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Reviving Heritage: Integrating Adaptive Reuse in the Framework of Ecomuseums

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Abstract

Ecomuseums serve as community-driven, place-based institutions that integrate tangible and intangible heritage with environmental stewardship. This open concept positions heritage not as a static artefact but as a living system shaped through local participation, cultural continuity, and ecological responsibility. Yet, rapid urbanisation and shifting societal demands have rendered many heritage buildings to disuse, neglect and eventual demolition. Conventional conservation practices struggle to keep these sites socially relevant or environmentally sustainable, leading towards the erosion of the cultural landscape. This study aims to (1) investigate how adaptive reuse can revitalise heritage structures, (2) examine the capacity of Ecomuseums to foster community participation and environmental education, and (3) identify sustainable conservation practices that emerge from integrating adaptive reuse within Ecomuseum frameworks. Using a document analysis approach, the research reviews literature and archival documents to enable a critical synthesis of theoretical perspectives, practical examples, and sustainability principles relevant to heritage conservation. The analysis reveals that adaptive reuse significantly enhances the lifecycle and social relevance of historic buildings. At the same time, Ecomuseums provide participatory platforms that deepen community engagement and environmental awareness, underscoring that integrating both approaches supports sustainable conservation. The findings highlight the importance of community-centred heritage strategies and the need for design innovations that navigate the complexities of historical integrity and present-day use. Building on these insights, future studies may develop a comprehensive framework toolkit to assist architects, planners, and policymakers in operationalising adaptive reuse within Ecomuseum models across diverse cultural and geographical contexts.

1.0 INTRODUCTION

In the context of increasing environmental awareness and rapid urban transformation, architectural heritage emerges not only as a valuable cultural resource but also as a site of escalating vulnerability, often threatened by neglect, demolition, or unsympathetic redevelopment. This growing tension underscores the need for more integrated and future-oriented conservation strategies. Within this landscape, the concept of Ecomuseums offers a community-centred and dynamic model of heritage interpretation through which adaptive reuse can be critically repositioned. Ecomuseums not only safeguard tangible and intangible heritage but also cultivate environmental education and sustainable practices rooted in local contexts. In contrast to conventional museums, these spaces prioritise lived environments, social memory, and ecological reciprocity, creating a foundation for integrating adaptive reuse, heritage conservation, and sustainability into a cohesive strategy rather than treating them as separate or competing objectives (Sutter et al., 2016; Pelliccioni et al., 2025). This paper examines how adaptive reuse can be an integrative and meaningful approach within the Ecomuseum framework, adding contemporary relevance while strengthening long-term cultural and ecological resilience.

Adaptive reuse is a critical strategy in this framework, enabling historic buildings to be repurposed for modern uses while reducing the need for new construction. This approach not only conserves resources but also minimises the environmental footprint associated with urban development. Adaptive reuse transforms heritage structures into functional spaces that address contemporary societal needs while promoting sustainability. By reintegrating these neglected sites into the urban fabric, the approach not only mitigates waste and reduces consumption but also revitalises surrounding communities, strengthening their social, cultural, and economic resilience within evolving sustainable urban environments (Bullen & Love, 2011; Dell'Anna, 2022).

The practical implications of these adaptive reuse practices within Ecomuseums are profound, as they embody a holistic vision in which cultural heritage is not viewed in isolation but is intertwined with environmental and social contexts. The Ecomuseum model strengthens heritage conservation by fostering active community participation and engagement, enriching the educational value of preservation efforts while grounding them in locally lived experience. At the same time, its community-centred approach underscores the need to align heritage reconstruction with contemporary regulatory and sustainability standards, ensuring that revitalised sites remain relevant, functional, and responsibly integrated into modern societal frameworks.

For Malaysia, a developing nation navigating the pressures of urban growth and shifting socio-economic priorities, adaptive reuse thus emerges not only as a technical intervention but as a culturally responsive strategy capable of reconciling preservation with progress. The National Heritage Act of 2005 legally protects historical buildings and recognises cultural heritage in urban planning (Mari et al., 2024). However, its implementation faces challenges, as urban modernisation can conflict with conservation efforts. A balanced approach is essential to maintain the relevance of cultural assets in today's market (Lee & Sulieman, 2024; Ismail et al., 2014).

The preservation of heritage structures, such as the shophouses in George Town, Penang, is increasingly constrained by conservation processes dominated by small expert circles that often fail to engage younger generations or reflect their evolving values. Although youth express appreciation for these historic buildings, their attachment is frequently driven by trends or aesthetic consumption, reinforcing perceptions of heritage as static and detached from contemporary life. To foster long-term engagement, it's essential to adopt a diversified stakeholder approach that includes local communities and youth (Phua & Tan, 2023; Febrianti & Eprilianto, 2022). Initiatives such as the preservation of traditional craftsmanship demonstrate how heritage conservation can intersect with youth-oriented economic opportunities, generating culturally grounded forms of entrepreneurship and skill development (Ariffin et al., 2023). Local identity further plays a critical role in sustaining conservation momentum; active community participation not only cultivates a shared sense of ownership but also helps articulate a distinctly Malaysian cultural identity that negotiates between modern aspirations and traditional values (Sani et al., 2025; Hussin, 2018).

However, these dynamics also reveal broader challenges in reviving heritage through adaptive reuse within Malaysia's evolving Ecomuseum landscape. Regulatory inconsistencies, high restoration costs, and limited technical expertise continue to impede the transformation of heritage buildings into community-centred, environmentally responsive spaces. At the same time, market pressures, particularly gentrification and tourism-driven commercialisation, risk eroding local continuity and diminishing cultural authenticity.

By reactivating heritage buildings as functional, community-relevant spaces, adaptive reuse supports sustainable development goals while maintaining the integrity of Malaysia's diverse cultural landscapes. This approach positions heritage not as an obstacle to modernisation but as an active resource that can anchor identity, stimulate local economies, and contribute meaningfully to resilient urban futures. This paper, therefore, investigates how Ecomuseums can function as a critical platform for integrating adaptive reuse, positioning it as an approach that upholds ecological responsibility, strengthens cultural relevance, and deepens community engagement.

