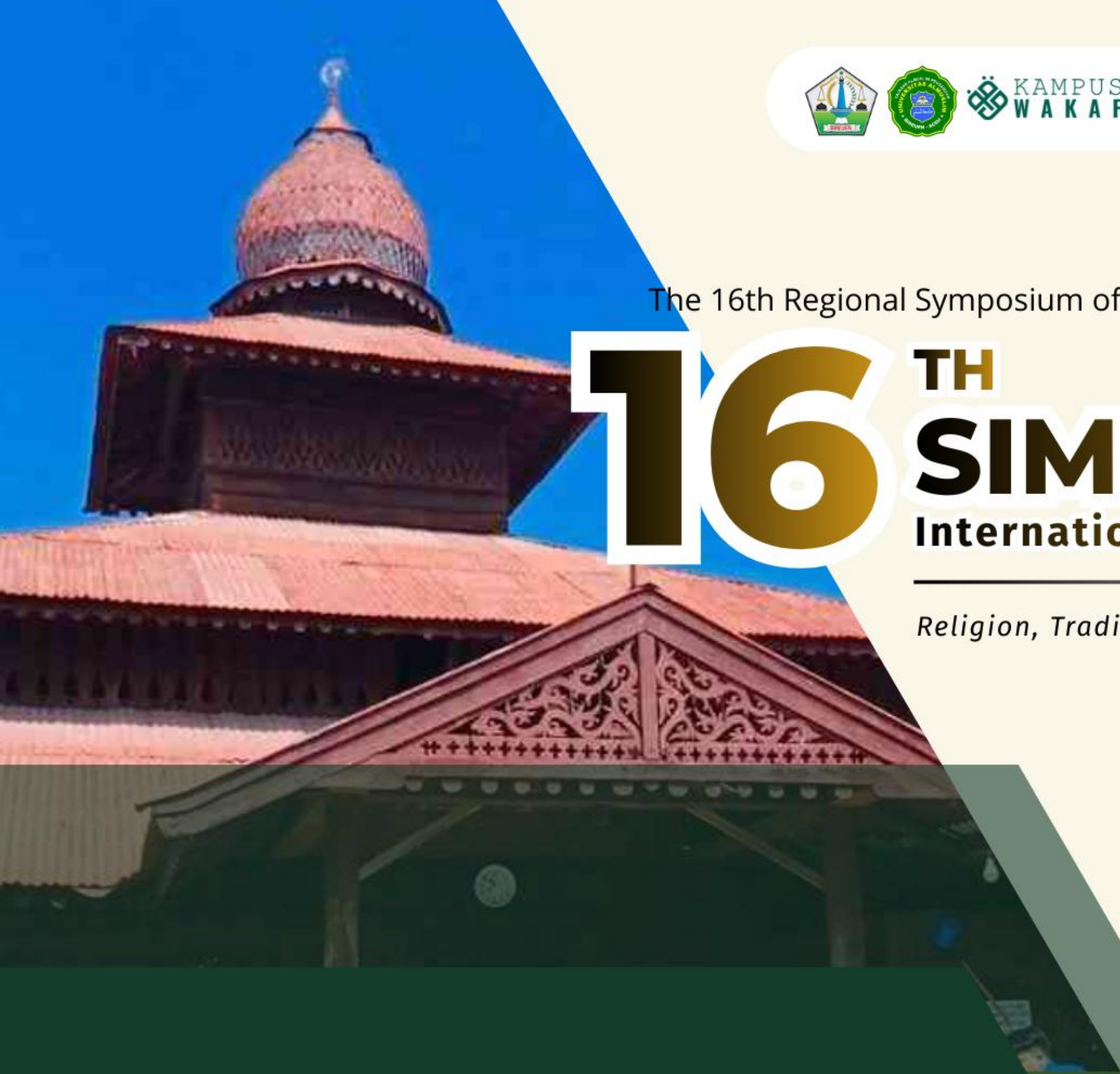

eISSN : 3030-5543

The 16th Regional Symposium of The Malay Archipelago

16TH SIMPORA International Conference

Religion, Traditions and Local Wisdom

Proceedings International SYMPOSIUM NUSANTARA

Organised by:
Centre for Knowledge and Understanding of Tropical Architectural and Interior (KUTAI)
Universiti Teknologi MARA Perak Branch
Seri Iskandar Campus, Perak, MALAYSIA

eISSN 3030-5543

PROCEEDINGS OF THE 16TH REGIONAL SYMPOSIUM OF THE MALAY ARCHIPELAGO

SIMPORA XVI: 2025

Organised by:

Centre for Knowledge and Understanding of Tropical Architectural and Interior (KUTAI)
Universiti Teknologi MARA Perak Branch
Seri Iskandar Campus, Perak, MALAYSIA

Diterbitkan oleh:

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32610 Seri Iskandar Perak, Malaysia.

05-3742716

uitmperakpress@gmail.com

Perpustakaan Negara Malaysia Cataloguing in Publication Data

No e- ISSN: 3030-5543

Cover Design: Richard Mareno
Typesetting : Dr Nur Huzeima Mohd Hussain
Dr Wan Faida Binti Wan Mohd Azmi

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KEYNOTE SPEAKER 2

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STRATEGIC PATHWAYS FOR STAKEHOLDERS IN RETROFITTING EXISTING BUILDINGS

