

## OPTIMISATION OF THE SUSTAINABLE FACILITIES MANAGEMENT FOR PRESERVING MOSQUE FUNCTIONALITY

ZAFIRAH AB. MUIN<sup>1\*</sup>, MAIMUNAH SAPRI<sup>2</sup>, IBRAHIM SIPAN<sup>2</sup>, ROHAYA ABDUL JALIL<sup>1</sup> AND SITI MARIYAM ABD RAZAK<sup>1</sup>

<sup>1</sup>Faculty of Built Environment & Surveying, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia. <sup>2</sup>Centre for Real Estate Studies, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia.

\*Corresponding author: [zafirah2@utm.my](mailto:zafirah2@utm.my)

<http://doi.org/10.46754/jssm.2024.02.015>

Submitted final draft: 26 September 2023

Accepted: 29 October 2023

Published: 15 February 2024

**Abstract:** Nowadays, sustainability concerns have reached an unprecedented stage, making the need for sustainable means to safeguard the planet more pressing. As one of the centres for worship, mosques play crucial roles in being at the forefront of sustainability efforts. However, there is a lack of understanding exists regarding the mosque management committee's skills and abilities to administer the mosque facilities sustainably. Therefore, this study aims to explore how Sustainable Facilities Management (SFM) can be applied in mosque management to increase the mosque's operational efficiency and effectiveness. An exploratory study was carried out using scientometrics and content analysis with the aid of NVivo 12 software based on the literature from 2012 to 2022 derived from ScienceDirect, Emerald, Scopus, and Web of Science databases. The analysis revealed three crucial pillars in sustainability implementation. Pillars are environmental, social, and economic pillars in the sustainability triangle. Through the implementation, Mosques can build a balanced and holistic strategy that helps the environment, the community, and the institution's financial stability by addressing all three pillars of sustainability in mosque management. It ensures that mosques are responsible and ethical institutions that actively contribute to congregation well-being, environmental preservation, and the long-term sustainability of their operations.

Keywords: Sustainable Facilities Management (SFM), Facilities Management (FM), mosque, mosque management.

### Introduction

In an era marked by profound environmental challenges and a growing awareness of the need for sustainable practices, the nexus of faith-based institutions and sustainability emerges as a salient arena for scholarly investigation (Omar *et al.*, 2018; Azmi & Kandar, 2019). Among these institutions, mosques, revered as central places of worship and communal congregations for Muslims worldwide, occupy a distinctive and integral role within this discourse. The sustainability of these sacred spaces goes beyond the boundaries of spiritual and architectural dimensions to encompass multiple socio-ecological considerations of utmost importance.

The mosque is the fundamental symbol of Islamic culture, and it has contributed to the development of Islamic society over time. Mosques have played an important part in many aspects of history, and it has become a tremendous

battle to maintain the mosque's position as an Islamic society centre. The increasing number of mosques has generated a new difficulty in mosque administration, demanding the creation of an efficient system. Many people believe that well-managed services allow a firm to operate at its most efficient and effective level, bringing considerable value to the core business while boosting flexibility.

Notably, Mat Yamin (2021) contends that the mosque historically functioned as the epicentre of governance and administration for the Islamic State of Madinah during the era of the Prophet Muhammad SAW. Beyond its primary role as a place of worship, the mosque also served as an institution where the community had access to various facilities, asserted their rights, enforced justice, and engaged in a spectrum of activities within their district.

However, with the rapid increase of global development, the scope of mosque function has shrunk. Currently, the primary role of a mosque is viewed by the community as a place of worship (Rasdi, 2004; Mustari *et al.*, 2008; Mohammad *et al.*, 2011; Mahazan, 2013). The role of the mosque as the foremost institution in Islamic society appears to be increasingly marginalised and nearly forgotten by today's age, particularly by certain young people. As a result, contemporary mosques have transformed into institutions with a broader and more expansive purpose and show the potential to serve as focal points for the propagation of Islamic principles across myriad dimensions of human existence, including the imperative of environmental sustainability (Matin, 2010; Azmi & Kandar, 2019).

Hence, as posited by Omar *et al.* (2018) and Bakri *et al.* (2018), the efficacy of sustainable facilities management in mosques transcends the mere upkeep of physical infrastructure. It attests to the seamless amalgamation of faith, ecological stewardship, and operational efficiency, rendering it an intricate and multifaceted endeavour that warrants scholarly exploration and diligent application. In addition, Facilities Management (FM) is a realistic option for mosque management to consider, and it is regarded as a plan that will aid in the mosque's continuous operation. In response to the concerns above, this study tries to answer a question about how the FM strategy might be used in mosque management to help mosques become sustainable. According to a review of the literature, research on FM has been widely explored in various case studies such as higher education institutions, health care services, commercial buildings, and office buildings. However, studies concentrating on religious buildings such as mosques are still scarce. This is hardly surprising given the scarcity of knowledge on the value of FM in assisting non-profit organisations in achieving their fundamental business objectives.

In conjunction, buildings significantly impact climate change, with the operating stage

responsible for more than 80 percent of these effects (Baaki *et al.*, 2016). This emphasises the substantial impact that buildings have on exacerbating climate change and underscores the necessity of addressing their operational phase to mitigate these effects. As a result, the literature emphasises the importance of addressing existing structures to achieve sustainable objectives. Moreover, most buildings will remain in use for the next fifty years, carrying their embodied and operational energy requirements. The operating stage of a building, characterised by its day-to-day functions and maintenance, has garnered newfound recognition as a significant contributor to climate change. This is especially pertinent to mosques, where numerous energy-intensive activities take place regularly (Sapri *et al.*, 2016; Azmi & Kandar, 2019). Therefore, Bakri *et al.* (2018) argue that addressing the sustainability of existing buildings such as mosques is paramount, as these structures have the potential to continue contributing to resource depletion and environmental degradation for decades to come. Hence, Elmualim *et al.* (2010), Olaniyi (2015), Asbollah *et al.* (2016), and Silva *et al.* (2022) asserted that the operational phase of a building's life cycle is critical to FMs' roles, and it plays a significant part in executing the sustainable agenda.

Nevertheless, although mosques need to be at the forefront of sustainability efforts, there is a lack of awareness in terms of the mosque management committee's knowledge and expertise to manage the mosque facilities sustainably (Sapri *et al.*, 2014; Oriade *et al.*, 2021). These committees are tasked with the intricate responsibility of overseeing the functioning of the mosque, yet the nuanced field of sustainable facilities management often remains outside the purview of their expertise (Sapri *et al.*, 2016). This dearth of knowledge poses a considerable challenge, as it hinders informed decision-making and the implementation of sustainable practices. Consequently, mosques are left vulnerable to unsustainable resource consumption and suboptimal operational efficiency.