2.0 LITERATURE REVIEW

The literature reveals a growing global recognition of adaptive reuse as a sustainable design practice. Scholars such as Douglas (2006) and Plevoets & Van Cleempoel (2011) advocate for reuse strategies that preserve architectural integrity while introducing new functions. Meanwhile, Davis (2007) and Corsane (2006) have expanded on the Ecomuseum model as an evolving institution rooted in place, memory, and environmental stewardship. In the Malaysian context, research by Zainul Abidin (2010) and Ismail et al. (2014) emphasises the need for integrated heritage management policies that align with national sustainability goals.

2.1 The Concept of Ecomuseum

Ecomuseums offer a transformative model of heritage preservation by integrating cultural heritage, environmental education, and active community engagement. Unlike traditional museums that focus on static collections within enclosed buildings, Ecomuseums extend across landscapes, emphasising ecological awareness and participatory governance. The framework for Ecomuseums is discussed in various literature, including insights from Hugues de Varine. His work, *L'écomusée singulier et pluriel* (2017), offers the most sustained intellectual genealogy of the model, situating it within five decades of community-based museology. According to Hugues de Varine, the Ecomuseum's role is multiple – to gather population around a project, to transform the inhabitants into actors and users of their own heritage, to develop a database for the community, and, from that, promote meetings and discussions. His text foregrounds the Ecomuseum's capacity to adapt to local contexts, while insisting on its singular commitment to community agency, democratic governance, and holistic territorial interpretation. The social purpose of Ecomuseum was put into practice by Marcel Évrard and Mathilde Bellaigue at Le Creusot, moving de Varine's perspective away from the classical model towards the concept of a community museum, driven by local people and for their own development (Valentino & Soares, 2019).

Table 1. Differentiation Between Traditional Museum and Eco-Museum

Aspect	Traditional Museum	Ecomuseum
Focus	Collections, artifacts and exhibitions	People, Culture, and environment
Location	Confined to a building	Spread across a territory or landscape
Community Role	Passive visitors	Active participants and contributors
Sustainability	Limited focus on environmental issues	Strong emphasis on ecological stewardship
Example	Louvre Museum, Paris	Ecomuseum of Salina, Italy

The new museum definition adopted at the ICOM General Conference in Prague (2022) further strengthens the conceptual legitimacy of Ecomuseums by aligning global museological standards with principles long championed by its advocates. The updated definition emphasises inclusivity, sustainability, community participation, and ethical stewardship, all of which resonate directly with the model's philosophy. In effect, the 2022 definition positions the Ecomuseum not as an alternative or peripheral model, but as a precursor to a broader museological shift that recognises heritage as socially co-produced and environmentally accountable.

The "Strategic Manifesto for Ecomuseums" (Rau et al., 2018) provides a forward-looking framework that operationalises these principles into concrete commitments. The manifesto articulates Ecomuseums as engines of local empowerment, ecological transition, and cultural democracy, underscoring their responsibility to act as active agents in territorial care rather than passive repositories of heritage. It calls for renewed attention to sustainable development, intergenerational learning, and collaborative governance, framing Ecomuseums as strategic nodes in broader socio-ecological networks. Challenges remain in reconciling historical authenticity with modern functionality (Jamal et al., 2024), but the model offers significant opportunities for heritage conservation aligned with sustainability goals.

2.1.1 Place, Authenticity, and Meaning

The concept of place in heritage discourse transcends mere physical geography, encompassing social, cultural, and emotional dimensions that shape community identity and a sense of belonging. This expanded understanding reflects a shift in heritage studies from viewing heritage simply as static artefacts to recognising it as dynamic and relational, influenced by people and their interactions with both tangible and intangible elements of their environments. It includes the socio-cultural and emotional dimensions shaped by memory, identity, and interaction. Relph (1993) and Tuan (1977) emphasise that authentic places reflect their cultural narratives and lived experiences, which must be carefully preserved amid urbanisation and commercialisation. In adaptive reuse, preserving both tangible structures and intangible cultural expressions ensures the continuity of local identity. Authenticity, as Lowenthal (1985) suggests, is socially constructed and evolves with community values, making its conservation a dynamic, context-sensitive process.

Hasan et al. further elaborate on this by describing how community engagement is essential to heritage conservation. They argue that a locality's heritage embodies social, historical, cultural, economic, and traditional values. This inclusive perspective promotes community attachment and identity, which are essential to sustainable conservation efforts. The authors discuss how participatory practices can strengthen community cohesion and literacy surrounding heritage while addressing conflicting demands of development and conservation (Hasan et al., 2022).

2.1.2 Ecomuseums and the Representation of Place

Ecomuseums offer a holistic representation of place by integrating natural landscapes, built heritage, and community practices. Unlike traditional museum typologies, they decentralise authority, enabling local populations to narrate their heritage through participatory mechanisms (Corsane, 2006). This inclusive model represents both material culture and intangible heritage, facilitating cultural sustainability and ecological stewardship. Harrison (2013) underscores that Ecomuseums cultivate a living heritage ethos in which cultural expression and environmental awareness coalesce, ensuring that heritage remains adaptive, relevant, and resilient. Heritage is not merely about preservation but also about engaging communities in ongoing narratives of identity.

The role of cultural heritage in fostering a sense of place is also elaborated by Spennemann, who discusses its contribution to community identity and individual mental health. He emphasises that heritage places are central to creating environments that foster connection and engagement among residents (Spennemann, 2022). The phenomenon of placemaking, emphasised in various discussions of heritage and urban spaces, stresses the relationship between individuals and their environments. This approach encourages not just the preservation of historical sites but also the creation of vibrant, engaging spaces that resonate with communities (Samir et al., 2019).

