Conceptual Framework for Sustainable Facility Management in Emerging Urban Economies

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Abstract- Sustainable facility management (FM) has emerged as a critical enabler for addressing the unique challenges of urbanization in emerging economies, where rapid population growth, infrastructure deficits, and resource constraints converge. This proposes a conceptual framework for sustainable facility management tailored to the realities of emerging urban economies, integrating economic viability, environmental stewardship, and social responsibility. The framework builds on the principles of the triple bottom line, lifecycle management, and resilience theory, positioning FM as a strategic function that extends beyond operational efficiency to encompass long-term urban sustainability. Key drivers shaping sustainable FM include economic imperatives such as cost efficiency and value creation; environmental demands such as energy optimization, carbon reduction, and resource circularity; social considerations including occupant well-being, inclusivity, and community engagement; and technological enablers such as smart systems, digital twins, and predictive analytics. The framework outlines six core components: strategic alignment with urban development policies; resource efficiency across energy, water, and materials; lifecycle-based asset management; technology integration for real-time monitoring and optimization; stakeholder engagement in co-creating sustainable services; and governance mechanisms aligned with global and local sustainability standards. Emerging urban economies face barriers such as financial constraints, limited technical expertise, and weak institutional enforcement; however, opportunities exist through green financing, public–private partnerships, technological leapfrogging, and community-driven innovation. The proposed model conceptualizes sustainable FM as a dynamic process involving inputs (resources, policies, stakeholder priorities), processes (planning, operations, monitoring), outputs (efficient and inclusive facilities), and outcomes (resilience, economic savings, enhanced quality of life). By embedding sustainability into FM practices, the framework provides a pathway for governments, organizations, and urban managers to advance resilient, affordable, and inclusive infrastructure systems. It highlights the role of facility management as a catalyst for sustainable urban transformation in emerging economies.

Index Terms- Conceptual Framework, Sustainable Facility Management, Emerging Urban Economies, Resource Efficiency, Energy Management, Cost Optimization

I. INTRODUCTION

Facility management (FM) has traditionally been understood as the integration of multidisciplinary activities aimed at ensuring the functionality, comfort, safety, and efficiency of the built environment by managing people, processes, technology, and physical assets (Lawal and Afolabi; 2015; Nwokediegwu *et al.*, 2019). Within urban development, FM plays a critical role as cities expand and demand for reliable infrastructure, energy, and public services increases. Unlike conventional maintenance, FM is strategic in scope: it encompasses the entire lifecycle of facilities, from design and construction through operation, adaptation, and eventual decommissioning (Lawal, 2015; Iyabode, 2015). In this sense, FM is not only a technical service but also an enabler of sustainable urban systems.

In contemporary urban development, FM has become a central determinant of performance and resilience. The operation of buildings, transportation hubs, healthcare facilities, and public utilities represents a significant proportion of a city's environmental footprint (Otokiti, 2012; SHARMA *et al*., 2019). Globally, buildings alone account for nearly 40% of energy-related carbon dioxide emissions, underscoring the urgent need to rethink how facilities are managed. Effective FM therefore extends beyond operational efficiency, contributing directly to broader sustainability objectives such as reducing greenhouse gas emissions, optimizing resource consumption, and improving occupant well-being (Akinbola and Otokiti, 2012; Lawal *et al*., 2014).

The urgency of advancing sustainable FM practices is particularly evident in emerging urban economies. These economies—spanning regions such as Sub-Saharan Africa, South Asia, and parts of Latin America—are experiencing unprecedented demographic and spatial transformations. According to United Nations projections, nearly 90% of global urban population growth by 2050 will occur in Asia and Africa (Lawal *et al*., 2014; Otokiti, 2018). This rapid urbanization is creating a surge in demand for housing, transport systems, healthcare services, and commercial facilities, often outpacing the ability of governments and private actors to deliver reliable infrastructure (Amos *et al*., 2014; Otokiti, 2017).

Urban growth in emerging economies is characterized by resource scarcity, fragmented planning, and infrastructural deficits. Facilities in such contexts often operate under unreliable power grids, limited water supply, and inadequate waste management systems (Ajonbadi *et al*., 2014; Otokiti and Akorede, 2018). The pressure is compounded by informal settlements, where infrastructure and services are minimal yet populations are dense. This dual challenge of growing demand and constrained resources amplifies the importance of FM, which must ensure that limited assets are optimized to deliver maximum service quality while minimizing environmental degradation. Furthermore, emerging urban economies frequently encounter institutional and financial barriers that hinder adoption of advanced sustainability measures, necessitating context-specific frameworks that balance ambition with feasibility (Kong *et al*., 2016; Gertler, 2017).