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Abstract: This study explores the perception of stakeholders related to barriers in retrofitting existing buildings and proposed efficient strategies for supporting decision-making in retrofits. Although it is widely accepted that building retrofitting has the power to enhance energy efficiency and sustainability, retrofit activity in Malaysia is very much underutilized. Practical limits are restricting the implementation of retrofit activities and preventing national energy and environmental objectives from being met. The situational constraints consist of economic limits, technical constraints, regulatory constraints, and lack of education or knowledge from stakeholders. The complications associated with retrofitting buildings are further exacerbated by the lack of standard procedures and applicable reference guidelines, making it difficult for building owners and experts involved in retrofit projects to make decisions. Adopting building retrofitting programs in Malaysia is hampered by regulatory constraints such as the absence of clear and enforceable laws forcing energy efficiency standards for older buildings and the absence of financial incentives for retrofit projects. Therefore, as the initial step in addressing the barrier faced by stakeholders in retrofitting existing buildings. This study employed a quantitative research approach to examine stakeholders' experiences with retrofitting. A total of 174 respondents were targeted, representing stakeholders directly involved in or affected by retrofitting activities. Data were collected using a structured questionnaire survey, which was distributed to capture stakeholders' perceptions, experiences, and insights. The questionnaire served as the primary tool for data collection, ensuring consistency and comparability across responses, while enabling the systematic analysis of trends and patterns within the dataset. The originality of this study lies in its focus on stakeholders' real-world experiences with retrofitting, an area often overlooked in favor of technical performance or cost analysis. The study adds value for stakeholders among building owners, tenants and practitioners by highlighting factors that influence decision-making in retrofitting projects. These insights can guide the development of more user-centered retrofitting strategies, improve project outcomes and foster wider adoption of sustainable building practices.

***Keywords*:** Retrofitting, Strategic Pathways, Existing Buildings, Ipoh

INTRODUCTION

The Malaysian building sector significantly contributes to the nation's energy consumption and environmental footprint. According to the Malaysia Green Building Confederation (MGBC), buildings account for approximately 40% of national energy use and around one-third of carbon dioxide emissions. With rapid urbanization and ongoing economic growth, the demand for energy-efficient and environmentally sustainable buildings is steadily increasing. Although retrofitting has strong potential to reduce energy use and emissions, its implementation in Malaysia faces several challenges. Key barriers include financial limitations, technical complexities, and low levels of awareness among building owners and stakeholders (Kamalakannan et al., 2021). In addition, the absence of supportive regulations and incentives further hampers retrofitting initiatives. Overcoming these obstacles requires a comprehensive approach that integrates technical solutions, financial mechanisms, and policy interventions tailored to the Malaysian context (Mustaffa et al., 2021). Overall, retrofitting represents a vital strategy for improving energy efficiency and advancing sustainability in Malaysia's built environment. This research points out the importance of retrofitting in reducing energy consumption, curbing carbon emissions, and supporting national sustainability targets. Despite persistent challenges ranging from financial and technical barriers to regulatory shortcomings there is increasing recognition of the importance of retrofitting existing buildings to achieve long-term environmental and economic gains (Ishak & Azizan, 2021).

Although building retrofitting is widely recognized to improve energy efficiency and sustainability, its adoption in Malaysia remains limited. Several practical constraints hinder the implementation of retrofit initiatives, thereby slowing progress toward national energy and environmental goals. These constraints include economic barriers, technical challenges, regulatory shortcomings, and insufficient awareness among building owners and stakeholders (Petsou et al., 2023). Technical issues are particularly significant, as many Malaysian buildings were originally constructed without consideration for energy efficiency or sustainability standards. Retrofitting older or historic buildings often requires extensive modifications and upgrades, which further escalate project costs. The absence of standardized procedures and reference guidelines complicates decision-making for both owners and professionals engaged in retrofit projects (Zhao & Mo, 2023). Regulatory barriers also play a major role; the lack of clear, enforceable legislation mandating energy efficiency standards for older buildings reduces the incentive for owners to invest in retrofitting. Moreover, the absence of financial support mechanisms, such as subsidies or incentives, makes retrofit investments less appealing to both residential and commercial property owners (Liao et al., 2023). Addressing these barriers represents a crucial first step toward promoting the wider adoption of retrofit practices for existing buildings in Malaysia.

LITERATURE REVIEW

2.1 Building Retrofitting Approach

Retrofitting involves upgrading existing buildings to improve energy efficiency, performance, and sustainability without altering their main structure. Common measures include improved insulation, efficient HVAC systems, modern lighting, and renewable energy installations such as solar panels (Ghisleni & Simões, 2024). These upgrades reduce energy demand, cut operational costs, and extend building lifespan while supporting carbon reduction goals (Oh et al., 2025). Retrofitting also provides a cost-effective alternative to demolition, preserving architectural or cultural value while meeting modern energy needs (Agya et al., 2025). Its flexibility allows for both minor improvements and comprehensive energy management systems, adaptable to local climate, building type, and codes (Ahmed et al., 2020). Overall, retrofitting offers a practical pathway to sustainability by lowering emissions, improving comfort, and aligning with energy efficiency standards (Tan et al., 2023). Building retrofitting is the process of upgrading existing structures to enhance energy efficiency, sustainability, and occupant comfort. It begins with energy audits to identify inefficiencies, followed by setting goals with stakeholders to assess cost, savings, and environmental impact (Razzaq et al., 2023). Improvements typically start with the building envelope, such as insulation, before upgrading mechanical, electrical, and lighting systems to high-efficiency alternatives (Riley & Rodenbaugh, 2021; Alazazmeh & Asif, 2021). Renewable energy sources, like solar panels, may also be integrated to reduce reliance on conventional energy (BPIE, 2019). Energy Management Systems are then used to monitor performance and ensure savings, while user training helps occupants adopt efficient practices (Madushika et al., 2023). This systematic approach extends building lifespan, prevents obsolescence, and ensures compliance with modern energy standards.