2.2 Heritage Conservation

Heritage encompasses the values and meanings attributed to material culture and to the natural and built environment (ICOMOS, 1999), while broader interpretations, reflected in Malaysia's National Heritage Act (2005) and ICOMOS (1982), also include intangible cultural expressions such as traditions, customs, and social structures (Sodangi et al., 2011). Heritage conservation therefore involves the preservation and management of both tangible and intangible elements to ensure continuity across generations (ICOMOS, 2013). The ICOMOS Cultural Tourism Charter further underscores the need to balance the safeguarding of heritage values with enriching visitor experiences, positioning heritage as both a cultural touchstone and a resource for sustainable community development (El-Din, 2019). Within the built environment, conservation supports sustainability by retaining embodied energy and reducing the environmental costs of demolition and new construction, though poor maintenance can accelerate deterioration and compromise safety (Sodangi et al., 2011). Additionally, heritage buildings also anchor local identity and contribute to economic vitality, particularly in urban centres where they enhance the public realm and can catalyse conservation-led regeneration.

2.2.1 Principles of Heritage Conservation

The principles of heritage conservation, articulated through foundational documents such as the Venice Charter (1964-1994), the Burra Charter (2013), and the Nara Document on Authenticity (1994), establish a comprehensive ethical and methodological framework for safeguarding cultural heritage. These charters collectively emphasise significance-based decision-making, minimal intervention, reversibility, authenticity, and respect for cultural diversity—principles that continue to guide conservation practice in response to evolving social, environmental, and cultural conditions.

The Venice Charter remains a cornerstone of modern conservation philosophy. Central to the Venice Charter is the primacy of historical authenticity. It asserts that conservation interventions should respect the original material, design, and fabric of monuments, avoiding conjectural reconstructions or additions that distort historical truth (ICOMOS, 1994). Restoration, when undertaken, must be minimal, clearly distinguishable from the original work, and meticulously documented to ensure the historical record remains intelligible to future generations. This principle foregrounds respect for the accumulated historical narrative, acknowledging that each phase of a building's evolution contributes to its significance.

The Charter underscores the primacy of historical and cultural significance, advocating interventions that preserve original fabric and avoid distortions of heritage meaning. As Goetcheus and Mitchell (2014) observe, the Charter has evolved from a monument-focused paradigm toward a more inclusive understanding of cultural heritage, recognising a wide array of expressions beyond traditional architectural monuments. This shift aligns with contemporary conservation's holistic approach, which values intangible cultural narratives alongside tangible structures.

Complementing this, the Burra Charter enhances heritage conservation principles by shifting from a purely fabric-centred approach to a values-based framework, foregrounding intangible heritage, stakeholder participation, and adaptive management (Australia ICOMOS, 2013). It complements the Venice Charter by retaining core commitments to authenticity and minimal intervention, while expanding the scope of conservation to include socially constructed meanings, community engagement, and sustainable utilisation. The Charter defines cultural significance as encompassing historical, aesthetic, scientific, and social dimensions that must be carefully understood and respected throughout the conservation process (Le & Nguyen, 2024). As Jouan and Hallot (2019) underscore, an accurate understanding of these values forms the foundation of all effective conservation strategies, ensuring that interventions are aligned with both local meanings and broader heritage objectives.

The Nara Document on Authenticity further deepens these principles by reframing authenticity as a culturally contingent and context-specific concept. It asserts that authenticity is not limited to physical attributes but extends to historical contexts, cultural practices, and the evolving narratives associated with heritage sites (Shah et al., 2025; Cho, 2025). The Nara Document also underscores that values attributed to cultural properties differ from culture to culture – a perspective that affirms the dynamic

nature of cultural identity and argues for conservation approaches that remain sensitive to local traditions, ethical considerations, and shifting socio-cultural realities (ICOMOS, 1994).

Across these charters, the principle of reversibility is consistently emphasised as a safeguard against irreversible damage. Reversible interventions allow for future reinterpretation as conservation knowledge and technologies advance (Palazzi et al., 2021). This approach aligns with ICOMOS guidelines promoting flexibility and adaptability, ensuring that conservation actions preserve historical integrity while accommodating changing needs.

Equally important is the principle of community participation, which positions heritage as a shared resource whose meaning is co-produced by custodians, users, and local stakeholders. As Amouvi and Pessoa (2025) note, maintaining authenticity and integrity in rapidly changing cultural landscapes requires collaborative frameworks involving conservation professionals, communities, and policymakers. Such inclusive governance fosters shared understanding and enhances the capacity to safeguard diverse cultural narratives (Lin et al., 2024).

These principles form a robust and adaptive framework for contemporary heritage conservation, ensuring that heritage sites are preserved not as static artefacts but as living cultural assets capable of sustaining meaning, relevance, and resilience across generations.

2.2.2 Challenges in Heritage Conservation

Heritage conservation is a multifaceted discipline facing several pressing challenges driven by technological, sociopolitical, and environmental factors. One of the most significant challenges pertains to the management and preservation of Indigenous heritage. The destruction of the Juukan Gorge rockshelter in Western Australia exemplifies the ongoing crisis in understanding and protecting Indigenous sites, highlighting failures in existing cultural heritage governance and policies (Cros, 2022). This incident has drawn widespread criticism and prompted calls for reform in the approach to Indigenous heritage management, reflecting a broader tension between development and cultural preservation.

In addition to governance issues, integrating digital technologies into heritage conservation presents both opportunities and challenges. As digital tools become more prevalent, they can enhance site management, facilitate information sharing, and promote conservation methods by developing heritage information systems (Baharuddin et al., 2024). However, implementing these systems in regions such as Malaysia has encountered notable difficulties, including the need for greater understanding of data management and the integration of technology into conservation practices (Baharuddin et al., 2024). The efficacy of digital solutions is further complicated by challenges of data ownership and ethical considerations, particularly concerning Indigenous rights and cultural representation (Pasupuleti, 2025; Rafee, 2025).

Moreover, the preservation of built heritage is increasingly challenged by the need to retrofit for energy efficiency and adapt for contemporary use while maintaining historical integrity (Pereira et al., 2021). Higher education heritage buildings, in particular, face the dual challenge of modernisation to meet current energy standards and the preservation of their original characteristics (Pereira et al., 2021). As urbanisation and climate change continue to exert pressure on historical sites, conservationists are compelled to develop innovative methodologies, such as Digital Twin Technology, which facilitates real-time monitoring and restoration simulations (Pasupuleti, 2025).

