Journal of Civil Engineering, Science and Technology
Volume 17, No.2, September 2026, 177-188

EFFECTIVE GREEN BUILDING MAINTENANCE PRACTICES (GBMP) IN MALAYSIAN PUBLIC UNIVERSITIES: A SYSTEMATIC LITERATURE REVIEW

Zaimah Zainal Abidin[1]*, Nur Azfahani Ahmad[2], Nor Rima Muhamad Arif[3], Wan Norizan Wan Ismail[1], and Nur Anis Asneeda Mohamed[1]

[1]College of Built Environment, Universiti Teknologi MARA (UiTM) Perak Branch, 32610 Seri Iskandar, Perak, Malaysia
[2]Green Safe Cities (GreSafe), College of Built Environment, Universiti Teknologi MARA (UiTM) Perak Branch, 32610 Seri Iskandar, Perak, Malaysia
[3]College of Built Environment, Universiti Teknologi MARA (UiTM) Shah Alam Branch, 40450 Shah Alam, Selangor, Malaysia

Date received: 11/06/2026 **Date revised:** 05/08/2026 **Date accepted:** 05/08/2026 **Date published:** 30/09/2026
*Corresponding author's email: zaimah@uitm.edu.my
DOI: 10.33736/jcest.13359.2026

Abstract — Green buildings have been increasingly implemented in Malaysian public universities to align with national sustainability goals. However, many certified green buildings still face performance degradation during operation due to ineffective maintenance practices. While most studies focus on design and assessment tools, limited attention is given to maintenance as a strategic element of building sustainability. This paper aims to identify key drivers of effective Green Building Maintenance Practices (GBMP) in Malaysian public universities and to develop a conceptual framework that supports long-term green performance. Using a Systematic Literature Review (SLR) approach, peer-reviewed articles published between 2015 and 2024 were retrieved from Scopus, Web of Science, ScienceDirect, and Google Scholar. After a structured screening and eligibility process, thematic frequency analysis was conducted. The results reveal five main factors influencing GBMP effectiveness: Human and Behavioural, Organisational and Management, Technical and Design, Financial and Economic, and Regulatory and Policy. These factors are synthesised into a conceptual framework illustrating their interrelationships and impact on GBMP. This study contributes by providing an SLR-based synthesis of GBMP drivers within the Malaysian public university context and offers practical insights for facilities managers, administrators, and policymakers to enhance sustainability and operational performance.

2462-1382 / © 2026 The Author(s). Published by UNIMAS Publisher. This is an open access article under the CC BY-NC-SA 4.0 license (http://creativecommons.org/licenses/by-nc-sa/4.0/).

***Keywords*:** green building maintenance practice, green building, sustainability performance, public university, driving factor

1.0 INTRODUCTION

Green buildings have been widely promoted as an effective approach to reducing environmental impacts, improving resource efficiency, and enhancing occupants' well-being [1]. In Malaysia, the public sector plays a significant role in advancing green building development through policies, certification schemes, and sustainable asset management initiatives [2, 3]. However, achieving sustainability objectives does not end at the design and construction stages [4]. The operation and maintenance phase represents the longest and most cost-intensive stage of a building's life cycle, during which the intended green performance must be sustained [3]. Previous studies have shown that a substantial proportion of green buildings fail to operate as designed due to ineffective maintenance practices, lack of skilled personnel, and weak organisational support [5, 6]. In public buildings, these challenges are further compounded by institutional constraints such as rigid administrative procedures, annual budgeting systems, and fragmented maintenance responsibilities [7, 8]. As a result, green systems, including energy-efficient mechanical installations, water-saving devices, and building management systems, are often underutilised or poorly maintained [9]. Although building maintenance has been widely studied, most existing frameworks primarily focus on conventional buildings or emphasise design and assessment criteria [10]. There remains a lack of systematic synthesis addressing green building maintenance within the public university context, particularly in developing countries [4].

This gap highlights the need for a comprehensive understanding of the key factors influencing maintenance effectiveness in green buildings. Therefore, this study aims to identify the driving factors influencing effective Green Building Maintenance Practices (GBMP) in Malaysian public universities through a Systematic Literature Review (SLR). The findings are synthesised into a conceptual framework to support informed decision-making and provide a foundation for future empirical research.

2.0 LITERATURE REVIEW

2.1 Green Building Maintenance Practices (GBMP)

Green Building Maintenance Practices (GBMP) refer to systematic and sustainability-orientated maintenance activities aimed at preserving the environmental, functional, and economic performance of green buildings [11]. These practices emphasise preventive and predictive maintenance, performance monitoring, optimisation of energy and water use, and continuous improvement of building systems [6].

Previous research indicates that approximately 70–80% of a building's total life-cycle cost is incurred during the operation and maintenance phase, highlighting the strategic importance of maintenance management [12, 13]. Ineffective maintenance can negate the benefits of green design, resulting in increased energy consumption, higher defect occurrence, and reduced occupant satisfaction [1, 3].

2.2 Maintenance Challenges in Malaysian Public Universities

Studies on Malaysian public sector buildings indicate that maintenance practices are predominantly reactive rather than proactive [14, 15]. Common challenges include insufficient maintenance budgets, lack of skilled personnel, limited performance monitoring, and weak integration between design intent and operational practices [16, 17]. In public universities, these challenges are further exacerbated by organisational complexity and regulatory constraints, leading to inconsistent maintenance outcomes and gradual performance deterioration of green buildings [18]. The absence of dedicated green maintenance guidelines within public sector asset management frameworks further intensifies these issues [19].