The situation is further exacerbated by the escalating construction of new mosques, resulting in larger facilities that demand maintenance and management (Bakri *et al.*, 2018). However, these endeavours are frequently constrained by limited resources, both in terms of financial capacity and available staffing. Baaki *et al.* (2016) assert that this limitation frequently leads to reliance on volunteer-based staff, a practice that is emblematic of the community's unwavering dedication. However, it introduces an element of variability into the equation that warrants consideration. One prominent manifestation of this variability arises from the dynamic nature of leadership positions within volunteer-based staff. These positions can undergo relatively frequent changes, often precipitated by personal commitments, career transitions, or other life events (Kamaruzzaman *et al.*, 2017).

Thus, the confluence of escalating mosque construction, resource limitations, and the dynamic nature of volunteer-based staffing, including leadership changes, presents a multifaceted challenge in the pursuit of sustainable facilities management within mosques. By addressing these challenges proactively, mosques can not only preserve their spiritual sanctity but also serve as beacons of sustainability, guiding their communities towards a more environmentally responsible and socially conscious future.

Besides, facilities significantly affect how well an organisation performs (Amaratunga, 2002; Kamaruzzaman *et al.*, 2017). Inadequate facilities lead to subpar performance, which impacts an organisation's whole business operations. According to Khalit (2011), the mosque's ability to operate successfully is constrained by insufficient facilities. As a result, it makes it more difficult for the modern mosque in Malaysia to act as if it were built during the Prophet Muhammad S. A. W. Also, insufficient facility supply may result in poor program planning for diverse target groups in the mosque (Khalit, 2011).

While this is happening, a mosque with poor service will undoubtedly make the congregation less likely to frequent the mosque (Mustari *et al.*, 2008; Mahazan, 2013). Thus, in order to ensure the long-term viability of mosque operations in today's changing climate, mosque administration should seek to boost congregation contentment while decreasing displeasure. Henceforth, this study aims to explore how Sustainable Facilities Management (SFM) can be applied in mosque management to increase the mosque's operational efficiency and effectiveness as a centre for Islam beyond its current use as a place of worship and, as a result, help it have a more significant impact on the community, starting from a theoretical perspective.

## Literature Review

### *Sustainable Facilities Management (SFM)*

Rapid temperature increases and harsh weather conditions that led to several natural disasters have demonstrated the need for swift action to preserve and safeguard the ecosystem. If it is not appropriately handled, possible environmental issues may have several detrimental effects, including the need for more costly environmental cleanup (Asbollah *et al.*, 2016). Therefore, sustainability is becoming even more crucial to mitigate the effect due to the pressing need to change how people think and behave. BIFM (2007) asserted that as one of the fastest-growing professions and sectors in the built environment, FM is responsible for contributing to spreading the sustainability agenda. Elmualim *et al.* (2010), Baaki *et al.* (2016), and Twumasi & Ameyaw (2020) emphasised that "Facilities managers play a big part in reducing the negative environmental effects of the physical environment and advancing the sustainability agenda across the three sustainability bottom lines.: economics, environmental, and social." Thus, the facilities managers must be committed, proficient, and equipped with the necessary knowledge to ensure that an organisation's comprehensive and holistic sustainable plan can be implemented (Okoro, 2023).

Besides, sustainability initiatives are critical not only in the management of the new buildings but also in the existing buildings, as the literature states that existing building stocks have outnumbered the new building constructions (Hasim *et al.*, 2021; Hauashdh *et al.*, 2022). According to estimates, the operational phase of existing buildings produced between 80 and 90 percent of the climate change repercussions. These events indirectly influenced the buildings' energy, water, and waste consumption. Indeed, the operational phase of the building life cycle indicates the most prolonged duration in the asset life cycle. To generate electricity and heat, Hasim *et al.* (2021) noted that buildings typically used roughly 45 percent of energy during this period. Facilities managers should possess extensive knowledge and a solid commitment to consider the embodied energy of structures carefully, particularly when pursuing sustainability in the management of existing buildings, where energy savings, productivity increases, reductions in the waste stream, water conservation, and other benefits of sustainable facility management in existing buildings greatly outweigh the potential benefits from sustainable new construction. Moreover, research has shown that sustainable building design and operation can also provide significant economic and social benefits in addition to environmental benefits (Johnlee *et al.*, 2020).

Sustainable facilities management practices lead to cost reductions from an economic perspective. According to a study by Alfalah & Zayed (2020), energy-efficient strategies, such as efficient lighting systems and HVAC optimisation, can result in significant decreases in energy consumption and operating costs. Energy-efficient lighting and appliances, for instance, cut down on utility costs for building owners and tenants (Collins & Junghans, (2015). Furthermore, Chan (2014) and Collins & Junghans (2015) added that buildings that employ sustainable facilities management practices have a greater resale value, making them more appealing to future tenants or buyers. In parallel, organisations can promote

both economic growth and environmental stewardship by adopting sustainability.

Additionally, sustainable facilities management practices can also lead to social benefits such as improved health and well-being of building occupants. Sustainable practices produce healthier and more comfortable indoor workplaces by enhancing air quality, temperature control, and natural lighting, which later improves occupant happiness, productivity, and general well-being (Alfalah & Zayed, 2020; Mondal & Sahoo, 2020; Hasim *et al.*, 2021). Hence, by lowering toxin exposure, providing enough ventilation, and upholding a clean and safe atmosphere, these procedures benefit the health and safety of building inhabitants and personnel.

In conclusion, employing sustainable facilities management techniques in buildings has several advantages. By lowering energy use, conserving water, minimising trash, and enhancing indoor air quality, it contributes to environmental protection. Additionally, it offers financial benefits like cost reductions, increased asset value, and long-term operational efficiency (Okoro, 2023). Additionally, employing sustainable facilities management techniques fosters community involvement, improves health and safety, and enhances occupant comfort. Henceforth, sustainability facility management must be implemented as buildings may contribute to a greener and healthier future for all.

### ***Sustainable Facilities Management (SFM) for Mosque***

Mosques are revered as sacred sites of worship and are to be treated with the utmost respect. Hence, implementing Sustainable Facilities Management (SFM) for mosques involves integrating sustainable practices into the management and operations of mosque facilities. Mosque facilities include a variety of structures and amenities used for both prayer and non-prayer activities. As a result, it is typically split into two distinct sections: interior and exterior

areas. Typically, interior spaces consist of a prayer room for men and women, a multipurpose room, and an office space. Meanwhile, the outdoor space is made up of parking spaces, landscaping, and restrooms (Sapri *et al.*, 2016; Bakri *et al.*, 2018). Each of these amenities contributes significantly to accomplishing the functions of mosques by meeting the users' needs and demands. Accordingly, the mosque must be functional following the Qur'an and the Prophet's Sunnah, be well-maintained, and function well (Bakri *et al.*, 2018).