The social aspects of heritage conservation are paramount, as community involvement and stakeholder engagement are essential for successful conservation efforts. Insufficient community participation often leads to reduced support for local heritage initiatives and neglect of cultural landscapes (Mekonnen et al., 2022; Verma & Devi, 2024). Moreover, factors such as urban development, funding shortages, and inadequate governmental support exacerbate the challenges faced by heritage conservationists, underscoring the need for a more coordinated, interdisciplinary approach to address these multifaceted issues (Zailani et al., 2024).

2.3 Adaptive Reuse

Adaptive reuse is the process of repurposing existing buildings for new uses while preserving their historical, architectural, and cultural significance. As a sustainable alternative to demolition and new construction, adaptive reuse minimises resource consumption, energy usage, and construction waste (Bullen & Love, 2011). This approach supports sustainable development by extending the life cycle of built assets and preserving cultural heritage within a changing urban landscape.

Adaptive reuse closely aligns with principles of international heritage charters, such as the Venice Charter (1964) and the Burra Charter (2013), which emphasise authenticity, minimal intervention, and contextual adaptation. It also supports the circular economy model by promoting reuse and retrofitting over resource-intensive redevelopment (Ellen MacArthur Foundation, 2015).

2.3.1 Benefits of Adaptive Reuse

Adaptive reuse contributes significantly to environmental sustainability by reducing the demand for new construction materials and minimising waste generation. Rather than demolishing existing structures and starting from scratch, adaptive reuse leverages the embodied energy within buildings—preserving materials that have already undergone extraction, processing, and transportation. This approach reduces the overall environmental footprint of development projects and supports climate change mitigation by lowering carbon emissions associated with new construction (Bullen & Love, 2011).

Another vital benefit of adaptive reuse is the preservation of cultural heritage. Repurposing heritage buildings allows for the retention of historical identity and architectural character, fostering a continued connection between communities and their built environment, by conserving buildings with significant cultural narratives, adaptive reuse safeguards intangible heritage values, such as collective memory, craftsmanship, and place identity, which are often embedded in architectural forms and spatial arrangements. This cultural continuity is essential for maintaining a sense of place and promoting intergenerational appreciation of local history.

In addition, adaptive reuse supports economic revitalisation by transforming underused or abandoned heritage structures into functional assets. These revitalised spaces often stimulate economic activity by attracting investment, tourism, and creative industries. For instance, converted heritage sites may house museums, cultural centres, galleries, or commercial ventures, generate employment opportunities and increase property values in surrounding areas. By reintegrating obsolete buildings into the urban economy, adaptive reuse enhances community vibrancy and contributes to sustainable urban regeneration (Bullen & Love, 2011).

2.3.2 Strategies for Adaptive Reuse

Effective adaptive reuse hinges on a comprehensive understanding of the existing building's physical condition, historical significance, and architectural potential. One fundamental strategy involves retrofitting outdated mechanical, electrical, and environmental systems to comply with contemporary standards, ensuring that the building functions efficiently without compromising its historical fabric. Additionally, meaningful community engagement is critical to the success of adaptive reuse projects, as it ensures that new interventions align with local stakeholders' cultural values, needs, and aspirations. This participatory approach enhances social acceptance and fosters a sense of ownership among the community.

The use of sustainable, locally sourced materials also plays a pivotal role in minimising the environmental impact of adaptive reuse interventions. Such materials not only reduce the building's carbon footprint but also support regional economies and reinforce cultural authenticity through traditional construction methods. Another essential strategy is to design flexible spaces that can accommodate multiple uses over time, thereby extending the building’s relevance and usability across generations.

In the context of Ecomuseums, adaptive reuse strategies introduce both challenges and opportunities. Jamal et al. (2024) and Said et al. (2025) underscore the complexity of balancing the

preservation of historical authenticity with the integration of modern technologies, such as HBIM, for documenting and conserving architectural heritage in Malaysia, particularly in addressing environmental performance and visitor accessibility. Meanwhile, Wong and Lee (2023) argue that adaptive reuse within Ecomuseums creates unique opportunities for environmental education, cultural continuity, and community-based programming. These adaptive strategies not only conserve-built heritage but also actively contribute to broader sustainability and cultural engagement goals.

2.4 Relationship Between Adaptive Reuse and Ecomuseum

The relationship between adaptive reuse and the Ecomuseum concept is grounded in shared objectives of sustainability, community empowerment, and heritage preservation. Adaptive reuse, as a strategy, focuses on repurposing historic buildings for new functions while retaining their architectural and cultural value, thus extending the lifespan of built heritage and reducing the environmental footprint associated with demolition and new construction. In parallel, Ecomuseums are community-based heritage initiatives that emphasise the conservation of both cultural and natural environments. The incorporation of adaptive reuse within Ecomuseum frameworks enables the transformation of heritage buildings into functional, educational, and cultural spaces that serve contemporary community needs.

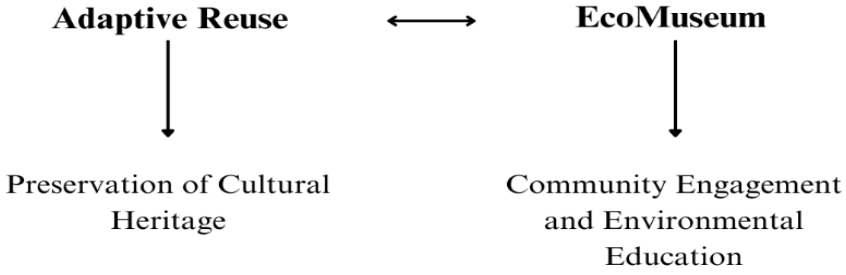

Figure 1. Synergy Between Adaptive Reuse and Ecomuseum. Source: Author

This synergy is particularly evident in the way both approaches prioritise community engagement. While adaptive reuse may involve stakeholders in the design and reuse process, Ecomuseums go further by positioning local communities as active participants and co-curators in the preservation and interpretation of their cultural heritage. By repurposing heritage structures into exhibition spaces, learning centres, or workshops, adaptive reuse within Ecomuseums reinforces local identity, facilitates intergenerational knowledge transfer, and fosters a sense of ownership and pride.