2.2 Types of Buildings for Retrofitting

In the context of urban development, different types of buildings present varied opportunities and challenges for retrofitting. The selection of retrofit measures depends on the building's age, design, function, and cultural value. In a city like Ipoh, Malaysia, where historic structures coexist with modern developments, retrofitting plays an important role in preserving heritage, improving efficiency, and extending the life span of buildings. The following categories highlight the main building types that are suitable for retrofitting. **Residential buildings** in Ipoh reflect both its historic and modern development. Older areas, such as Ipoh Old Town, feature pre-war terrace houses and bungalows with elements like wooden shutters, decorative tiles, and pitched roofs, showcasing the city's cultural heritage. Newer developments include high-rise apartments and gated communities that cater to population growth. Some residential projects also promote sustainability with energy-efficient designs and green spaces, serving diverse groups such as families, professionals, and the elderly. **Commercial buildings** range from historic shop houses to modern shopping malls. Traditional shop houses, found in heritage areas like Concubine Lane, are notable for their narrow facades, wooden windows, and tiled designs. Many are now repurposed into cafes, boutique hotels, and artisan shops, attracting both locals and tourists. Modern developments, such as Ipoh Parade and AEON Mall, provide shopping, dining, and entertainment, supporting the local economy and tourism. **Institutional buildings** include government offices, schools, and healthcare facilities. Examples include Ipoh City Hall, St. Michael's Institution, and Raja Permaisuri Bainun Hospital. The city also hosts higher education institutions like UTAR and UniKL. These buildings are central to governance, education, and healthcare, supporting daily life and community development in Ipoh. **Religious buildings** are reflecting Malaysia's multicultural society; Ipoh has mosques, churches, temples, and shrines. These buildings are architecturally diverse, such as the Moorish–Mughal styled Panglima Kinta Mosque, the Gothic St. Michael's Church, and the cave-based Sam Poh Tong Temple. They serve as places of worship, cultural events, and community gatherings, while also adding heritage and tourism value. There are also industrial buildings around Ipoh, mostly in the Tasek and Jelapang areas. These include factories, warehouses, and processing plants. Historically tied to tin mining, they now support food processing, rubber, and light manufacturing. Designed for function and efficiency, these buildings provide jobs, sustain industries, and contribute to Ipoh's economic growth. The last types are **heritage buildings**, where Ipoh is renowned for heritage landmarks such as the Edwardian-Moorish Ipoh Railway Station and the Birch Memorial Clock Tower. Concentrated in Old Town and New Town, many heritage buildings are repurposed for modern uses like cafes, museums, and galleries while retaining their historical character. They symbolize Ipoh's colonial past, attract tourists, and support the city's cultural identity and economy.

2.3 Barriers and Strategies in Retrofitting

Despite its clear benefits, building owners frequently face multiple obstacles when deciding whether to pursue retrofitting most notably high upfront and ongoing operational costs, limited access to finance, low awareness and technical knowledge, regulatory shortcomings, and the potential for disruption to occupants (Kaczmarek, 2025; Olanrewaju et al., 2021; Abdul-Rahman et al., 2021; Goh et al., 2021; Zhao & Mo, 2023; Khair et al., 2023; Tan & Yusof, 2024). Several studies further identify technical complexities such as outdated building fabric, lack of reliable data, and shortages of skilled contractors that amplify uncertainty and raise retrofit costs (Wahab et al., 2024; Ma'bdeh et al., 2023; Alam et al., 2022; Yunus et al., 2022). Research on decision-making and stakeholder behaviour highlights knowledge gaps, weak information flows, and perceived risks that reduce owner confidence in retrofit investments (Basarir et al., 2021; Zhang, 2023; Rahman et al., 2021; Ibrahim et al., 2023). Together, comparative and region-specific studies point to the critical need for coordinated policy responses clear regulatory standards, targeted financial incentives, capacity building, and guidance for heritage-sensitive interventions to enable owners to adopt energy efficient retrofits and help cities meet environmental targets while protecting built heritage (Zhou et al., 2022. Table 1.1 shows the frequency of barriers that has been identified by previous researchers.

Table 1: Frequency of Barriers to Retrofitting for Stakeholders

NO	BARRIES TO RETROFITTNG FOR BUILDING OWNERS	AUTHORS																				FREQUENCY
		Kaczmarek (2025)	Olanrewaju et al. (2021)	Abdul-Rahman et al. (2021)	Goh et al. (2021)	Zhao & Mo (2023)	Khair et al. (2023)	Tan & Yusof (2024)	Wahab et al. (2024)	Ma'bdeh et al. (2023)	Alam et al. (2022)	Yunus et al. (2022)	Basaric et al. (2021)	Zhang (2023)	Rahman et al. (2021)	Ibrahim et al. (2023)	Zhou et al. (2022)	Hernandez et al. (2023)	Kumar & Patel (2020)	Smith & Jones (2019)	Brown et al. (2022)	
1	High initial cost	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	20
2	Limited Access to Financing	/		/	/	/		/	/	/	/	/	/	/		/	/	/	/		/	16
3	Lack of knowledge	/		/	/		/	/	/	/	/		/	/		/		/	/		/	15
4	Complexity of retrofit	/		/		/	/	/	/		/	/		/	/	/		/		/	/	14
5	Uncertain ROI	/	/	/		/		/	/		/		/	/			/	/		/	/	13
6	Disruption to occupants			/			/			/	/	/		/		/	/		/		/	13
7	Regulatory Constrains		/			/		/	/		/	/	/	/	/		/		/		/	12
8	Insufficient Expertise	/			/	/	/		/	/	/			/	/		/		/	/		12
9	Experience			/		/	/		/				/	/	/		/	/	/		/	11
10	Uncertain energy savings		/					/		/	/	/	/		/	/		/		/		10
11	Government Incentives			/		/		/	/		/		/		/		/			/	/	10

The literature review indicates that building retrofitting faces numerous interrelated barriers, especially within heritage cities. This section examines eleven key barriers, identified based on a cut-off frequency of ten findings in previous research. It also discusses corresponding strategies to address these barriers, aligning with the second objective of this study.

