. (2020). A Built Heritage Information System based on Point Cloud Data: HIS-PC. *ISPRS International Journal of Geo-Information*, *9*(10). https://doi.org/10.3390/ijgi9100588

Rahman, M. A. A., Akasah, Z. A., & Zuraidi, S. N. F. (n.d.). *The Importance of On-Going Maintenance in Preserving the Heritage Listed Buildings*.

Salleh, S. Z., & Bushroa, A. R. (2022). Bibliometric Analysis on the Implementation Digitization Technologies in Cultural Heritage in Malaysia. *Malaysian Journal of Society and Space*, *18*(2). https://doi.org/10.17576/geo-2022-1802-22

Santana Quintero, M., Awad, R., & Barazzetti, L. (2020). Harnessing digital workflows for the understanding, promotion and participation in the conservation of heritage sites by meeting both ethical and technical challenges. *Built Heritage*, *4*(1). https://doi.org/10.1186/s43238-020-00005-7

Trillo, C., Aburamadan, R., Mubaideen, S., Salameen, D., & Makore, B. C. N. (2020). Towards a Systematic Approach to Digital Technologies for Heritage Conservation. Insights from Jordan. *Preservation, Digital Technology and Culture*, *49*(4), 121–138. https://doi.org/10.1515/pdtc-2020-0023

Wang, X., Lasaponara, R., Luo, L., Chen, F., Wan, H., Yang, R., & Zhen, J. (2020). Digital Heritage. In *Manual of Digital Earth* (pp. 565–591). Springer Singapore. https://doi.org/10.1007/978-981-32-9915-3_17

Wan-Mohamad, W. N. S., & Abdul-Ghani, A. N. (2011). The Use of Geographic Information System (GIS) for Geotechnical Data Processing and Presentation.

Procedia Engineering, *20*, 397–406. https://doi.org/10.1016/j.proeng.2011.11.182

WDBG Historic Preservation Subcommittee. (2023, May 8). *Apply The Preservation Process Successfully*. National Institute of Building Sciences.

Yang, X., Grussenmeyer, P., Koehl, M., Macher, H., Murtiyoso, A., & Landes, T. (2020). Review of Built Heritage Modelling: Integration of HBIM and other Information Techniques. *Journal of Cultural Heritage*, *46*, 350–360. https://doi.org/10.1016/j.culher.2020.05.008

Zuraidi, S. N. F. (2014). *Model Rangka Kerja Pemuliharaan Struktur Fabrik bagi Bangunan Bersejarah*.