Moreover, Ecomuseums extend the scope of conservation by incorporating environmental education and ecological stewardship. Adaptive reuse practices, when aligned with the goals of Ecomuseums, facilitate a comprehensive approach that addresses not only the built environment but also the interrelation between culture and nature. In this context, the adaptive reuse of heritage buildings becomes a vehicle for sustainable development, supporting both ecological resilience and cultural continuity. Thus, adaptive reuse is not merely a technical intervention but a strategic tool that Ecomuseums employ to promote holistic heritage conservation and sustainable community development.

2.5 Sustainable Design

Sustainable design encompasses a set of architectural principles that aim to reduce the environmental impact of buildings while enhancing their long-term viability and operational performance. In the realm of heritage conservation, sustainable design plays a crucial role by integrating modern sustainability practices into the rehabilitation and continued use of historic structures. This integration not only safeguards cultural significance but also ensures the adaptive functionality of heritage assets in the face of contemporary environmental challenges.

Key principles of sustainable design include energy efficiency, water conservation, improved indoor environmental quality, and the use of sustainable materials. Energy efficiency can be achieved

through passive solar design strategies, high-performance insulation, and the integration of energy-efficient systems such as lighting and HVAC. Water conservation strategies, such as low-flow fixtures and rainwater harvesting, reduce resource consumption while enhancing operational sustainability. Indoor environmental quality is addressed through the use of low-VOC (volatile organic compound) materials and effective ventilation systems, which promote occupant health and comfort. Additionally, selecting recycled, reclaimed, or locally sourced materials reduces environmental impact while maintaining architectural integrity (McLennan, 2004).

However, integrating sustainable design into heritage buildings presents distinct challenges. Many heritage structures were not originally designed with modern performance standards in mind, and retrofitting such buildings must be done sensitively to preserve their character-defining elements. Sustainable conservation strategies, such as installing unobtrusive solar panels, improving insulation without damaging historic finishes, or employing reversible interventions, can enhance the performance of heritage structures without compromising their authenticity (Ozmen et al., 2024).

A holistic, context-sensitive approach is therefore required, balancing environmental considerations with historical values. Sustainable design, when effectively applied to heritage conservation, supports both climate resilience and cultural preservation, ensuring that historic buildings remain viable and valuable assets in the built environment for future generations.

3.0 METHODOLOGY

This research adopts a qualitative research design to address the paper's objectives of proposing a sustainable Ecomuseum approach that preserves historical value while fostering community development. Integrating adaptive reuse into the Ecomuseum model, this paper employs a methodology centred on document analysis and a comprehensive literature review, supported by a theoretically informed case study strategy.

3.1 Document Analysis and Comprehensive Literature Review

A document analysis approach forms the core methodological basis for examining how Ecomuseums operationalise adaptive reuse within heritage environments. This method allows for the systematic interpretation of textual and visual materials, including conservation reports, planning documents, architectural drawings, policy guidelines, project websites, and archival records, pertaining to selected Ecomuseum initiatives. The study identifies significant buildings like the Penang Heritage Ecomuseum and Las Casas Filipinas de Acuzar for their strong connections to industrial heritage reuse, community-led conservation, and sustainable development practices. Instead of relying on fieldwork, this analysis leverages a wide range of secondary data, including scholarly publications, institutional reports, heritage inventories, and visual documentation.

This document-based approach is particularly suitable given the dispersed nature of Ecomuseum practices and the varying levels of public accessibility to heritage sites. By focusing on curated documentation, the study maintains methodological consistency, reduces site-based limitations, and ensures that the analysis captures both the conceptual intentions and material outcomes of adaptive reuse interventions.

The empirical insights derived from document analysis are interpreted through a theoretical framework grounded in adaptive reuse, community-based heritage management, and sustainable development. Key conceptual lenses include conservation planning theory, cultural landscape frameworks, and Ecomuseum principles, enabling a nuanced understanding of how reuse practices mediate cultural significance, community identity, and ecological responsibility. This theoretical integration deepens the analysis and links the Malaysian context to broader global discourses on heritage revitalisation.

3.2 Comprehensive Literature Review

A comprehensive literature review complements the document analysis by mapping existing scholarship on themes relevant to the Ecomuseum framework. Using the keywords *adaptive reuse,*

environmental impact, heritage conservation, heritage museum, sustainable infrastructure, a total of 355 peer-reviewed publications, book chapters, and research papers were collected from four academic databases: Emerald Insight, ScienceDirect, Google Scholar, and ResearchGate. The review synthesises debates on sustainability, authenticity, community engagement, industrial heritage, and museum innovation, providing a robust scholarly foundation for evaluating the relevance and applicability of Ecomuseums within Malaysia's heritage landscape.

Table 2. Screening Phases of Literature Review

Database	Total Articles Gathered	Screening Process (2 times)	Further refinement
Emerald Insight	57	35	13
Sciencedirect	109	43	15
Google scholar	87	41	13
ResearchGate	102	52	11
Total	355	171	52

3.3 Document Analysis of Ecomuseum Projects

Instead of traditional field-based case study methods, this research employs a document analysis approach to examine how Ecomuseum initiatives integrate adaptive reuse, heritage conservation, and sustainability. Document analysis provides a systematic and rigorous method for interpreting textual, visual, and archival materials that describe the planning, design, implementation, and management of Ecomuseum projects. This approach is particularly suited to heritage research where access to sites may be limited, and where a substantial portion of knowledge is embedded in reports, conservation documents, policy texts, and published studies. Several criteria guide the selection of documents and case study relating to specific Ecomuseum projects:

i. **Relevance to Industrial or Cultural Heritage** – Documents on projects involving the revitalisation of historically significant structures, particularly those associated with industrial, vernacular, or community-based heritage such as former industrial facilities, merchant districts, or colonial-era buildings.
ii. **Evidence of Adaptive Reuse Strategies** – The materials chosen to illustrate how historical structures have been transformed into functional spaces for community use, education, or cultural tourism, while retaining their architectural and historical integrity.
iii. **Alignment with Ecomuseum Principles** – Selected documents demonstrated the presence of Ecomuseum values, including community participation, environmental stewardship, and sustainable heritage management within the project's narrative or implementation.
iv. **Geographical and Cultural Diversity** – Documents are drawn from projects in various cultural and national contexts to facilitate comparative interpretation and enhance the transferability of insights to the Malaysian context.