This highlights a critical gap in the systematic understanding of the driving factors influencing GBMP. Without such understanding, public universities risk compromising the environmental and economic value of their green building investments [20].

2.3 Theoretical Underpinning

This study is underpinned by two complementary theories: the Resource-Based View (RBV) and Institutional Theory, which together provide a comprehensive explanation of the factors influencing GBMP effectiveness. The Resource-Based View (RBV) posits that organisational performance is driven by internal resources and capabilities that are valuable, rare, inimitable, and non-substitutable. In the context of GBMP, resources such as skilled maintenance personnel, technical expertise, management commitment, and maintenance systems constitute strategic capabilities that support sustained green performance [6]. Institutional Theory, on the other hand, explains how external pressures such as regulatory requirements, professional norms, and industry standards influence organisational practices. Public sector buildings are particularly affected by institutional forces, including government policies, green building standards, and compliance requirements, which shape maintenance decision-making [21, 22]. The integration of these theories provides a theoretical basis for understanding how internal organisational capabilities and external institutional pressures interact to influence the adoption and effectiveness of GBMP. Figure 1 illustrates the theoretical underpinning of this study by integrating Institutional Theory and the Resource-Based View. The framework demonstrates that effective GBMP implementation is achieved through the alignment between institutional pressures and organisational resources, ultimately leading to sustained green building performance.

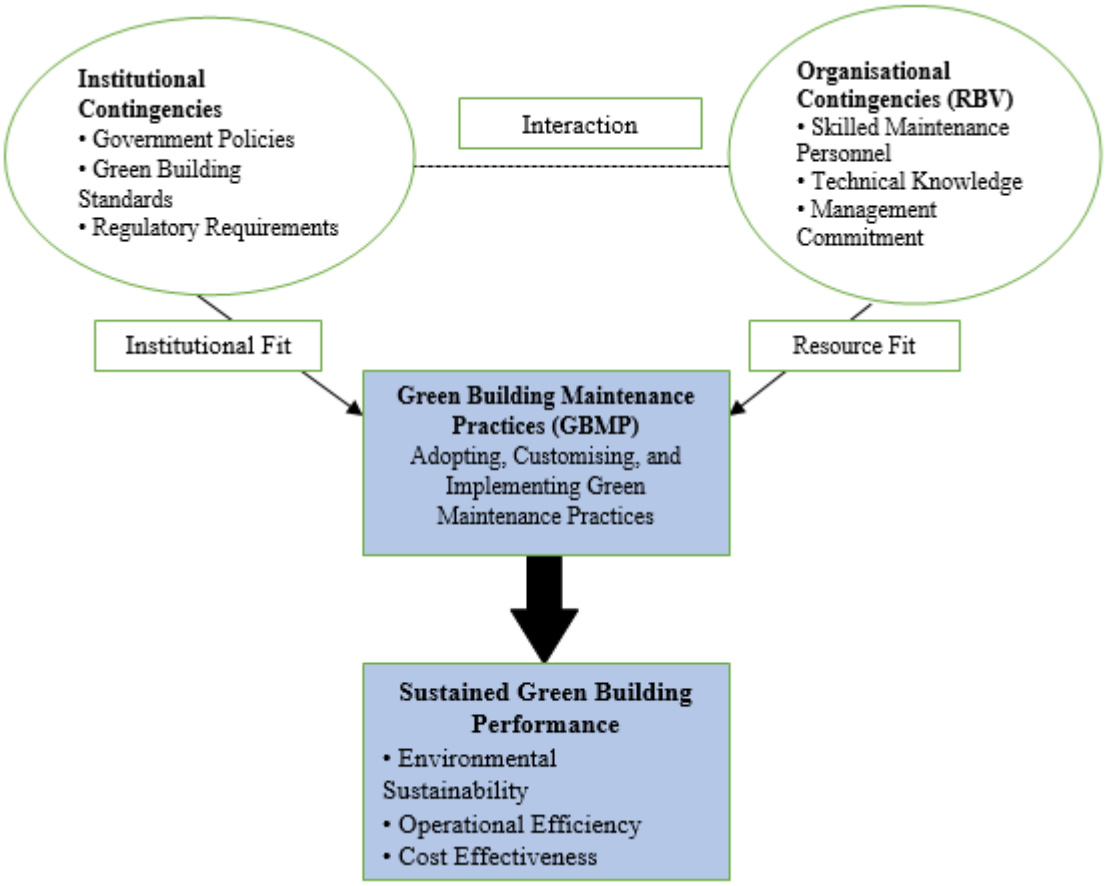


Figure 1 The theoretical underpinning of this study, integrating Institutional Theory and the Resource-Based View to explain the adoption of Green Building Maintenance Practices (GBMP).

3.0 RESEARCH METHODOLOGY

3.1 Literature Search Strategy / SLR Process

This study adopts a Systematic Literature Review (SLR) approach to identify the driving factors influencing Green Building Maintenance Practices (GBMP). The review process consists of four main phases: identification, screening, eligibility, and data abstraction.