Given these dynamics, the rationale for a sustainable FM framework in emerging urban economies is both compelling and urgent. First, resource efficiency is paramount. Facilities in energy- and water-constrained cities must adopt practices that reduce consumption, integrate renewable energy, and promote circular resource use such as recycling and waste-to-energy initiatives. Sustainable FM thus provides the operational mechanisms to translate sustainability goals into measurable outcomes across facility lifecycles (Nielsen *et al*., 2016; Boyle, 2016).

Second, resilience has become a defining feature of contemporary FM. Climate change, environmental shocks, and socio-economic volatility expose facilities in emerging cities to heightened risks. Hospitals, schools, transport hubs, and commercial buildings must not only operate efficiently but also withstand disruptions such as flooding, heat stress, or supply chain interruptions. A sustainable FM framework embeds resilience by emphasizing risk assessment, adaptive maintenance strategies, and robust asset management systems (Alexander *et al*., 2016; Wang *et al*., 2017).

Third, affordability remains a central constraint in emerging urban economies. Sustainable practices must be accessible, cost-effective, and scalable. Unlike high-income regions where advanced green technologies may be financially viable, many cities in emerging economies require FM solutions that deliver environmental and social value without prohibitive upfront costs (Gelband *et al*., 2016; Busch *et al*., 2018). Sustainable FM frameworks, therefore, need to leverage innovations such as low-cost sensors, community-based monitoring, and modular design, while also aligning with financing mechanisms such as public–private partnerships and international climate funds.

Contextualizing FM within the landscape of urban development highlights its strategic role in shaping sustainable cities. As emerging economies grapple with population growth, infrastructure deficits, and environmental pressures, FM becomes a crucial mechanism for operationalizing sustainability. A framework that bridges efficiency, resilience, and affordability offers a pathway to ensure that facilities not only support immediate service demands but also contribute to long-term sustainable urban transformation.

II. METHODOLOGY

The methodology followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach to ensure a transparent and replicable review of literature that informed the conceptual framework for sustainable facility management in emerging urban economies. The review began with a comprehensive search of electronic databases including Scopus, Web of Science, ScienceDirect, SpringerLink, and Google Scholar. Keywords and Boolean operators such as "sustainable facility management," "urban economies," "emerging cities," "infrastructure sustainability," and "built environment management" were combined to capture a wide scope of relevant studies published between 2000 and 2025. Additional gray literature from institutional reports, policy briefs, and international organizations such as UN-Habitat and the World Bank was also considered to provide contextual grounding.

The search generated an initial pool of records which were screened for relevance by examining titles and abstracts. Duplicate records were removed, and remaining articles underwent full-text review against predetermined eligibility criteria. Studies were included if they discussed sustainability-oriented practices, frameworks, or models applicable to facility management within emerging or rapidly urbanizing economies. Articles focusing exclusively on developed contexts without transferability to emerging regions were excluded, as were papers lacking substantive methodological or conceptual contributions.

Data extraction captured information on study context, theoretical basis, sustainability dimensions considered, methodological approach, and relevance to urban facility management. Quality appraisal was conducted using adapted checklists emphasizing clarity of conceptual contribution, robustness of methodology, and applicability to emerging urban environments. The process ensured that only studies with substantial relevance and rigor informed the development of the framework.

The synthesis process followed a narrative and thematic strategy. Extracted data were coded and clustered into themes reflecting economic, environmental, social, technological, and governance dimensions of sustainability in facility management. Cross-comparison of studies enabled the identification of converging ideas, contextual challenges, and innovative approaches specific to emerging economies. The iterative synthesis process resulted in a consolidated evidence base that informed the development of the conceptual framework, emphasizing the interplay between urban infrastructure, resource efficiency, community engagement, policy integration, and institutional capacity.