By applying these criteria, the document analysis focuses on projects that are both contextually rich and conceptually aligned with the research objectives. This method enables the study to extract key strategies, identify recurring challenges, and evaluate the cultural and ecological impacts documented in existing records. Ultimately, the document analysis contributes to a robust, evidence-based framework for integrating adaptive reuse into Ecomuseum development, supporting sustainable and culturally responsive heritage practices.

Table 3. Summarisation of Selected Case Study on its Criteria

Case Study	Location	Original Use	Adaptive Reuse	Key Features & Objectives
Penang Heritage Ecomuseum (PH)	George Town, Penang, Malaysia	Old shophouses, clan houses, colonial structures	Cultural centers, artisan workshops, exhibition spaces	Preserves multicultural heritage; promotes eco-cultural tourism; highlights crafts, history, and biodiversity
Las Casas Filipinas de Acuzar (LCF)	Bagac, Bataan, Philippines	Spanish colonial-era houses (relocated)	Heritage resort and museum	Revitalizes Filipino architecture; preserves houses from urban destruction; showcases cultural richness
Nagoya City Ecomuseum of Shikemichi (NC)	Nagoya, Japan	17th-century merchant houses	Shops, cafes, cultural spaces	Restores historic merchant district; revives tourism; maintains architectural and historical significance
Tai O Heritage Hotel (TH)	Tai O, Lantau Island, Hong Kong	1902 British colonial police station	Boutique heritage hotel	Preserves colonial architecture; part of a government revitalization scheme; cultural and hospitality destination
Kampong Glam Malay Heritage Centre (KG)	Kampong Glam, Singapore	Royal palace (Istana Kampong Glam)	Malay Heritage Centre (museum)	Blends Malay and European styles; educates on Malay culture; community engagement and exhibitions

4.0 RESULT AND DISCUSSIONS

Ecomuseums redefine heritage conservation by transforming static sites into dynamic cultural hubs that integrate historical narratives, environmental education, and community participation. The comparative analysis of the five case studies, Penang Heritage Ecomuseum (PH), Las Casas Filipinas de Acuzar (LCF), Nagoya City Ecomuseum of Shikemichi (NC), Tai O Heritage Hotel (TH), and the Kampong Glam Malay Heritage Centre, (KG) reveals that adaptive reuse, when embedded within an Ecomuseum framework, can significantly extend the lifecycle and contemporary relevance of historic buildings. This integration demonstrates how Ecomuseums can effectively mobilise adaptive reuse as a practice that upholds ecological responsibility, strengthens cultural meaning and community engagement. Key strategies include minimal intervention, material conservation, and energy-efficient retrofits, though challenges like structural deterioration, regulatory constraints, and financial viability remain.

Table 4. Cross Case Analysis of Ecomuseum-Oriented Adaptive Reuse Projects.

Theme	Penang Heritage Ecomuseum (PH)	Las Casa Filipinas de Acuzar (LCF)	Nagoya City Ecomuseum of Shikemichi (NC)	Tai O Heritage Hotel (TH)	Kampong Glam Malay Heritage Centre (KG)	Cross-Case Insights
Architectural Strategies for Long-term Sustainability	Minimal intervention; retention of shophouse typologies; passive ventilation	Reconstruction with heavy intervention; hybrid authenticity	Conservative restoration; fire-resilient retrofits	Energy-efficient systems; sensitive insertion of services	Climate-responsive design; careful façade retention	Tension between minimal intervention and functional retrofit persists; deeper interventions often correlate with tourism-oriented development.
Environment Education & Community Participation	Strong community driven narratives; local curator	Limited participation; curated through developer lens	High community involvement; local stewardship	Guided tours emphasise ecology; moderate community role	Educational programmes tied to Malay cultural identity	Participation varies; adoption of 'Ecomuseum' different across boards.
Socio-Economic & Cultural Impacts	Supports local economy via cultural tourism; maintain living heritage	Significant revenue generation but contested cultural presentation	Revitalises local district; strengthens intangible heritage	Boosts ecotourism; improved local pride	Enhances cultural identity and tourism economy	Economic benefits often overshadow cultural equity; commodification risks are visible.
Limitations & Contested Aspects	Funding constraints; regulatory delays	Out of context, Authenticity debated	Balancing safety codes with narrow streets	Limited guest capacity restricts financial sustainability	Tension between national heritage and local identities	Cases reveal frictions between authenticity, governance, and market imperatives.
Challenges: Authentic Materials & Integrating Modern Infrastructure	Sourcing traditional timber difficult; discrete modern services	Use of relocated structures questioned; high renovation costs	Authentic materials preserved; seismic upgrades required	Structural integrity complex; humidity control	Reconciling AV systems, accessibility with heritage fabric	Struggle involves high costs, scarcity of craftsmen, and regulatory mandates that risk compromising authenticity.

The application of adaptive reuse principles is not merely a technical exercise but a transformative process that redefines the relationship between heritage, community, and sustainability. Table 4.1 illustrates the transformation of a historical building into an Ecomuseum through adaptive reuse, which involves preserving cultural identity, integrating modern functionality, and fostering community engagement.