Phase 1: Identification

A comprehensive and systematic search was conducted to identify relevant studies related to GBMP. A total of 512 articles were initially retrieved using the search strings “green building maintenance”, “sustainable maintenance”, “facilities management”, and “public universities”. The search was performed across four major academic databases, namely Scopus, Web of Science, ScienceDirect, and Google Scholar. The selection was limited to English-language publications from 2015 to 2024 to reflect recent developments in green building operation and maintenance.

Phase 2: Screening

The screening phase involved reviewing the titles and abstracts of the retrieved articles to assess their relevance to the research objectives. This stage ensures alignment between the selected studies and the research focus [23]. Out of the 512 articles, 75 were retained for further evaluation, while irrelevant studies were excluded.

Phase 3: Eligibility
A full-text review was conducted to evaluate the relevance and methodological quality of the screened articles [24]. Only studies that explicitly addressed maintenance practices, influencing factors, or management strategies related to green or sustainable buildings were included. Following this process, 25 articles met the eligibility criteria and were selected for analysis.

Phase 4: Data Abstraction
In the final phase, the selected articles were analysed using thematic analysis to identify recurring patterns and key themes [25]. The extracted data were systematically organised based on maintenance-related factors influencing GBMP. Table 1 presents the frequency distribution of these factors, which forms the basis for the development of the conceptual framework.

3.2 Inclusion and Exclusion Criteria

Studies were selected based on predefined inclusion and exclusion criteria to ensure the relevance and quality of the reviewed literature [26]. The inclusion criteria comprised: (i) studies related to green building maintenance, sustainable maintenance, or facilities management; (ii) peer-reviewed journal articles published between 2015 and 2024; (iii) publications written in English; and (iv) studies focusing on institutional, public sector, or educational buildings. Conversely, conference abstracts, duplicate records, non-English publications, and studies unrelated to building maintenance were excluded from the review process. These criteria ensured that only relevant and high-quality studies were considered for further analysis.

3.3 Quality Assessment and PRISMA Validation

To ensure the reliability and rigour of the selected studies, a quality assessment process was conducted. Each article was evaluated based on predefined criteria, including (i) relevance to green building maintenance practices, (ii) clarity of research methodology, (iii) contribution to knowledge, and (iv) credibility of the publication source. Articles that did not meet these criteria were excluded during the eligibility stage.

In addition, a PRISMA-inspired approach was adopted to enhance transparency in the literature selection process. The review followed four structured stages: identification (n = 512), screening (n = 75), eligibility, and final inclusion (n = 25). Articles were excluded due to irrelevance, duplication, or insufficient methodological rigour. The final selection of 25 articles is justified as they represent the most relevant and methodologically robust studies that explicitly address green building maintenance practices within institutional and public sector contexts.

Table 1 presents the quality assessment criteria applied in this study to evaluate the relevance, methodological rigour, and overall contribution of the selected articles. The use of these criteria ensures the inclusion of high-quality studies, thereby strengthening the validity and reliability of the SLR findings.

Table 1 Quality Assessment Criteria

Criteria	Description
Relevance	Alignment with GBMP
Methodology	Clear research design
Contribution	Theoretical/empirical value
Source Quality	Indexed journal

Each selected article was evaluated using four assessment criteria, namely relevance to the research topic, methodological clarity, contribution to knowledge, and publication quality. Studies that fulfilled all criteria were retained for further analysis. This assessment process enhanced the reliability and validity of the findings by ensuring that only methodologically sound and relevant studies were included in the synthesis.

The final selection of 25 articles was considered sufficient because these studies consistently addressed the key dimensions of green building maintenance practices and provided adequate theoretical and empirical evidence to support thematic analysis. Data saturation was achieved when no new themes emerged from the reviewed literature, indicating that the selected studies adequately represented the current state of knowledge in the field.

4.0 RESULTS AND DISCUSSION

Table 2 presents the distribution of driving factors identified across the reviewed studies, highlighting their occurrence and relative significance within the literature. Five key factors were derived through thematic analysis and are further supported by the literature summarised in Table 3.

Table 2 The Driving Factors for Effective GBMP

Driving Factors	[11]	[5]	[14]	[16]	[6]	[7]	[8]	[15]	[17]	Total Frequency (f)
Human & Behavioural Factors	●				●					2
Organisational & Management Factors		●				●				2
Technical & Design Factors				●				●		2
Financial & Economic Factors			●						●	2
Regulatory & Policy Factors							●			1

Table 3 Driving Factors for Effective GBMP

The Driving Factors for Effective GBMP	Author
Human and Behavioural Factors	[6, 11]
Organisational and Management Factors	[5, 7]
Technical and Design Factors	[15, 16]
Financial and Economic Factors	[14, 17]
Regulatory and Policy Factors	[8]

The identified factors were derived based on thematic similarities across the reviewed studies.

Table 3 provides a consolidation of the identified driving factors and their corresponding supporting studies, offering a clearer mapping of the literature evidence. Collectively, these factors represent the core dimensions influencing the implementation of effective GBMP in public universities.

4.1 Human and Behavioural Factors

Human and behavioural factors are recognised as key operational drivers influencing of GBMP effectiveness. The competency, knowledge, and environmental awareness of maintenance personnel and building users play a critical role in sustaining green performance [6, 11]. However, inadequate training and low awareness levels remain significant barriers within Malaysian public universities, limiting the effective implementation of green maintenance practices.