The importance of implementing SFM in mosques lies in its potential to uphold the principles of Islamic stewardship (Khalifah) and environmental responsibility (Bakri *et al.*, 2018). Islam has encouraged Muslims to embrace the idea of sustainability from the outset. Mat Yamin (2021) asserts that one of the green deen (religion) principles proposed by Ibrahim Matin (2010) is to maintain the balance of the ecosystem. Henceforth, mosques are central to the Muslim community and can serve as role models for sustainable practices. By embracing SFM, mosques demonstrate a commitment to preserving the environment, conserving resources, and fostering a sense of responsibility towards the planet (Singapore Islamic Religious Council, 2005; Mat Yamin, 2021). From an economic standpoint, sustainable practices in mosques also contribute to cost savings, as they help reduce utility bills, maintenance expenses, and waste disposal costs (Awuzie & Isa, 2017; Kamaruzzaman *et al.*, 2017). Moreover, from a social standpoint, SFM implementation enhances the well-being of mosque attendees by providing a healthy and comfortable environment that aligns with Islamic teachings on cleanliness and preservation (Mondal & Sahoo, 2020; Hasim *et al.*, 2021). Consequently, by implementing SFM in mosques, multifunctional community one-stop centres that are accessible and respectful to their environment while upholding Islamic stewardship principles can be established.

However, to successfully implement SFM in mosques, mosque management needs to make strategic decisions based on the contribution

that facilities can make toward the success and objectives of the mosque (Muin *et al.*, 2016; Sapri *et al.*, 2016; Bakri *et al.*, 2018). The SFM approach should be aligned with mosque management and must support the business and processes according to the needs of the mosque. Therefore, first and foremost, it is critical to evaluate how the mosque is currently operating and using its resources. This evaluation provides a starting point for tracking progress and aids in identifying areas where improvements can be made (Støre-Valen & Buser, 2019). Indirectly, administrators of mosques can learn more about the precise areas that need care by analysing energy consumption, water usage, garbage generation, and interior air quality (Adriani *et al.*, 2019).

In conjunction, a sustainability plan should be prepared based on the assessment made (Støre-Valen & Buser, 2019). The goals, plans, and steps outlined in this plan will enable the mosque to operate its facilities sustainably (Awuzie *et al.*, 2015; Lok *et al.*, 2018). Thus, it ought to have clear objectives and an execution schedule. Additionally, proper waste management practices should be implemented to reduce the mosque's environmental impact. The implementation of sustainable facilities management practices in mosques should be aligned with their strategic objectives and specific needs to ensure that the facilities provided support the efficient operation of the mosque and contribute to its success (Okoro, 2023). So indirectly, the mosque can be a role model for the community in promoting sustainability awareness and enhancing the community's quality of life. Henceforth, these should be done by identifying how SFM can assist the mosque to be more efficient, functional and sustainable.

## Materials and Methods

As the study aims to explore how Sustainable Facilities Management (SFM) can be applied in mosque management to increase the mosque's operational efficiency and effectiveness as a centre for Islam beyond its current use as a place

of worship, data scanning based on primary keywords was deemed insufficient. Fink (2005), Piper (2013), and Paul *et al.* (2021) argue that the key to a successful independent literature review is a well-developed methodology and structure. It ought to be easy to understand the methodology employed, comprehensive in its coverage of the topic at hand, and repeatable by other researchers while enabling the discovery of the limitations, value, and perspective of the extant literature. Consequently, a thorough evaluation of the literature was done through scientometrics and content analysis with the assistance of NVivo 12 to find and analyse the information gathered for the study. The study is done through eight steps of a systematic literature review outlined by Okoli & Schabram (2010).

(i) The Aims

The aim of the study must be established, along with any associated goals, as the first stage. Thus, this study aimed to explore how sustainable facilities management (SFM) can be applied in mosque management to increase the mosque's operational efficiency and effectiveness in delivering its core and non-core business while adhering to the goal of being sustainable in the process.

(ii) Research Methodology

The study plunged into the systematic qualitative literature review approach through scientometrics to obtain the data. To ensure clear and consistent techniques are employed during the data collection process, a thorough protocol is sketched out and followed. Later, content analysis with the assistance of NVivo 12 is used to examine the data that was acquired.

(iii) Selection of Journal's Article

Journal articles are acquired by examining the electronic databases to which the institution, Universiti Teknologi Malaysia has subscribed. The databases used for the study are ScienceDirect, Emerald,

Scopus, and Web of Science. The database was chosen using the following keywords: Sustainable, Sustainable Facilities Management, Facilities Management, Mosque, and Green Mosque. Hence, the search round resulted in 22,446 related articles within the keywords.

(iv) Screening

Next, explicit data screening is conducted to evade any irrelevant articles. The first screening involves assigning the limitation of dates during the search, focusing on articles from 2012 to 2022 and only Open Access journal articles. The screening was done to include as much recent literature as feasible, given the growing importance of sustainability in facilities management, the futuristic nature of the topic, and the need to examine current issues to inform future research directions. Therefore, only studies published since 2012 were included in the bibliometric assessment. In conjunction, the inclusion of keywords is enhanced. The keywords for the second inclusion are "Built Environment," which resulted in 2,395 articles in the second round based on their emphasis on the built environment's operational, management, usage phases, and at least one of the sustainability factors, which are social, environmental, and economic was taken into account. Next, the second screening is done based on the types of documents, which only include the articles and conference papers and excludes the reviews and book chapters. The second screening resulted in 1,765 of the articles being taken into consideration. Next, the third screening was conducted to limit only the articles from journals and conference proceedings while excluding the articles from newspapers and websites, which resulted in 1,367 articles being included. This is done because articles from journals and conference proceedings play crucial roles in the research on sustainability (Okoro, 2023). Finally, the last screening

method involved the inclusion criteria based on the topics and titles related to the sustainability facilities management in the mosque, which resulted in only 47 related articles included in the study. This will ensure that the study incorporates more focused literature (Okoro, 2023).

(v) Critical Assessment

Then, 30 articles were selected for further examination based on their abstract and other inclusion criteria, which discussed the management of mosques. Additionally, the publications that did not address the

study’s focus on environmental, economic, or social pillars of sustainability and the usage, maintenance, or management of the existing facility were eliminated. Table 1 presents the summary of the search results of the study.