Historical Building	>	Adaptive Reuse Process	>	Ecomuseum
Preservation of Cultural Identity		Modern Functionality (e.g., Tourism, Education)		Community Engagement (e.g., Local Involvement, Cultural Programs)

Figure 2. Transformation of a historical building into an Ecomuseum through adaptive reuse.

4.1 Architectural Strategies and Ecological Responsibility

Sustainable design is central to adaptive reuse. The architectural strategies across all cases span a spectrum from minimal intervention to deep retrofitting. Projects like TH and NC highlight how historical buildings can be retrofitted with modern amenities while preserving their heritage value. While NC and PH foreground conservation-oriented approaches, privileging material authenticity and climatic responsiveness, TH and KG integrate more extensive infrastructural upgrades, such as energy-efficient systems, without compromising the integrity of the original structure. LCF stands apart as it operates through reconstruction and transplantation rather than in-situ preservation, raising questions about authenticity and historical context. Collectively, these cases highlight a core tension of balancing preservation ethos and contemporary functionality. While minimal intervention maintains historical integrity, it restricts the building's operational flexibility; conversely, deep retrofits enhance usability but risk eroding the very values they seek to conserve. However, integrating modern infrastructure without compromising historical integrity requires careful planning and skilled craftsmanship, often increasing project costs and complexity. These dialectics foreground the ecological responsibility of demanding precise calibration to material conditions, local climate and community use patterns.

4.2 Environmental Education and Community Participation

Community engagement ensures social sustainability, fostering local ownership and cultural continuity. The case studies present an uneven but instructive pattern of environmental education and participatory governance. NC exemplifies a community-anchored model in which residents steward both tangible and intangible heritage, integrating disaster awareness, local ecology, and neighbourhood memory into interpretive programming. In contrast, the PH Ecomuseum model similarly embeds local voices, allowing community curatorship to drive meaning-making. By comparison, LCF displays a highly curated, commercially driven structure where environmental narratives and local participation are selectively orchestrated. TH and KG sit between these poles: each incorporates educational components, mangrove ecology in TH and Malay cultural identity in KG, but the depth of community agency remains mediated by state or institutional bodies. These differences reveal that Ecomuseums do not inherently guarantee participatory empowerment, but what emerged is a negotiated practice shaped by governance structures, funding models, and the political economy of the heritage itself.

4.3 Socio-Economic and Cultural Impacts

All presented cases generate socio-economic benefits, though in different ways. TH and PH demonstrate that sensitively executed adaptive reuse can stimulate local economies without overwhelming cultural identities. NC's modest-tourism model preserves neighbourhood rhythms while supporting local craft economies. KG's integration into Singapore's heritage tourism circuitry reinforces national identity narratives while simultaneously revitalising local cultural industries. In contrast, LCF commodifies heritage through a highly aestheticised, museum-village model that generates economic revenue at the expense of contextual authenticity and local authorship. This raises a critical contradiction whereby economic revitalisation may coexist with cultural displacement, especially when heritage is repackaged for external consumption.

The case studies reveal common challenges, including balancing tourism with preservation, sourcing authentic materials, and complying with modern safety standards. Despite these obstacles, adaptive reuse has proven effective in revitalising heritage sites, boosting local economies, and promoting cultural education. Each project underscores the importance of multidisciplinary collaboration in heritage conservation.

4.4 Limitations and Contested Dimensions

There are recurring limitations across all cases, including scarcity of authentic materials, regulatory constraints, tourism pressures, and ideological tensions. The scarcity of skilled craftspeople includes those in PH and NC, where traditional timber construction requires specialised knowledge. Regulatory constraints, such as fire codes and seismic retrofitting, place pressure on integrating modern infrastructure within fragile heritage envelopes. In terms of tourism pressure, TH and KG, visitor surges risk overwhelming the ecological and cultural carrying capacity of local communities. Most visible in LCF is the ideological tension in which the transplanting of buildings challenges conventional conservation ethics. These limitations show that adaptive reuse is a negotiated process rather than a harmonious synthesis.

4.5 Adaptive Reuse-Ecomuseum Integration Framework

The study aims to investigate how Ecomuseums can function as a critical platform for integrating adaptive reuse, positioning it as an approach that upholds ecological responsibility, strengthens cultural relevance, and deepens community engagement.

Adaptive reuse in Ecomuseums offers a sustainable model for preserving cultural heritage while adapting to contemporary needs. By combining architectural innovation, environmental stewardship, and community involvement, these projects ensure historical sites remain relevant and resilient. Future initiatives can learn from these examples, addressing challenges through innovative design, policy support, and inclusive planning. Ultimately, integrating adaptive reuse into the Ecomuseum framework as a dynamic, iterative process that sustains heritage lifecycles while promoting environmental stewardship, cultural continuity, and social equity.