4.2 Organisational and Management Factors

Organisational and management factors operate at the institutional level and closely linked to leadership commitment, maintenance policy, and strategic planning. Strong organisational support is essential to ensure coordination, effective resource allocation, and continuous improvement in GBMP implementation [5, 7]. This highlights the critical role of institutional governance in enabling the successful integration of sustainability practices within maintenance operations.

4.3 Technical and Design Factors

Technical and design factors to encompass the physical and technological aspects that influence building maintainability and performance. The integration of Building Management Systems (BMS) and design-for-maintenance principles is critical in supporting effective monitoring and operational efficiency [15]. The absence of such considerations may result in inefficient system performance and increased maintenance challenges.

4.4 Financial and Economic Factors

Financial and economic factors significantly influence the ability of institutions to sustain green maintenance initiatives. Adequate budget allocation, financial planning, and the adoption of life-cycle costing (LCC) approaches are essential for ensuring long-term maintenance efficiency [15, 17]. However, financial constraints within the public sector may limit proactive maintenance strategies, thereby affecting overall GBMP effectiveness.

4.5 Regulatory and Policy Factors

Regulatory and policy factors function as external institutional drivers that shape the direction of maintenance practices. Compliance with green building regulations, government guidelines, and sustainability standards serves as a coercive mechanism that influences organisational behaviour [8]. These include adherence to frameworks such as the Green Building Index (GBI) and Malaysian Standard MS 1525. However, within public universities, the absence of dedicated green maintenance policies has resulted in inconsistent implementation across institutions, highlighting a gap between policy formulation and operational practice. Strengthening regulatory enforcement and establishing standardised guidelines are therefore essential to ensure alignment with national sustainability objectives.

4.6 Comparative Analysis of Driving Factors

While all five driving factors contribute to the effectiveness of Green Building Maintenance Practices (GBMP), the findings indicate that organisational and management factors demonstrate the highest level of influence. This suggests that leadership commitment, policy direction, and structured maintenance planning play a dominant role in shaping maintenance outcomes within public universities. The prominence of organisational factors arises from their function as an enabling mechanism that integrates other operational dimensions. Strong organisational support facilitates the effective deployment of human resources, the utilisation of technical systems, and the allocation of financial resources. In the absence of such support, even well-trained personnel and advanced technologies may not be fully optimised, thereby limiting overall maintenance performance. Technical and design factors, together with human and behavioural factors, also exhibit relatively high importance, indicating their critical role in day-to-day maintenance operations.

These factors directly influence the efficiency of building systems and the execution of maintenance activities. However, their effectiveness remains highly dependent on organisational coordination and support. In contrast, regulatory and policy factors demonstrate comparatively lower influence, suggesting that external pressures alone are insufficient to drive effective GBMP implementation. This reflects a common challenge within public sector institutions, where compliance requirements exist but are not consistently translated into operational practices. Financial and economic factors, while essential, function primarily as supporting enablers rather than primary drivers. Although adequate funding and life-cycle costing approaches are necessary for sustaining maintenance activities, their impact is contingent upon effective organisational planning and governance. The analysis highlights that effective GBMP is not driven by isolated factors but by the integration of organisational, technical, human, financial, and regulatory dimensions. Among these, organisational and management factors serve as the central coordinating force that determines the extent to which other factors can be effectively operationalised.

The predominance of organisational and management factors reflects the importance of institutional commitment in coordinating maintenance activities. Unlike human and technical factors, organisational factors influence resource allocation, policy formulation, and strategic planning, thereby functioning as an enabling mechanism for the effective implementation of GBMP. This finding is consistent with the Resource-Based View, which emphasises that organisational capabilities constitute strategic resources that contribute to sustained performance.

Consequently, strong leadership and structured maintenance management are critical for translating technical capabilities and human competencies into effective maintenance outcomes.

4.7 Hierarchical Structure of Driving Factors (Onion Model)

Figure 2 illustrates that effective Green Building Maintenance Practices (GBMP) are not driven by isolated factors but rather emerge from the alignment of between operational resources, organisational capabilities, and institutional pressures. To further explain these relationships, an onion model is used to represent the hierarchical structuring of the identified driving factors.

From a theoretical perspective, the Resource-Based View (RBV) explains the role of internal resources in enabling GBMP, while Institutional Theory highlights the influence of external pressures in shaping maintenance practices. The integration of these theories supports the use of the onion model, which illustrates how organisational capabilities, operational resources, and institutional forces interact to influence GBMP effectiveness.