(vi) Data Extraction and Analysis

Relevant information from the journal articles is later extracted using content analysis and divided into several columns based on the research discussion. The columns are based on:

Table 1: Search Results

Process	Search Terms	Database	Number of Articles	Total of Article
Selection of Journal Article	Journal Articles with the keywords of “Sustainable AND Facilities AND Management.”	Science Direct	16,396	22,446
		SCOPUS	2,082	
		EMERALD	902	
		WEB OF SCIENCE	3,066	
Screening	Journal Articles with the keywords “Sustainable AND Facilities AND Management AND Built AND Environment.”  (Inclusion Criteria: Open Access Journal, From 2012-2022	Science Direct	6	47
		SCOPUS	13	
		EMERALD	17	
		WEB OF SCIENCE	11	
Critical Assessment	Journal Articles with the keywords “Sustainable AND Facilities AND Management AND Built AND Environment AND Mosque.”  (Inclusion Criteria: Open Access Journal, From 2012-2022	Science Direct	2	30
		SCOPUS	4	
		EMERALD	23	
		WEB OF SCIENCE	1	

- The article's focus: The degree to which it aimed to concentrate on knowledge production—whether it was just about the construction, processes during usage and operation, managerial aspects, or a combination of these.
- Sustainability from an environmental, social, and economic perspective: The three pillars of Brundtland's definition of sustainability are environmental, social, and economic sustainability. Some articles only address one aspect of sustainability, while others address half or all of them.
- Property type (office/housing/mosque/other): It is acknowledged that the SFM context is essential and that relevance changes based on usage, ownership, and other features. As a result, best practices and solutions may vary between properties and depend on the specifics of each property.
- The Methodology: Understanding what information has been created and what may still be lacking requires consideration of the study technique.
- Data sample: Variable data samples are the foundation of the articles. What was their primary goal?
- Applied theories: Since the FM field, particularly SFM, is still developing, it is crucial to recognise the linked areas of theory to comprehend the foundation now in place and spot any gaps.
- Fundamental discoveries: What have SFM researchers discovered so far?

(vii) Integration of Knowledge

This stage entails analysing the data gathered. The data obtained throughout the study are analysed and examined using content analysis with the assistance of NVivo 12 software.

(viii) Review's Composition

The results are then interpreted, combined, formulated, and reported to answer the study's objective.

### Results and Discussion

The integration of sustainable facilities management and mosque management should be a strategic decision made with insight into the contribution that well-managed facilities can make toward the overall organisational success of the mosque. From the analysis, it is discovered that three sustainable pillars of sustainable facilities management need to be implemented in support of the mosque's critical objectives, namely social, environmental, and economic pillars.

#### *Initiative for Environmental Sustainability*

In general, the analysis discovered eight environmental pillar initiatives. It includes systems for managing energy, waste, emissions, water, policy, green building, reporting, and buildings. Table 2 depicts the lists of the initiatives and their descriptions, while Figure 2 shows the percentage of literature that discusses the initiatives.

Prioritising environmental sustainability marks a pivotal step in the convergence of sustainable facility management and mosque management, forging a path toward a more conscientious and environmentally responsible future (Azmi & Kandar, 2019; Aziz *et al.*, 2021). This commitment entails the identification and implementation of eight significant environmental pillars, each representing a distinct avenue through which mosques can contribute to sustainability and foster a more environmentally conscious community. Systems for managing energy, waste, emissions, water, policy, green building, reporting, and buildings are all included in these programs. According to Rasli *et al.* (2021) and Azmi *et al.* (2023), energy management in the context of mosques involves