2.3.1 High Initial Capital Cost

High initial capital cost is a major barrier to building retrofitting, as it demands substantial upfront investment in advanced materials, specialized equipment, and skilled labor (Kaczmarek, 2025; Ma'bdeh et al., 2023; Zhao & Mo, 2023). Retrofitting often involves expensive interventions such as insulation, high-performance HVAC systems, energy-efficient windows, and renewable energy technologies, further raising costs (Goh et al., 2021; Khair et al., 2023; Li et al., 2023; Wahab et al., 2024; Tan & Yusof, 2024). Moreover, long payback periods and delayed financial returns reduce investment attractiveness, especially for small building owners (Zhao & Mo, 2023; Abdul-Rahman et al., 2021; Zhang, 2023; Olanrewaju et al., 2021; Wahab et al., 2024). In heritage cities like Ipoh, balancing conservation and modern energy standards heightens financial risks (Alam et al., 2022; Rahman et al., 2021; Chew et al., 2023; Hussain et al., 2022), making high upfront costs the predominant deterrent to retrofitting despite long-term sustainability benefits (Zhao & Mo, 2023; Wahab et al., 2024; Tan & Yusof, 2024; Zhang, 2023).

2.3.2 Limited Access to Financing

Limited access to financing remains a major obstacle to retrofitting projects, as many building owners especially those managing smaller or older properties lack sufficient credit or funding options to cover high upfront costs (Kaczmarek, 2025; Olanrewaju et al., 2021; Abdul-Rahman et al., 2021). The financial sector often views retrofitting as high-risk and low-return, leading to conservative lending, limited loan amounts, and unfavorable terms such as high interest rates or short repayment periods (Goh et al., 2021; Zhao & Mo, 2023; Khair et al., 2023; Tan & Yusof, 2024; Wahab et al., 2024). These challenges are amplified for heritage buildings, which require specialized, costly preservation methods and longer project timelines not accommodated by standard financing (Ma'bdeh et al., 2023; Alam et al., 2022; Yunus et al., 2022). Government incentives and subsidies for energy efficient retrofitting are also limited, complex, and poorly promoted, reducing accessibility for building owners (Basarir et al., 2021; Wahab et al., 2024; Khair et al., 2023). Consequently, both private and public financing limitations significantly restrict building owners' capacity to undertake energy-efficient retrofitting (Olanrewaju et al., 2021; Wahab et al., 2024; Zhang, 2023).

2.3.3 A Lack of Knowledge on Retrofitting Benefits

A lack of knowledge about retrofitting benefits has also been well-established in the literature as an important barrier to adoption; for instance, Wahab et al. (2024) stated that many building owners do not know about the potential cost savings in the long run and increase in property value, as well as comfort from building retrofitting. Abdul-Rahman et al. (2021) and Goh et al. (2021) similarly note building owners have an understanding of the cost benefit of retrofitting or that it will be an unattractive or unnecessary expenditure. Olanrewaju et al. (2021) highlight that a lack of knowledge specifically about the opportunities to reduce operational costs related to energy-efficient improvements encourages owners to hold off making improvements. It has been argued (Zhao & Mo, 2023; Zhang, 2023) that awareness and knowledge barriers are frequently worsened due to the lack of credible and easy to understand information about the financial and environmental benefits of retrofitting. Khair et al. (2023) and Tan and Yusof (2024) state that many owners do not have sufficient knowledge of their payback periods, potential energy savings, and support mechanisms that could advance a more attractive retrofitting concept. Ma'bdeh et al. (2023) add that the absence of exposure to retrofitting practices and the associated benefits is particularly problematic for owners of older or smaller buildings. Rahman et al. (2021) further stated that if there is not enough knowledge, building owners are likely to see retrofitting as only a capital-intensive exercise with little to no reward. Basarir et al. (2021) suggest this knowledge gap is due to the absence of prospects for systematic participation and promotion of retrofitting local case studies. Kaczmarek (2025) notes that enhancing education and improving how clear and reliable information on retrofit outcomes are communicated to building owners could help to expand willingness to invest in efficient retrofitting. Wahab et al. (2024) and Olanrewaju et al. (2021) all suggest formal campaigns, supported by accessible information on financial incentives, could address the outstanding hurdle on awareness to expand retrofit awareness.

2.3.4 The Complexity of the Retrofitting Process

The complexity of the retrofitting process poses a significant barrier to building owners, involving technical, structural, and logistical challenges that can overwhelm those without construction or project management experience (Wahab et al., 2024; Goh et al., 2021; Olanrewaju et al., 2021). Planning and implementing retrofitting require detailed assessments and coordination among multiple stakeholders, making the process appear overly complicated (Zhao & Mo, 2023). Older and heritage buildings further intensify these challenges due to structural limitations, hidden defects, and the need to comply with modern codes while preserving historical integrity (Ma'bdeh et al., 2023; Alam et al., 2022; Yunus et al., 2022). In heritage-rich areas, strict conservation requirements often conflict with energy efficiency goals, leaving owners uncertain about how to achieve both (Rahman et al., 2021; Chew et al., 2023). Complex regulatory processes, including planning approvals and heritage compliance, contribute to perceptions of bureaucratic delay and high administrative burden (Khair et al., 2023; Basarir et al., 2021). Moreover, concerns about hidden issues, escalating costs, and project delays further discourage participation (Zhang, 2023; Tan & Yusof, 2024). Ultimately, without accessible technical guidance and coordinated support, the perceived complexity of retrofitting continues to deter building owners from undertaking such projects (Wahab et al., 2024; Olanrewaju et al., 2021).