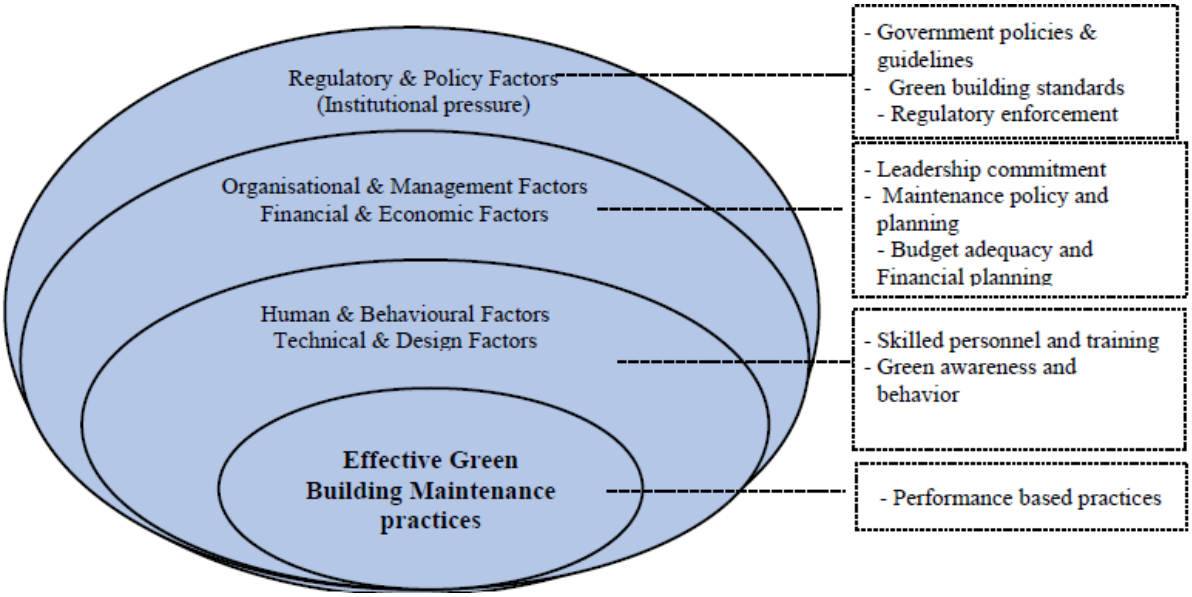


Figure 2 The hierarchical structuring of driving factors influencing effective Green Building Maintenance Practices (GBMP) in Malaysian public buildings.

In this model, as illustrated in Figure 2, Effective Green Building Maintenance Practices (GBMP) are positioned at the core, representing the implementation of sustainability-orientated maintenance activities, including preventive maintenance, performance monitoring, and continuous optimisation of building systems.

The inner layer comprises Human and Behavioural Factors and Technical and Design Factors, representing the operational resources directly involved in daily maintenance activities. Competent personnel, continuous training, and environmental awareness are essential to ensure that green technologies are effectively operated and maintained. Similarly, technical aspects such as maintainability, availability of documentation, and performance monitoring tools directly influence maintenance effectiveness.

The middle layer consists of Organisational and Management Factors and Financial and Economic Factors, which represent organisational capabilities that support the deployment of operational resources. Leadership commitment, structured maintenance planning, and financial allocation play a crucial role in enabling sustained GBMP implementation.

The outer layer represents Regulatory and Policy Factors, which act as external institutional pressures influencing maintenance practices. Government policies, sustainability standards, and regulatory requirements shape organisational priorities and guide implementation strategies. Overall, the onion model demonstrates that effective GBMP is achieved through the integration of operational resources, organisational capabilities, and institutional

pressures. This layered structure provides a conceptual basis for understanding the interdependencies among the identified driving factors.

4.8 Driving Factor and Sub-Driving Factor for Effective GBMP

This section extends the analysis by detailing the sub-driving factors associated with each identified dimension, providing deeper insight into their operational implications. Table 4 and Figure 3 illustrate the key driving factors influencing the implementation of effective Green Building Maintenance Practices (GBMP).

Table 4 The Frequency Distribution and Interpretative Justification Derived from the Reviewed Literature

Driving Factor	Sub-Driving Factors	Key Literature	Frequency Count	Rationale
Human & Behavioural	Competency, training, green awareness, occupant behaviour	[6, 11]	**28**	Human factors such as training, awareness, and behavioural attitudes are consistently emphasised as crucial to promoting sustainability culture and effective maintenance practices.
Organisational & Management	Leadership support, maintenance policy, planning & scheduling, continuous improvement	[5, 7]	**32**	Organisational leadership, structured maintenance policy, and continuous improvement initiatives are identified as the strongest drivers in ensuring long-term implementation of GBMP.
Technical & Design	Maintainability, technical documentation, building management system (BMS), performance monitoring	[15, 16]	**30**	Technical and design-related aspects play a vital role in ensuring the maintainability and operational efficiency of green buildings through robust documentation and system monitoring.
Financial & Economic	Budget adequacy, life-cycle costing, financial planning	[14, 17]	**25**	Financial considerations remain significant, with adequate budgeting and life-cycle costing viewed as key enablers of sustainable maintenance execution.
Regulatory & Policy	Green standards, government guidelines, enforcement	[8]	**22**	Regulatory and policy measures contribute to GBMP adoption; however, limited enforcement and policy integration often constrain their overall effectiveness.

Figure 3 visualises the comparative distribution of the identified driving factors, providing a clearer interpretation of their relative influence on GBMP implementation. Organisational and Management Factors recorded the highest frequency, indicating their dominant role in driving structured maintenance planning and leadership engagement. Technical and Design Factors and Human and Behavioural Factors follow closely, highlighting the importance of technical capability and workforce competency in operational performance. In contrast, Financial and Economic Factors and Regulatory and Policy Factors show relatively lower frequencies, suggesting that financial limitations and weak policy enforcement remain key challenges. Overall, the findings suggest that organisational leadership and technical capability function are the primary drivers of GBMP effectiveness, while financial constraints and regulatory limitations continue to moderate implementation outcomes.