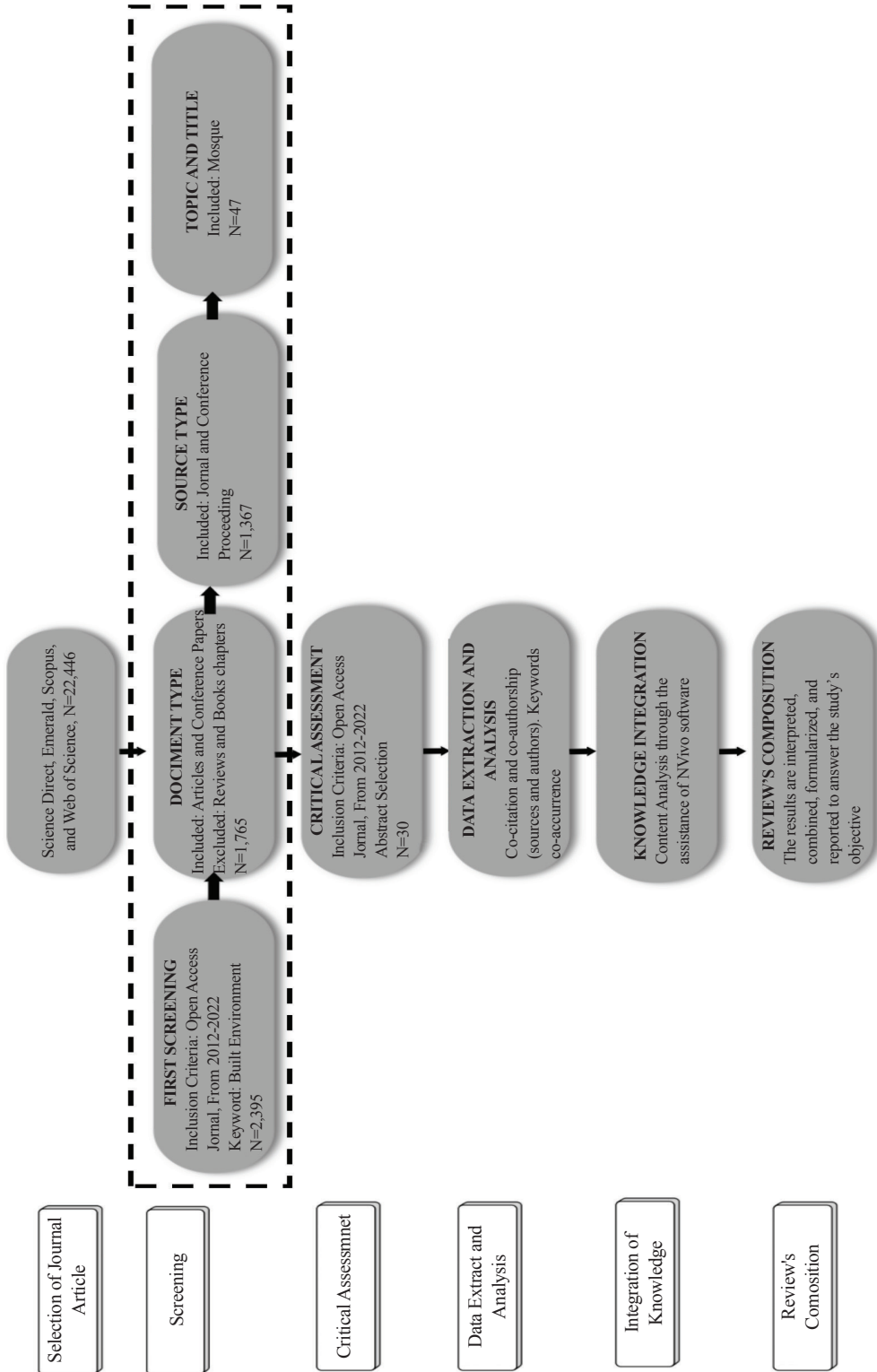


Figure 1 : Methodology of the study

a multifaceted approach aimed at optimising energy usage and fostering greater efficiency while embracing environmental responsibility. Mosques can take several measures to enhance their energy management practices. Firstly, they can adopt energy-efficient technologies and practices, including the installation of energy-efficient lighting, and HVAC systems, and the implementation of smart technologies like occupancy sensors and programmable thermostats (Asbollah *et al.*, 2016; Tjenggoro & Prasetyo, 2018; Azmi *et al.*, 2023). These measures reduce energy wastage and enhance the overall energy performance of the mosque.

In addition, emission control in the context of the mosque involves a comprehensive approach to reducing harmful pollutants and greenhouse gas emissions. Mosques can achieve this through measures such as transitioning to cleaner energy sources, adopting emission control technologies, promoting sustainable transportation options, and implementing air quality monitoring systems (Azmi & Kandar, 2019; Ahriz *et al.*, 2021; Rasli *et al.*, 2021). In addition, educating congregants about the environmental impact of emissions and developing policies for emission reduction are also some of the efforts that the mosque management committee can take to reduce greenhouse gas emissions. By proactively implementing these measures, mosques not

only contribute to improved air quality and reduced climate change impacts but also serve as influential role models for their communities, inspiring a collective effort towards a greener and more sustainable future.

Meanwhile, Tjenggoro & Prasetyo (2018) suggest that waste control at the mosques should be conducted through a comprehensive approach that includes waste separation and recycling programs, composting of organic waste, and waste reduction initiatives. For instance, mosques can implement recycling bins and collection systems for various recyclable materials, which can assist in reducing landfill waste and conserving resources (Salleh *et al.*, 2021). Mosques can also minimise trash output by promoting awareness through programs at the mosque, such as banning single-use plastics and encouraging reusable alternatives among the congregation. Indirectly, these actions would further sustainability initiatives while also enhancing the mosques’ hygienic conditions and cleanliness. However, a policy that may be applied to help the process should be employed to support these efforts.

According to Bullock and Navis (2019), policy implementation involves the crucial process of translating an organisation’s goals and objectives into concrete actions and measurable outcomes. To effectively embark on this journey

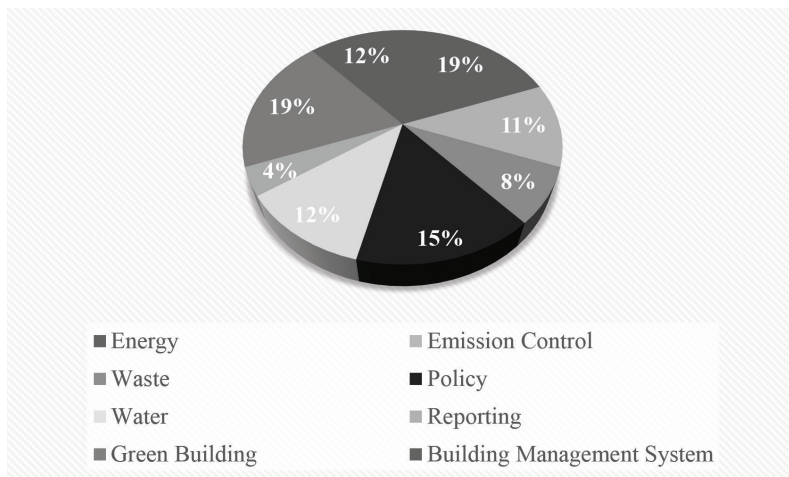


Figure 2: The environmental sustainability initiatives literature’s discussions

Table 2: The Environmental Sustainability Initiatives Descriptions

Environmental Initiatives	Description	Cited In
Energy	Implemented energy-saving measures including installing energy-efficient equipment and zoning systems (LED lights, timers, sensors), Incorporating passive design strategies, solar panel	Asbollah <i>et al.</i> , 2016; Tjengggoro & Prasetyo, 2018; Azmi & Kandar, 2019; Rasli <i>et al.</i> , 2021; Azmi <i>et al.</i> , 2023
Emission Control	Carbon measurement to lessen carbon emissions	Azmi & Kandar, 2019; Ahriz <i>et al.</i> , 2021; Rasli <i>et al.</i> , 2021
Waste	Schemes for reducing waste separation and recycling, such as establishing a volunteer program to monitor recycling using a task roaster, gathering rainwater for irrigation of plants, among other uses, and conducting a “gotong-royong” or mutual assistance program	Tjengggoro & Prasetyo, 2018; Salleh <i>et al.</i> , 2021
Policy	Incorporating sustainable practices into new projects or existing structures (i.e., environmental plan)	Suprati <i>et al.</i> , 2018; Bakri <i>et al.</i> , 2018; Salleh <i>et al.</i> , 2021; Yip & To, 2021; Mewomo <i>et al.</i> , 2022
Water	Recycling and conservation (using rainwater harvesting and greywater adoption)	Tjengggoro & Prasetyo, 2018; Isik & Hasan, 2021
Reporting	Providing information on environmental factors, including energy, water use, and waste (i.e., provides to mosque committees and congregations)	Tjengggoro & Prasetyo, 2018; Salleh <i>et al.</i> , 2021
Green Building	Adoption of a rating system for green buildings (i.e., Green Building Index (GBI)-Malaysia, LEED -USA, BREEAM- UK, GreenMark- Singapore)	Tjengggoro & Prasetyo, 2018; Azmi & Kandar, 2019; Ismail <i>et al.</i> , 2019; Isik & Hasan, 2021
Building Management System	Create a system to regulate and track environmental requirements (i.e., the energy needed for the air conditioner)	Lim, 2015; Buser <i>et al.</i> , 2018; Salleh <i>et al.</i> , 2019; Aziz <i>et al.</i> , 2021

towards sustainability, mosque management should commence with a comprehensive stakeholder analysis (Yip & To, 2021). This analysis serves to identify the diverse roles and responsibilities of key stakeholders within the mosque community, including the mosque committee, congregants, suppliers, and contractors (Salleh *et al.*, 2021).