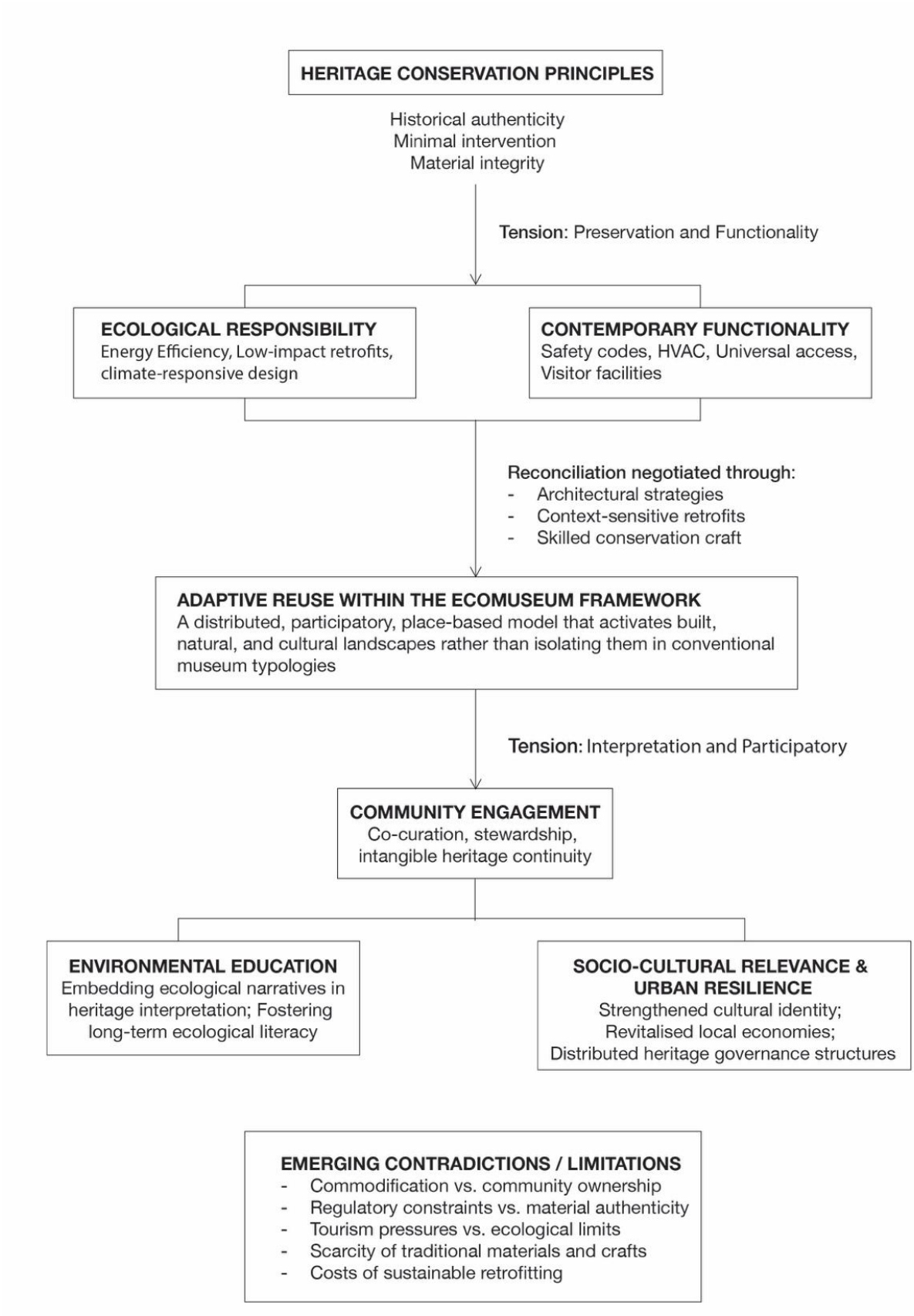

Figure 3. Adaptive Reuse-Ecomuseum Integration Framework.

5.0 CONCLUSIONS

This study examined how Ecomuseums can serve as a critical platform for integrating adaptive reuse, demonstrating that such integration can revitalise heritage structures, advance ecological responsibility, and deepen cultural and community relevance. The comparative analysis of the case study shows that adaptive reuse, when aligned with Ecomuseum principles, significantly extends the cultural and functional lifespan of historic buildings. Nonetheless, this integration is also shaped by conflicting values, structural constraints, and uneven participatory dynamics.

A key insight emerging from the findings is that adaptive reuse does not operate as a universally transferable solution. Instead, its effectiveness depends on the degree to which architectural interventions respect historical materiality while accommodating contemporary needs. While projects such as Penang Heritage Ecomuseum and the Nagoya City Ecomuseum exemplify context-sensitive strategies, Las Casas Filipinas illuminates the precarious boundary between conservation and commodification. This comparison underscores that what constitutes a "successful" adaptive reuse remains socially negotiated and ethically contested.

Equally significant is the study's demonstration that Ecomuseums can foster environmental education and community participation, but only under specific governance arrangements. Nagoya City Ecomuseum and Penang Heritage Ecomuseum illustrate robust local agency, while Tai O and Kampong Glam show more institutionally mediated participation, raising questions about how power circulates within heritage governance frameworks. These findings invite further reflection on how community engagement is configured, especially at the grassroots level, who is empowered to speak for heritage, and how environmental narratives are selectively emphasised or excluded.

Nonetheless, this study is also confronted by methodological challenges, such as the heterogeneity of the selected cases, which may limit the generalisability of cross-case comparisons. Secondly, the analysis relies heavily on publicly available documentation and secondary sources, which constrains the depth of insight into internal decision-making processes and community perspectives. These methodological constraints reveal gaps that future research must address. More ethnographic and participatory fieldwork is needed to capture the lived experiences of heritage communities and to analyse how adaptive reuse is negotiated in practice.

Despite these limitations, this study contributes an analytically grounded framework for understanding how adaptive reuse within Ecomuseum structures can cultivate more resilient, culturally significant, and environmentally responsible heritage landscapes. The results emphasise that the power of the Ecomuseum model lies not in resolving tensions but in providing a platform through which multiple, sometimes conflicting demands such as preservation, community participation, ecological stewardship, and economic viability, can be negotiated.

The implications of this integration are multifold. At the community level, it fosters stewardship, empowers local identity, and supports socio-economic vitality through heritage-led regeneration. At the environmental level, Ecomuseums are positioned as low-impact cultural infrastructures that align with global sustainability imperatives. At the policy level, it underscores the necessity for frameworks that encourage flexible, value-based conservation practices, bridging regulatory gaps that currently hinder adaptive reuse in heritage contexts.

Looking forward, the findings indicate that embedding adaptive reuse within Ecomuseum strategies can serve as a transformative pathway for countries like Malaysia, where diverse heritage resources and rapid urban development intersect. To conclude, adaptive reuse in an Ecomuseum framework holds significant potential, but its success depends on recognising and navigating the contradictions that inevitably accompany heritage transformation. Future scholarship will need to probe these tensions more deeply, attending to the methodological complexities that shape heritage practice in an increasingly precarious ecological and cultural future. As such, this research provides a conceptual foundation for developing design guidelines, community-centred policies, and interdisciplinary collaborations that can shape more resilient and culturally attuned heritage futures.

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