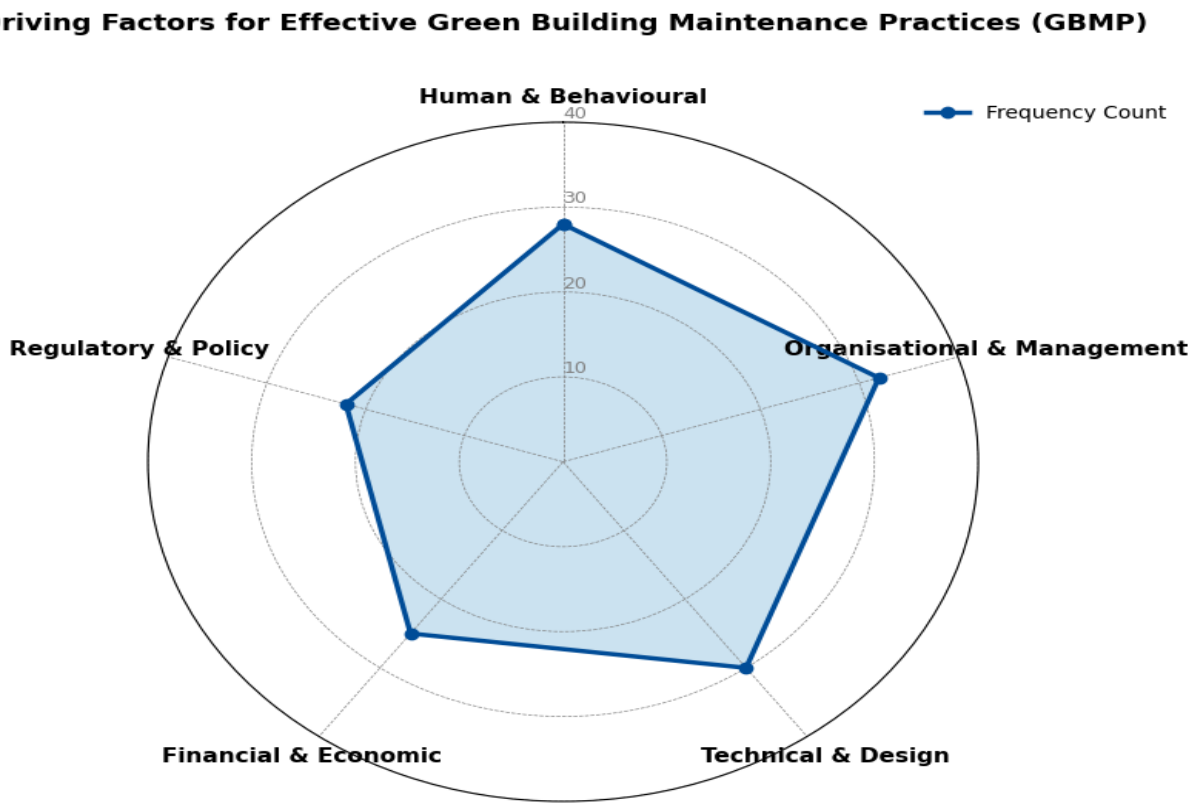


Figure 3 Radar chart of driving factors for effective Green Building Maintenance Practices (GBMP)

5.0 PROPOSED GBMP CONCEPTUAL FRAMEWORK

Based on the synthesis of SLR findings and the hierarchical structuring of driving factors, this study proposes a conceptual framework for effective Green Building Maintenance Practices (GBMP) in Malaysian public universities. The framework integrates key human, technical, organisational, financial, and regulatory dimensions to explain how maintenance effectiveness can be achieved and sustained in the public sector.

The model conceptualises five driving factors as independent variables influencing GBMP effectiveness, which in turn leads to sustained green building performance outcomes, including environmental sustainability, operational efficiency, reduced operational costs, prolonged building lifespan, and enhanced occupant satisfaction. The framework is theoretically grounded in the Resource-Based View and Institutional Theory, which together explain the interaction between internal organisational capabilities and external institutional pressures. Overall, the proposed framework provides a structured basis for future empirical validation.

Figure 4 presents the proposed conceptual framework derived from the synthesis of the reviewed literature and the hierarchical structure of driving factors. The framework illustrates how the interaction between internal organisational capabilities and external institutional pressures contributes to the effectiveness of Green Building Maintenance Practices (GBMP), which subsequently leads to sustained green building performance. The model provides a theoretical foundation for future empirical validation within Malaysian public universities.

Effective GBMP is positioned as the central construct, representing the adoption and implementation of sustainability-orientated maintenance practices. The framework further demonstrates that effective GBMP leads to sustained green building performance outcomes, including environmental sustainability, operational efficiency, reduced operational expenses, prolonged building lifespan, and enhanced occupant satisfaction. The model reflects the interaction between internal organisational capabilities and external institutional pressures, as explained by the Resource-Based View and Institutional Theory.