After conducting a thorough stakeholder analysis, the mosque management can leverage the insights gained to devise a comprehensive strategic plan. This plan will serve as a blueprint that outlines the policies, strategies, and actionable steps required to implement

sustainable initiatives effectively (Suprati *et al.*, 2018; Mewomo *et al.*, 2022). These initiatives may encompass integrating environmentally responsible practices into both new construction projects and existing mosque structures, ensuring a holistic and structured approach to sustainability implementation. In conclusion, the strategic alignment of stakeholders and the formulation of comprehensive policies are essential steps in realising sustainable initiatives within mosques. By incorporating sustainability into their policies, mosques can play a significant role in environmental conservation, such as water conservation.

Sustainable water management practices can be integrated into these policies, including efficient irrigation systems, rainwater harvesting, and water-efficient fixtures, ultimately contributing to the broader goal of environmental responsibility and resource conservation within the mosque community. For instance, mosques can replace older, less efficient plumbing fixtures with low-flow toilets, faucets, and showerheads. Additionally, educating congregants about responsible water use, such as fixing leaks promptly and turning off taps when not in use, contributes to conservation efforts. Moreover, the significance of these practices is substantiated by research conducted by Tjenggoro & Prasetyo (2018) and Isik & Hasan (2021), further underscoring their effectiveness in promoting sustainable water management within the mosque context. Furthermore, these initiatives complement the broader goal of reporting on environmental factors, including energy, water use, and waste.

By providing information on these critical aspects, mosques can enhance transparency and accountability within their community. Reporting not only informs mosque committees and congregations about their environmental impact but also inspires continuous improvement and a deeper commitment to sustainability (Tjenggoro & Prasetyo, 2018; Salleh *et al.*, 2021). In this holistic approach, mosques serve as exemplars of responsible resource management, not only in the context of water but also in various facets of environmental stewardship, driving positive change within their communities.

Besides, this can be enhanced in the form of green building accreditations and building management systems. Green building accreditation through green rating systems such as the Green Building Index (GBI) in Malaysia, LEED in the USA, BREEAM in the UK, and Green Mark in Singapore showcase the standard measures that the mosques commit through its achievement of multiple criteria.

According to Isik & Hasan (2021), green rating systems are beneficial for the mosque as they assist in fulfilling the functional needs

of the buildings and respecting the ecological needs of the planet. For instance, embracing green building practices in mosque construction involves meticulous planning, design, and operation with a focus on minimising environmental impact. This encompasses energy efficiency through well-insulated structures, energy-efficient lighting, and renewable energy sources such as solar panels (Tjenggoro & Prasetyo, 2018; Ismail *et al.*, 2019; Azmi & Kandar, 2019; Isik & Hasan, 2021).

Complementing these eco-conscious construction practices, building management systems (BMS) provide sophisticated solutions for efficient mosque operation (Lim, 2015; Buser *et al.*, 2018; Aziz *et al.*, 2021). BMS technology facilitates energy management by controlling heating, ventilation, and lighting based on occupancy and scheduling, thus minimising energy waste. While the implementation of green building practices and BMS in mosques may present initial challenges, such as the need for specialised expertise and financial resources, the long-term benefits are compelling.

Therefore, mosques can significantly reduce operational costs through energy and water savings while providing a more comfortable indoor environment for the users. This all-encompassing strategy shows mosques' dedication to environmental stewardship and serves as a role model for the neighbourhood, encouraging a greener and more sustainable future.

### ***Initiative for Economic Sustainability***

In general, the analysis discovered four economic pillar initiatives: Adopting a life cycle costing approach, generating funding, added value, and cost reduction.

Integrating sustainable facilities management into mosque management has various advantages in terms of economic sustainability. The life cycle costing technique, which takes into account the costs of a facility over its full existence, including building, operation, and maintenance, is one strategy that supports economic sustainability. For

instance, life cycle costing encourages mosques to make informed decisions about resource allocation during the design and construction phases. By prioritising energy-efficient systems and environmentally friendly materials from the outset, mosques can minimise long-term operational and maintenance costs (Mewomo *et al.*, 2022). Besides, mosques can choose energy-efficient systems such as lighting, heating, ventilation, and air conditioning (HVAC), environmentally friendly materials during the procurement stages, and maintenance procedures that result in long-term cost savings by using life cycle costing. By considering the full spectrum of costs associated with a facility's lifecycle, mosques can make informed decisions that lead to long-term cost savings.

Furthermore, in the pursuit of economic sustainability within mosque management, an essential component is the generation of funds (Pitchay *et al.*, 2018; Aldeen *et al.*, 2022; Mewomo *et al.*, 2022). According to the literature, firstly, the mosques can explore the possibility of applying for grants from governmental, non-profit, or private organisations that support sustainable initiatives. These grants can provide crucial financial assistance for the adoption of sustainable practices and technological advancements. Secondly, forging collaborations with businesses or organisations that share similar interests in sustainability can be mutually beneficial. Such partnerships may involve

financial contributions, in-kind donations, or joint sustainability projects that leverage the resources and expertise of both parties.

On top of that, engaging the congregation in fundraising efforts represents a powerful means of raising funds for sustainable initiatives. Mosques can organise campaigns, events, infaq, or donation drives that inspire congregants to contribute to the mosque's sustainability goals (Hossain *et al.*, 2019; Salleh *et al.*, 2021; Aldeen *et al.*, 2022). These funds not only help cover initial costs but also create a sense of collective ownership and commitment to environmental responsibility within the mosque community. In essence, fund generation diversifies the financial resources available to mosques, enabling them to implement sustainable practices effectively and contribute to economic sustainability while aligning with their broader environmental objectives.

Moreover, mosques can gain value by incorporating sustainable facilities management. By embracing sustainable management practices, a mosque not only demonstrates its dedication to environmental responsibility but also sets a noteworthy example for the entire community, particularly when considering its adaptability to eco-friendly measures (Ismail *et al.*, 2018). These elevated standards often translate into tangible benefits for the mosque, including increased local community support,