2.3.5 Uncertainty surrounding return on investment (ROI)

Uncertainty surrounding return on investment (ROI) is a major deterrent for building owners considering retrofitting, as projects often involve substantial upfront costs with delayed or unpredictable payoffs (Kaczmarek, 2025; Wahab et al., 2024; Olanrewaju et al., 2021). The incremental nature of benefits such as gradual energy savings and increased property value makes it difficult to estimate financial returns before investment, especially for older or heritage buildings requiring costly specialized materials and preservation methods (Goh et al., 2021; Zhao & Mo, 2023; Ma'bdeh et al., 2023; Alam et al., 2022). Economic factors like fluctuating energy prices, inflation, and regulatory changes further complicate financial forecasting (Tan & Yusof, 2024), while the absence of standardized evaluation models and limited financial literacy among owners heighten perceived risks (Zhang, 2023; Khair et al., 2023). Without clear cost-benefit data or reliable assessment tools, retrofitting is often viewed as a speculative rather than proven investment (Basarir et al., 2021). In heritage-rich contexts such as Ipoh, unique architectural characteristics and varying energy profiles add further uncertainty to ROI estimates (Rahman et al., 2021; Chew et al., 2023). Consequently, persistent financial ambiguity continues to discourage retrofitting adoption despite its potential long-term benefits (Wahab et al., 2024; Olanrewaju et al., 2021).

2.3.6 Disruption to Occupants

Disruption to occupants is a significant barrier to retrofitting, as construction activities often cause noise, dust, access restrictions, and operational interruptions that affect tenants and businesses (Wahab et al., 2024; Goh et al., 2021; Olanrewaju et al., 2021; Zhao & Mo, 2023). Such disturbances can lead to temporary closures, reduced rental income, and challenges in tenant retention, discouraging building owners from proceeding with retrofits. Logistical complications, particularly in multi-tenant or heritage buildings, further lengthen project timelines and increase complexity (Ma'bdeh et al., 2023; Chew et al., 2023). Safety concerns in older structures may necessitate temporary tenant relocation, adding financial and administrative burdens (Alam et al., 2022; Yunus et al., 2022). The risk of vacancies and loss of rental income during renovations also influences owners' reluctance to retrofit (Khair et al., 2023; Basarir et al., 2021). In heritage-rich urban contexts like Ipoh, limited access, structural restrictions, and densely occupied spaces amplify these challenges (Rahman et al., 2021; Hussain et al., 2022). As Zhang (2023) and Wahab et al. (2024) note, coordinating retrofits around long-tenured occupants is particularly difficult, making disruption a major deterrent despite retrofitting's long-term environmental and economic benefits (Goh et al., 2021; Olanrewaju et al., 2021).

2.3.7 Regulatory Constraints

Regulatory constraints represent a significant barrier to retrofitting, as obtaining necessary approvals can be time-consuming, unclear, and complex particularly for older or heritage buildings subject to conservation requirements (Wahab et al., 2024; Goh et al., 2019; Olanrewaju et al., 2021). Retrofitting projects must comply with multiple layers of building, energy, and safety regulations that vary by building type, age, and location, creating difficulties for owners lacking technical expertise (Khair et al., 2023). In heritage-rich areas like Ipoh, bureaucratic approval processes are especially cumbersome, often requiring permissions from both local and heritage authorities, which extend project timelines and costs (Alam et al., 2022; Yunus et al., 2022; Rahman et al., 2021; Chew et al., 2023). Regulatory limits can also restrict the scope of permissible retrofitting measures, particularly where heritage preservation laws prevent significant alterations to building facades or structures (Ma'bdeh et al., 2023; Zhang, 2023; Tan & Yusof, 2024). Consequently, strict planning controls and fragmented regulatory frameworks discourage participation, leading many owners to view retrofitting as a risky and impractical process despite its potential environmental and economic advantages (Wahab et al., 2024; Olanrewaju et al., 2021).

2.3.8 Insufficient Expertise

Insufficient expertise within both the construction industry and among building owners is a major barrier to retrofitting adoption. Many owners lack the technical knowledge or experience to plan and manage retrofit projects effectively (Wahab et al., 2024), while retrofitting often requires specialized skills in energy auditing, diagnostics, material selection, and sequencing that are not widely available in local markets (Olanrewaju et al., 2021; Goh et al., 2021; Khair et al., 2023). A shortage of qualified professionals limits access to accurate advice and reliable cost assessments, sometimes resulting in poorly designed retrofits with suboptimal energy performance or safety issues (Zhao & Mo, 2023; Zhang, 2023). Heritage buildings further intensify this challenge, as they demand experts capable of integrating modern efficiency measures with historical preservation (Ma'bdeh et al., 2023; Alam et al., 2022; Rahman et al., 2021; Chew et al., 2023). The limited training and awareness among construction professionals often reinforce a preference for traditional building methods over retrofitting (Basarir et al., 2021), while the scarcity of skilled consultants in smaller or less urban areas like Ipoh exacerbates the issue (Yunus et al., 2022; Wahab et al., 2024; Olanrewaju et al., 2021). Consequently, the lack of technical capacity and trusted expertise continues to hinder the widespread implementation of energy-efficient retrofits.