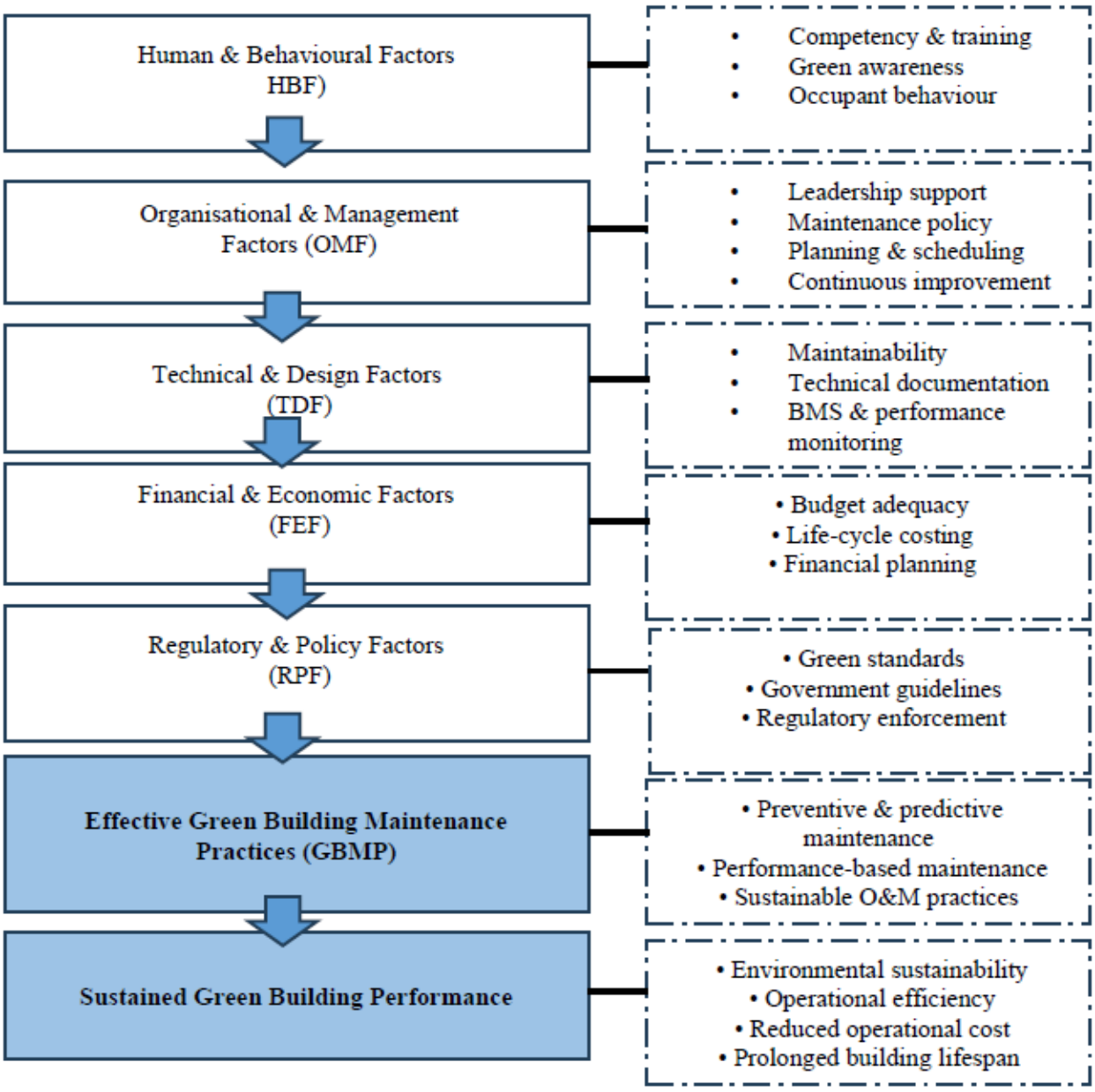


Figure 4 The proposed conceptual framework for effective Green Building Maintenance Practices (GBMP) in Malaysian public buildings.

6.0 CONCLUSION

This study systematically identifies the key driving factors influencing Green Building Maintenance Practices (GBMP) in Malaysian public universities through an SLR approach. Five major factors were identified, providing a structured foundation for understanding GBMP effectiveness. The findings contribute to the literature by offering a theory-informed synthesis of GBMP drivers and provide practical insights for university administrators and policymakers. The findings highlight the dominant role of organisational and management factors as the central coordinating mechanism in ensuring for effective GBMP implementation. Future research should empirically validate the proposed framework using quantitative methods to examine the relationships among the identified factors.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgement

The authors would like to express their sincere gratitude to the College of Built Environment, Universiti Teknologi MARA (UiTM), Malaysia, for the continuous support and facilities provided throughout this study. This research forms part of a doctoral study on Green Building Maintenance Practices (GBMP) in Malaysian public universities. The authors also wish to acknowledge the valuable contributions and encouragement received from colleagues and individuals who have directly and indirectly supported this research.

References

[1] Yee, H. C., Jing, K. T., & Loh, J. X. (2023). Barriers to green building implementation in Malaysia: A systematic review. Progress in Energy and Environment, 24(1), 11–21. https://doi.org/10.37934/progee.24.1.1121

[2] Kamar, K. A. M., & Hamid, Z. A. (2011). Sustainable construction and green building: The case of Malaysia. WIT Transactions on Ecology and the Environment, 1, 15–22. https://doi.org/10.2495/ST110021

[3] Liu, T., Chen, L., Yang, M., Sandanayake, M., Miao, P., Shi, Y., & Yap, P. (2022). Sustainability considerations of green buildings: A detailed overview on current advancements and future considerations. Sustainability, 14(21), 14393. https://doi.org/10.3390/su142114393

[4] Purumal, K., Ali, A. S., Zakaria, N., & Baaki, K. (2021). Systematic literature review on green maintenance principles and maintenance performance indicators for green buildings design. Journal of Design and Built Environment, 21(2), 59–75. https://doi.org/10.22452/jdbe.vol21no2.5

[5] Pitt, M., Tucker, M., Riley, M., & Longden, J. (2016). Towards sustainable facilities management. Proceedings of the ICE – Engineering Sustainability, 169(4), 165–175.