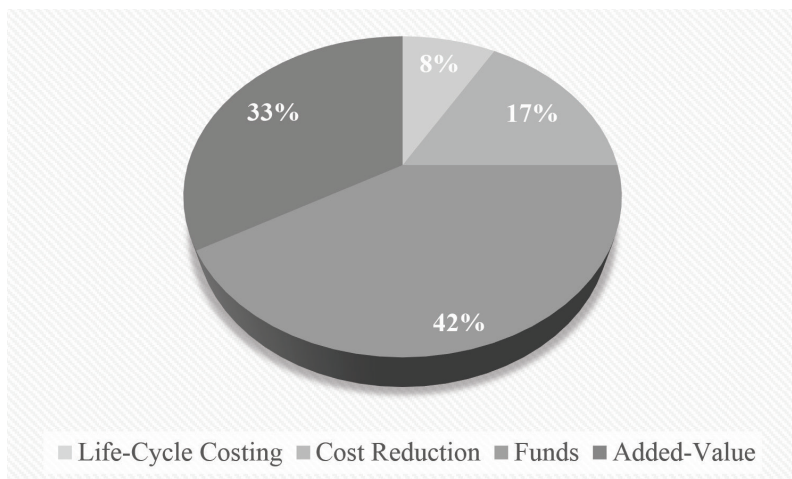


Figure 3: The Economic Sustainability Initiatives literature's discussions

Table 3: The Economic Sustainability Initiatives Descriptions

Economic Initiatives	Description	Cited In
Life Cycle Costing	Thoroughly done procurement process through life cycle costings.	Mewomo <i>et al.</i> , 2022
Funds	Congregation engagement through attractive activities with the external organisation can assist in raising financial funds and donations, <i>Zakat</i> .	Pitchay <i>et al.</i> , 2018; Hossain <i>et al.</i> , 2019; Salleh <i>et al.</i> , 2021; Aldeen <i>et al.</i> , 2022; Mewomo <i>et al.</i> , 2022
Added-Value	Identify and develop new markets and sales possibilities. Develop initiatives like food banks for those in need. Retrofit to achieve green parameters.	Ismail <i>et al.</i> , 2018; Penalver <i>et al.</i> , 2022
Cost Reduction	Switching to energy-saving choices for lighting systems, such as LED lights and solar systems, will assist in reducing costs for mosque management. Recruiting local contractors and workers to implement projects and use local products and materials in the mosque's everyday functions.	Tjenggoro & Prasetyo, 2018; Salleh <i>et al.</i> , 2021, Mewomo <i>et al.</i> , 2022

donations, and opportunities to work with other organisations. Besides, initiatives like food banks enhance the value of the mosque by attracting those in need and those who want to contribute (Penalver *et al.*, 2022). Indirectly, there is the possibility of a rise in the number of attendees to the mosque.

Meanwhile, long-term cost savings stand as a compelling advantage of adopting sustainable facilities management practices within mosques. Through strategic investments in sustainability, mosques can significantly reduce their utility costs, contributing to financial stability over time (Tjenggoro & Prasetyo, 2018; Salleh *et al.*, 2021). For instance, transitioning to energy-efficient measures, such as installing LED lighting and upgrading heating and cooling systems, can lead to substantial reductions in energy consumption, subsequently lowering electricity bills.

Additionally, the integration of renewable energy sources, like solar panels, can further offset energy expenses and reduce reliance on conventional, often costlier, energy sources. Furthermore, cost savings extend to waste management, where mosques can implement efficient recycling programs and waste minimisation techniques, thus curbing the costs

associated with garbage disposal and landfill fees. A proactive approach to maintenance, guided by regular inspections and preventive measures, not only ensures the longevity of mosque facilities but also minimises repair and replacement costs, which can be significant in the absence of effective maintenance strategies (Mewomo *et al.*, 2022). Palma *et al.* (2010) claimed that preventive maintenance would ensure that a system continues to fulfil its intended function. It is relevant to maintenance planning, which necessitates a long-term strategy for carrying out maintenance tasks at regular intervals (Basri *et al.*, 2017). In sum, sustainable facilities management not only aligns with environmental principles but also provides mosques with substantial long-term economic benefits by optimising resource use and reducing operational expenditures.

The adoption of a life cycle costing strategy, raising money via various channels, creating value through encouraging community engagement, and realising cost savings through resource and energy efficiency are all ways to achieve economic sustainability in mosque administration. Mosques may ensure their operations are financially viable in the long run, encourage environmental stewardship, and have

a greater overall impact on the community by emphasising economic sustainability.

**Initiatives for Social Sustainability**

Six general initiative topics of social sustainability were identified in the literature. They are participation and involvement, enhancing human capital, public access, health and safety, occupiers’ satisfaction, and collaboration. Table 3 depicts the social initiatives that should be implemented in SFM.

Social sustainability, which prioritises increasing the well-being of the community and involved stakeholders, is a crucial component of integrating sustainable facilities management into mosque management. Among the vital elements of social sustainability within mosque management are involvement and participation, as well as the improvement of human capital. The first aspect, involvement, and participation, centres on engaging the mosque community in decision-making processes and encouraging their active participation in the mosque’s activities and initiatives (Pitchay et al., 2018). By involving congregants in shaping the mosque’s direction and decision-making, a sense of ownership and belonging is cultivated among the users (Haigh et al., 2016; El-Mallah et al., 2019; Mewomo et al., 2022). This inclusivity not only fosters a deeper connection between

community members and the mosque but also ensures that the mosque’s activities align with the needs and aspirations of its congregation.

The second crucial endeavour focuses on improving human capital within the mosque community. This strategy involves investing in the abilities, expertise, and development of individuals through empowerment, education, and training initiatives (Shaikh et al., 2017; El-Mallah et al., 2019). By offering educational programs and skill-building opportunities, mosques empower community members to grow personally and professionally. These efforts can include workshops, seminars, and mentorship programs that enhance the knowledge and capabilities of mosque-goers (El-Mallah et al., 2019; Moghaieb, 2019; Radebe & Ozumba, 2021).

Empowering individuals within the mosque community not only benefits their personal development but also strengthens the community as a whole, contributing to a sense of self-reliance and resilience (Radebe & Ozumba, 2021; Laallam et al., 2020). In essence, involvement and participation, along with human capital development, underscore the holistic approach to social sustainability within mosques. These strategies promote community engagement, foster a sense of belonging, and empower individuals to reach