2.3.9 The Limited Experience and Knowledge

The limited experience and knowledge shared by building owners, contractors, and local authorities is commonly perceived as a major obstacle to the uptake of retrofitting. Wahab et al. (2024) reported that many building owners in Malaysia, such as in smaller cities, for instance, Ipoh has little or no prior experience managing retrofitting projects, leading to ignorance and indecision. Olanrewaju et al. (2021) and Goh et al. (2021) state that retrofitting is not yet a commonplace approach in the local construction industry, so there is insufficient track record, which could be used by owners to validate costs, durations, and anticipated benefits. Khair et al. (2023) additionally highlight that because owners are typically limited to examples of successful retrofits, they do not have the confidence to proceed due to costs, potential technical issues, or performance that did not meet expectations. Zhao and Mo (2023) and Zhang (2023) note that beyond the owners, construction professionals also lack hands-on experience, and many are more familiar with new construction and not as much with retrofitting, which often requires different strategies and sequencing. Ma'bdeh et al. (2023) and Alam et al. (2022) note that with heritage buildings, the absence of retrofitting experience specific to historic buildings can further hinder owners from undertaking energy efficiency improvements, as they are uncertain about best practices that will balance preservation with performance. Rahman et al. (2021) and Chew et al. (2023) also mentioned the impact of the lack of institutional knowledge and inadequate local authority guidance, as owners may not be able to see any applicable examples, methods of compliance, or streamlined processes to adopt. Yunus et al. (2022) further explain how this knowledge gap results in a cycle of inaction. Owners are hesitant to retrofit due to fear of the unknown, and the local industry does not develop further knowledge-based practices, as its iterative state relies on confirming the viability, affordability, and effectiveness of previous jobs; therefore, the building life cycle is halted. Wahab et al. (2024) and Olanrewaju et al. (2021) conclude that a lack of a local retrofit knowledge base, coupled with no project experience, limits whether the built environment sector continues to develop in heritage-rich cities like Ipoh.

Uncertain energy savings represent a significant deterrent to retrofitting, as actual post-retrofit performance often diverges from initial projections (Wahab et al., 2024). Variations between estimated and realized savings may arise from inaccurate energy audits, differences in occupant behavior, or unpredictable building performance, particularly in older structures (Goh et al., 2021; Olanrewaju et al., 2021; Zhao & Mo, 2023). The absence of consistent monitoring and verification further undermines confidence in achieving expected results, especially where owners lack the technical expertise to assess performance (Zhang, 2023; Ma'bdeh et al., 2023). Heritage buildings face additional uncertainty due to regulatory restrictions that limit energy-saving interventions, often resulting in lower achievable efficiencies compared to modern buildings (Alam et al., 2022; Yunus et al., 2022). In heritage-rich cities like Ipoh, the scarcity of locally validated performance data compounds this skepticism (Rahman et al., 2021). The perceived performance risks, combined with high initial costs and limited technical support, discourage owners from investing in retrofits (Chew et al., 2023). Ultimately, without reliable benchmarks, validated case studies, and trustworthy energy-saving projections, uncertainty in actual energy performance will continue to hinder the broader adoption of retrofitting (Wahab et al., 2024; Olanrewaju et al., 2021).

2.3.10 Limitation in Government Incentives

Government incentives play a crucial role in motivating building owners to undertake retrofitting; however, their limited effectiveness and accessibility are often identified as barriers. Many owners are unaware of existing programs or perceive them as insufficient to offset high upfront costs (Wahab et al., 2024), while limited funding, unclear eligibility, and poor promotion further restrict participation, particularly in smaller cities like Ipoh (Olanrewaju et al., 2021; Goh et al., 2021; Khair et al., 2023). The complex and time-consuming application processes deter owners from pursuing grants or subsidies (Zhao & Mo, 2023; Zhang, 2023). Moreover, existing incentives are often too generic and fail to address the higher costs and technical sensitivities of retrofitting older or heritage buildings, where tailored financial support is needed (Ma'bdeh et al., 2023; Alam et al., 2022). The lack of targeted programs for heritage preservation in cities such as Ipoh has slowed retrofitting activity, despite owners' willingness to improve energy efficiency (Rahman et al., 2021). Inconsistent or short-term policy commitments further weaken trust in incentive schemes, while complex bureaucratic procedures discourage applications altogether (Chew et al., 2023). As emphasized by Wahab et al. (2024) and Olanrewaju et al. (2021), clear, well-funded, and accessible government incentives are essential to boost retrofitting adoption and achieve broader sustainability goals.

METHODOLOGY

The aim of this research is to provide actionable recommendations to support building owners and tenants in implementing successful retrofit projects, as well as to develop guidelines for decision-making that contribute to achieving Malaysia's sustainability goals. This study was conducted through four sequential stages encompassing data collection and analysis. The first stage involved the development of the research framework, including the formulation of the problem statement and research objectives, supported by an extensive literature review on building retrofitting. The second stage focused on data collection, employing a questionnaire survey as the primary research instrument. The questionnaire comprised three sections addressing respondents' demographic backgrounds, barriers to retrofitting, and strategies to overcome these barriers. A total of 291 questionnaires were distributed to building owners and tenants in Ipoh, Perak, yielding 174 valid responses, representing a 60% response rate. The third stage entailed descriptive statistical analysis of the collected data to identify key patterns and trends. Furthermore, the reliability of the questionnaire was assessed using Cronbach's alpha to ensure the internal consistency of the instrument. The final stage involved synthesizing the findings, drawing conclusions, and formulating recommendations based on the outcomes of the data analysis.

FINDINGS AND DISCUSSION

4.1 Demographic

Table 2 presents the demographic profile of the 174 survey respondents. The sample was predominantly male (81%) and largely composed of tenants (85.6%), with building owners representing a smaller proportion (14.4%). Most respondents were associated with commercial buildings (82.8%), indicating a focus on the commercial sector. In terms of occupancy duration, the majority had occupied their premises for over five years, reflecting substantial experience with their buildings. Additionally, 60.9% reported that their buildings are currently used for purposes different from their original function, suggesting a strong trend toward adaptive reuse. Regarding retrofitting expenses, 76.4% of respondents incurred costs exceeding RM50,000, underscoring the significant financial investment typically required for retrofit projects.