[6] Elmualim, A., Valle, R., & Kwawu, W. (2018). Discerning policy and drivers for sustainable facilities management practice. International Journal of Sustainable Built Environment, 7(1), 16–25.

[7] Ali, A. S., Chua, S. J. L., & Lim, M. E. L. (2018). The barriers to implementing sustainable practices in building maintenance. Journal of Cleaner Production, 190, 815–823.

[8] Ismail, Z., Zawawi, E. M. A., & Salleh, H. (2019). Sustainable building maintenance management: Malaysian public sector perspective. Journal of Facilities Management, 17(3), 210–225.

[9] Zawanah, Z., & Nur Izzah. (2024). Key solutions towards reducing issues in green building maintenance management. UiTM Institutional Repository, Universiti Teknologi MARA.

[10] Hauashdh, A., Nagapan, S., Jailani, J., & Gamil, Y. (2024). An integrated framework for sustainable and efficient building maintenance operations aligning with climate change, SDGs, and emerging technology. Results in Engineering, 21, 101822. https://doi.org/10.1016/j.rineng.2024.101822

[11] Olanrewaju, A. L., & Abdul-Aziz, A. R. (2015). Building Maintenance Processes and Practices. Singapore: Springer. https://doi.org/10.1007/978-981-287-263-0

[12] Ghafoori, M., & Abdallah, M. (2022). Innovative optimization model for planning upgrade and maintenance interventions for buildings. Journal of Performance of Constructed Facilities, 36(6). https://doi.org/10.1061/(ASCE)CF.1943-5509.0001757

[13] Omar, N. S., Hatem, W. A., & Najy, H. I. (2019). Predictive modeling for developing maintenance management in construction projects. Civil Engineering Journal, 5(4), 892–900. https://doi.org/10.28991/cej-2019-03091297

[14] Mohd-Noor, N., Hamid, M. Y., Abdul Ghani, A.A. & Haron, S. N. (2011). Building maintenance budget determination: An exploration study in Malaysian government practice. Procedia Engineering, 20, 435-444. https://doi.org/10.1016/j.proeng.2011.11.186

[15] Zulkarnain, S. H., Zawawi, E. M. A., & Rahman, M. Y. A. (2020). Critical success factors of building maintenance management in public buildings. Facilities, 38(7/8), 441–456.

[16] Sharif, S., Kamaruzzaman, S. N., & Pitt, M. (2017). Implementation framework of green building for government buildings in Malaysia. Journal of Design and Built Environment, 17(2), 27–36.

[17] Salleh, H., Zawawi, E. M. A., & Ismail, Z. (2021). Performance-based maintenance management for public buildings. International Journal of Building Pathology and Adaptation, 39(3), 436–452.

[18] Jasme, N., Au-Yong, C. P., Chia, Y. Y., & Hou, H. (2025). Challenges and issues in maintaining green building features and facilities. International Journal of Sustainable Construction Engineering Technology, 16(3). https://doi.org/10.30880/ijscet.2025.16.03.004

[19] Htet, A., Poddar, S., Liana, S. R., Aung, T., & Giri, O. P. (2025). Long-term sustainability for diverse green building types. Advances in Civil and Industrial Engineering, 201–262. https://doi.org/10.4018/979-8-3693-2448-6.ch007

[20] Wuni, I. Y., Shen, Q., & Osei-Kyei, R. (2019). Scientometric review of global research trends on green buildings in construction journals from 1992 to 2018. Journal of Energy and Buildings, 190, 69–85. https://doi.org/10.1016/j.enbuild.2019.02.010

[21] DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review, 48(2), 147–160. https://doi.org/10.2307/2095101

[22] Sidrotul, A., Abdul Tharim, A. H., Ahmad, N. A., & Salleh, M. N. (2022). Systematic review of sustainable building maintenance in Malaysia: Issues and challenges. Journal of Sustainable Construction Materials and Technologies, 7(2), 45–56.

[23] Ghaffarianhoseini, A., Dahlan, N. D., Berardi, U., GhaffarianHoseini, A., Makaremi, N., & GhaffarianHoseini, M. (2013). Sustainable energy performances of green buildings: A review of current theories, implementations and challenges. Renewable and Sustainable Energy Reviews, 25, 1–17. https://doi.org/10.1016/j.rser.2013.01.010

[24] Chin, C. P., Alias, A., & Alkharabsheh, O. H. M. (2025). Urban housing regeneration strategies for sustainable city development: A systematic literature review. Discover Sustainability, 6(1). https://doi.org/10.1007/s43621-025-01923-1

[25] Shamsuddin, M. M., Ismail, W. N. W., Arabi, F., & Norazman, N. (2025). Cultivating sustainability facility management in Malaysian higher education institutions: A review on operation and maintenance practices. Semarak Proceedings of Applied Sciences and Engineering Technology, 1(1), 96–120.

[26] Amaral, A. R., Rodrigues, E., Gaspar, A. R., & Gomes, Á. (2021). Lessons from unsuccessful energy and buildings sustainability actions in university campus operations. Journal of Cleaner Production, 297, 126665. https://doi.org/10.1016/j.jclepro.2021.126665