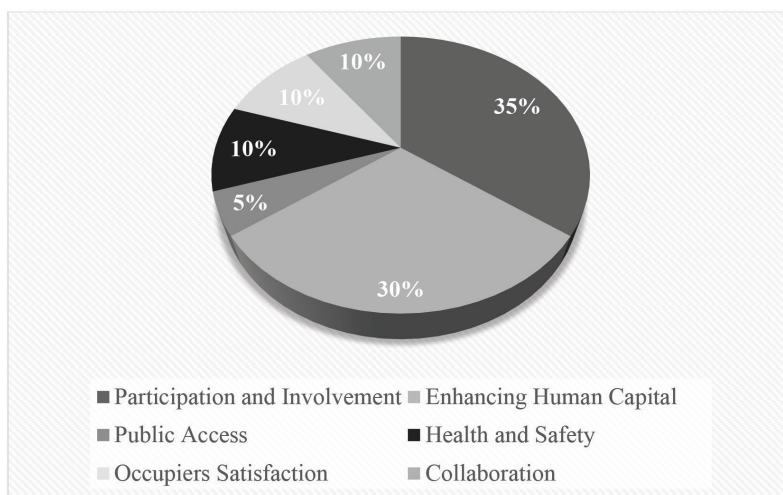


Figure 4: The Social Sustainability Initiatives literature’s discussions

Table 4: The Social Sustainability Initiatives Descriptions

Social Initiatives	Description	Cited in
Participation and Involvement	Promote the participation of many stakeholders (i.e., the neighbourhood community and the mosque committee).	Haigh <i>et al.</i> , 2016; Pitchay <i>et al.</i> , 2018; Buser <i>et al.</i> , 2018; Suprati <i>et al.</i> , 2018; El-Mallah <i>et al.</i> , 2019; Mewomo <i>et al.</i> , 2022
Enhancing Human Capital	Knowledge improvement initiatives are implemented by creating original websites, promotional efforts (such as posters on various subjects), online platforms, training and classes, and establishing training facilities based on the waqf to promote self-employment	Shaikh <i>et al.</i> , 2017; El-Mallah <i>et al.</i> , 2019; Moghaieb, 2019; Radebe & Ozumba, 2021; Laallam <i>et al.</i> , 2020
Public Access	Accessibility for those with disabilities, flexible operating hours, and simple facility access.	Jaffar <i>et al.</i> , 2020
Health and Safety	Users' and visitors' health and safety issues. Monitoring safety has advantages for productivity.	Tjenggoro & Prasetyo, 2018; Radebe & Ozumba, 2021
Occupiers' satisfaction	Surveys for participants, including the mosque's committee congregation.	Calis <i>et al.</i> , 2015; Pitchay <i>et al.</i> , 2018
Collaboration	Collaboration with the freelance speaker to educate the congregation on sustainable and green Islam	Ismail <i>et al.</i> , 2018; Rahman & Jalil, 2021

their full potential. By investing in the human capital of its congregation and involving them in decision-making processes, a mosque can create a vibrant and resilient community that is not only spiritually enriched but also socially and economically empowered.

Besides that, promoting inclusivity and ensuring open access to a mosque's facilities and services are pivotal elements of a robust social sustainability strategy (Jaffar *et al.*, 2020). Such an approach underscores the mosque's commitment to welcoming individuals from diverse backgrounds and socioeconomic levels, fostering a sense of unity and community cohesion (Jaffar *et al.*, 2020). By offering flexible operating hours that extend beyond prayer times, mosques can transform into vibrant community hubs, accommodating a wide range of activities and gatherings. This flexibility not only enhances accessibility but also encourages more frequent use of mosque facilities, reinforcing their role as community centres.

Furthermore, social sustainability encompasses the paramount concern for health and safety. Mosques should prioritise the creation of a secure and healthy atmosphere on their premises. This involves ensuring not only physical safety measures such as well-maintained infrastructure and adequate lighting but also comprehensive emergency facilities and procedures (Tjenggoro & Prasetyo, 2018; Radebe & Ozumba, 2021). By ensuring that the mosque is equipped to respond to emergencies swiftly and effectively, congregants and community members feel a heightened sense of security, fostering trust and well-being within the community.

In essence, a socially sustainable mosque goes beyond its role as a place of worship, becoming a vibrant and inclusive space that serves the diverse needs of the community. It extends its reach by accommodating various activities and offering a safe and welcoming environment for all, aligning with the core principles of social responsibility and community enrichment.



Occupants' happiness is a crucial indicator of social sustainability because it shows how well the mosque is doing at meeting the demands and expectations of those who use its amenities and services (Calis *et al.*, 2015; Pitchay *et al.*, 2018). This entails developing inviting prayer places, providing sufficient amenities, and preserving a warm environment that improves the entire experience for the users.

In addition, collaboration stands as a cornerstone of social sustainability within mosque management, fostering meaningful partnerships with a diverse array of organisations, community groups, and stakeholders. This cooperative approach not only amplifies the mosque's impact but also promotes shared resources and the pooling of expertise (Ismail *et al.*, 2018). By engaging in collaborative initiatives, mosques can expand their reach and influence within the community, working collectively to address more substantial societal issues. Collaborations can take various forms, including partnering with local non-profit organisations, educational institutions, or healthcare providers, each contributing their unique strengths to benefit the community.

Furthermore, collaborations often encourage a sense of shared responsibility, fostering a collaborative spirit that extends beyond the immediate mosque community (Ismail *et al.*, 2018; Rahman & Jalil, 2021). One noteworthy example of collaboration is engaging freelance speakers who bring specialised knowledge and perspectives to mosque events and educational programs. According to Rahman & Jalil (2021), these speakers can facilitate dialogue on various social and cultural topics, and they can cultivate public awareness of environmental conservation by linking the field of environmental conservation with religious knowledge. Moreover, they serve as bridges between the mosque and broader society, fostering understanding and cooperation. In summary, collaboration is a linchpin of social sustainability, enabling mosques to build bridges, pool resources, and create a stronger sense of community involvement. Through collaborative

efforts, mosques can become catalysts for positive change, addressing societal challenges and forging connections that transcend religious and cultural boundaries, ultimately fostering a more inclusive and harmonious society.

Mosques can develop into inclusive, empowering, and supportive community centres by focusing on these six social sustainability initiatives: participation and involvement, improving human capital, public access, health and safety, occupant satisfaction, and collaboration. This builds a sense of belonging, strengthens social ties, and advances people's general well-being both inside the mosque community and in society at large.

## Conclusion

In conclusion, the integration of sustainable facilities management in mosque management is crucial for addressing the multiple pillars of sustainability. Initiatives for environmental sustainability, such as energy management, waste reduction, emissions control, water conservation, and green building techniques, encourage responsible resource use and lessen the negative effects on the environment. The long-term financial viability of mosque operations is ensured by economic sustainability factors such as life cycle costing, funding creation, value addition, and cost reduction. Initiatives for social sustainability that prioritise community well-being, inclusivity, and empowerment include participation and involvement, human capital enhancement, public access, health and safety, occupier satisfaction, and collaboration. Mosques can become model places of worship that balance environmental stewardship, economic viability, and social responsibility by embracing all of the sustainability pillars. Such coordinated efforts establish a sustainable and thriving mosque ecosystem for future generations by having a good long-term effect on the environment, the neighbourhood, and the congregations' general well-being and finally assist in the effective and efficient operation of the mosques. Exploring the obstacles to adopting the initiative for environmental, economic,

and social sustainability in the integration of sustainable facilities management and mosque management is one of the prospective research topics that is proposed to be investigated in the future.

### Acknowledgements

The funding for this article is made possible through UTM Encouragement Research (UTMER) grant obtained from Universiti Teknologi Malaysia [Q.J130000.3852.20J03]

### Conflict of Interest

All authors declared that they have no conflicts of interest.

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