Table 2: Demographic Data

Items	Demographic Factors		Frequencies	Percentage %
Q1.	What is your gender	Male	141	81%
		Female	33	19%
Q2.	Occupation	Building Owner	25	14.4%
		Tenant	149	85.6%
Q3.	Type of Buiding	Residential	30	17.2%
		Commercial	144	82.8%
Q4.	Duration of ownership / Tenancy	Less than 1 year	3	94.4%
		1 – 3 years	25	14.4%
		3 – 5 years	38	21.8%
		5 – 10 years	51	29.8%
		More than 10 years	57	32.8%
Q5.	Function of the building	New Function	106	60.9%
		Original Function	68	39.1%
Q6	Approximately Cost of Retrofitting	Below RM50,000.00	41	23.6%
		Above RM50,000.00	133	76.4%

4.2 Analysis of Building Owners' and Tenants' Experiences and Agreement Levels Concerning Retrofitting Barriers

Table 3 shows the analysis of the survey data paints a clear picture financial concerns lead the pack when it comes to obstacles in energy-efficient retrofitting. Both "high initial cost" and “limited access to financing” top the list with mean scores of 4.26 practically tied. Not far behind, stakeholders also pointed to “lack of knowledge” (4.10), “uncertain return on investment” (4.10), and the challenge of “collaboration with professionals” (4.09). These are not exactly new revelations prior research (Smith et al., 2020; Choi et al., 2021; Nguyen et al., 2022; Lim et al., 2021; Raj et al., 2022; Lin & Chen, 2023) has been sounding the alarm about these very same barriers for years. What stands out is how close these top five issues are in terms of mean scores. Respondents apparently view them as nearly equal hurdles, which suggests a fairly even distribution of pain points across financial, informational, and collaborative domains. The survey’s alignment with established literature suggests that local and global stakeholders are wrestling with the same core challenges. Financial viability, knowledge gaps, and reliance on external professionals remain front and center so the fundamentals have not shifted much. That said, there are a few wrinkles worth noting. For instance, the complexity of retrofitting, which the literature review put in fourth place, slid down to sixth according to the survey. Meanwhile, “uncertain ROI” edged up a notch.

This could indicate that, locally, stakeholders are more worried about whether retrofitting will actually pay off financially than about the technical nuts and bolts. It is possible that many building owners simply defer the technical headaches to architects and consultants, making complexity feel less immediate. Local respondents’ heightened concern about uncertain ROI might also stem from a lack of reliable data or financial security, which is less of an issue in markets where energy performance and payback periods are more transparent. Without clear data, it is no wonder there is hesitation toward long-term investments. Another interesting finding: barriers tied to government incentives, regulatory constraints, and policy uncertainties, which tend to get a lot of attention in the literature, ranked much lower in this survey. Government incentives and complicated approval processes barely registered as concerns. This may reflect low awareness or engagement with local programs, or simply that policy is not as much of a pain point as financial concerns right now. In summary, the survey confirms that financial barriers, knowledge deficits, and the need for professional guidance continue to dominate the conversation around retrofitting. The tight clustering of scores among the top five factors reinforces the reliability of these findings. Variations between the survey and the literature can largely be chalked up to local conditions and market sensitivities. Moving forward, efforts to promote retrofitting locally should focus on improving financial accessibility, clarifying expected returns, and providing robust technical support.

Table 3: Frequency on Barriers in Retrofitting

Item	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Mean	Rank
	Respondents' frequency	*f*	*f*	*f*	*f*	*f*	*f*		
1	High initial cost	8	7	13	50	96	174	4.26	1
2	Limited access to Financing	8	7	13	50	96	174	4.26	2
3	Lack of Knowledge	8	10	16	65	76	175	4.10	3
4	Uncertain ROI	5	11	14	76	68	174	4.10	4
5	Collaborate with Professionals	3	15	18	65	73	174	4.09	5
6	Complexity of retrofit	9	12	14	66	73	174	4.05	6
7	Disruption to Occupant	2	17	15	77	63	174	4.05	7
8	Regulatory Constraints	6	15	19	71	63	174	3.98	8
9	Experience	10	9	14	80	61	174	3.99	9
10	Uncertain Energy Savings	9	10	20	78	58	175	3.97	10
11	Low Market Demand	5	18	14	80	57	174	3.95	11

4.3 Strategies for Assisting Building Owner and Tenant in Retrofitting Decision

As shown in Table 4, the survey results revealed that regulatory compliance emerged as the top-ranked strategy (M=4.19), reflecting Malaysia's increasingly stringent building regulations and differing from prior literature where it was not a primary focus. Respondents viewed compliance as a prerequisite rather than a benefit to retrofitting projects. Building performance evaluation (M=4.18) and long-term ROI considerations (M=4.18) followed closely, aligning with previous studies that emphasize assessing building conditions and financial viability. Financial incentives and funding opportunities (M=4.17) were also rated highly as enabling strategies, though perceived less as direct benefits due to limited governmental support. Interestingly, energy-efficient retrofits, widely prioritized in global literature, ranked fifth (M=4.15), suggesting that local practitioners place greater emphasis on regulatory and financial factors than on technical energy improvements. Other strategies such as coordination with professionals, flexible design, and comprehensive planning were rated moderately, while long-term maintenance planning ranked lowest (M=4.00), consistent with literature noting its frequent underestimation. Overall, the findings highlight both convergence and divergence between global and local perspectives: whereas international studies prioritize energy efficiency, Malaysian stakeholders emphasize compliance, cost management, and practical building performance due to contextual economic and regulatory factors.

Table 4: Frequency on Strategies

Item	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Mean	Rank
	Respondents' frequency	*f*	*f*	*f*	*f*	*f*	*f*		
1	Ensure compliance with local regulations	2	9	15	76	72	174	4.19	1
2	Access Building Performance and needs	4	8	16	71	75	174	4.18	2
3	Focus on long term ROI	6	7	12	73	76	174	4.18	3
4	Evaluate Financial Incentives and Funding	7	12	16	69	80	174	4.17	4
5	Prioritize Energy-Efficiency Upgrades	10	12	7	58	87	174	4.15	5
6	Focus on long term ROI	6	7	12	73	76	174	4.18	6
7	Collaborate with professional	8	4	21	68	73	174	4.11	7
8	Implement Flexible Design for future needs	8	11	10	74	71	174	4.09	8
9	Develop a comprehensive action plan	8	10	7	82	67	174	4.09	9
10	Plan for long term maintenance and durability	10	12	6	86	60	174	4.00	10

This study offers significant practical and theoretical contributions. From a practical standpoint, it provides a clear understanding of the key barriers, benefits, and effective strategies for implementing building retrofits in Ipoh. The findings can assist building owners, tenants, contractors, and policymakers in gaining deeper insight into the challenges encountered in retrofitting projects and the factors that facilitate their successful adoption. Moreover, the survey outcomes serve as a valuable reference for local authorities and government agencies in Ipoh to enhance financial assistance, streamline approval procedures and establish more transparent incentive mechanisms aimed at promoting energy-efficient retrofitting in Ipoh and comparable urban contexts.

CONCLUSION AND RECOMMENDATIONS

This study explored the barriers and strategies for assisting the building owners' and tenants' decision making related to building retrofitting in Ipoh, Malaysia, using a structured survey of building owners and tenants. The findings reveal that regulatory compliance, building performance evaluation, and financial planning are the most critical strategies driving retrofit success, while energy efficiency, commonly emphasized in global literature ranks lower in local priorities. These results reflect Malaysia's regulatory environment, limited financial incentives, and varying levels of awareness regarding advanced retrofit technologies.

Practically, the research offers valuable insights for policymakers, contractors, and building stakeholders to address key challenges and promote more effective retrofit adoption. It highlights the need for stronger financial support mechanisms, clearer regulatory procedures, and greater emphasis on sustainability-driven policies. Theoretically, the study contributes to the growing body of knowledge on retrofit practices in developing urban contexts by bridging global perspectives with local realities. Last but not least, achieving successful retrofitting worldwide, especially in Malaysia, requires coordinated efforts between policy, finance, and technical innovation to accelerate the nation's transition toward a more sustainable and energy-efficient built environment.

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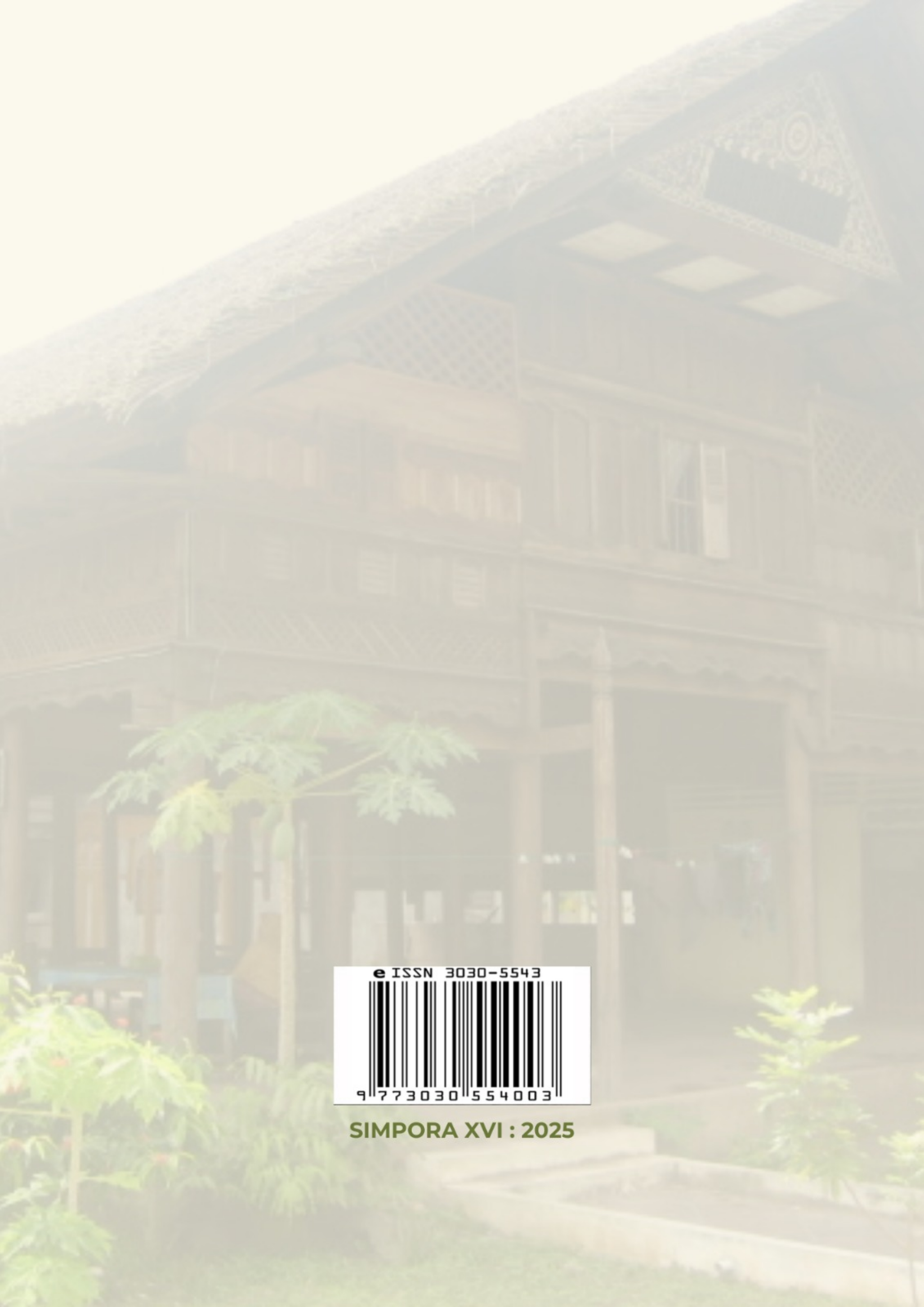

e ISSN 3030-5543

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