2.1 Theoretical Foundations

The pursuit of sustainable facility management in emerging urban economies is anchored in diverse theoretical foundations that integrate principles from sustainability science, facility management theory, and contemporary urban development models. These frameworks collectively provide the conceptual and analytical basis for aligning built environment practices with long-term ecological, social, and economic objectives. By examining sustainability principles through the triple bottom line, exploring facility management theory in terms of lifecycle management, asset optimization, and user-centricity, and situating these within the broader discourses of smart cities, circular economy, and resilience, a holistic perspective emerges (Anvari and Turkay, 2017; Islam *et al*., 2018). This synthesis not only advances theoretical understanding but also equips policymakers and practitioners with actionable guidance for addressing the challenges of rapid urbanization.

At the heart of sustainability discourse lies the triple bottom line (TBL) framework, which expands traditional economic metrics by incorporating environmental and social dimensions. From an economic perspective, sustainable facility management involves cost optimization across the lifecycle of infrastructure assets while ensuring long-term value creation for stakeholders. Instead of prioritizing short-term financial savings, emphasis is placed on strategies such as preventive maintenance, energy efficiency investments, and innovative procurement models that reduce operating costs while extending asset longevity. The environmental dimension emphasizes minimizing the ecological footprint of facility operations by reducing energy consumption, conserving water, limiting greenhouse gas emissions, and encouraging the adoption of renewable energy technologies. Socially, facility management extends beyond technical upkeep to ensuring equitable access, user comfort, health, and safety, as well as fostering inclusive spaces that contribute to community wellbeing. The TBL approach highlights the interdependence of these three dimensions, underscoring that sustainable facility management must simultaneously pursue efficiency, ecological stewardship, and social responsibility to be viable in rapidly urbanizing economies.

Complementing the TBL perspective, facility management theory provides the operational framework for translating sustainability principles into practice. Central to this is lifecycle management, which recognizes that decisions made during planning, design, and construction significantly affect the long-term sustainability of facilities. A lifecycle perspective encourages integrating sustainability metrics early in the process, reducing downstream costs and environmental burdens. For instance, selecting durable and recyclable materials at the design stage can minimize waste during demolition or renovation, thereby closing material loops. Beyond lifecycle considerations, asset optimization emphasizes maximizing the value derived from infrastructure through predictive maintenance, performance monitoring, and integration of digital tools such as Building Information Modeling (BIM) and Internet of Things (IoT)-enabled sensors (Fuggini *et al*., 2016; Perumallaplli, 2018). By enabling real-time data-driven decision-making, these tools ensure that facilities operate at peak efficiency, balancing operational costs with environmental performance. Additionally, facility management theory stresses the importance of user-centric services, reflecting a shift from purely technical management to an approach that prioritizes the needs and experiences of building occupants. In emerging urban economies, this user-centered focus is particularly relevant, as facilities often serve diverse populations with varying socio-economic backgrounds. Incorporating feedback mechanisms, adaptable spatial designs, and accessible services ensures that facility management contributes not only to operational sustainability but also to social inclusivity and human wellbeing.

These foundations are further enriched by theories from urban development models, which provide the systemic context within which facility management operates. The smart cities model emphasizes leveraging digital technologies to improve the efficiency and sustainability of urban systems, including facilities. Through integrated platforms, facility managers can connect building-level operations with city-wide energy grids, mobility systems, and service networks. This creates synergies between micro-level facility optimization and macro-level urban sustainability goals, such as reducing congestion, managing resources efficiently, and improving quality of life. The circular economy framework introduces principles of closed-loop resource flows, where waste is minimized, and materials are continually reused or repurposed. Applying circular economy thinking to facility management means prioritizing modular construction, designing for disassembly, and establishing systems for recycling building materials. This approach is especially crucial in emerging urban economies where rapid construction often generates significant waste streams. Finally, resilience frameworks add a crucial dimension by focusing on the capacity of facilities and urban systems to withstand and adapt to shocks, including climate change, natural disasters, and socio-economic disruptions. Facility management strategies grounded in resilience theory emphasize redundancy, flexibility, and adaptive capacity, ensuring that buildings and infrastructure continue to function under stress and contribute to broader community recovery.

The convergence of these theoretical perspectives creates a robust foundation for conceptualizing sustainable facility management in emerging urban economies. The TBL framework ensures that decisions remain balanced across economic, environmental, and social imperatives. Facility management theory translates these imperatives into actionable strategies through lifecycle planning, asset optimization, and user-centric practices. Urban development models expand the scope further, embedding facilities within wider systems of digital integration, circular material flows, and resilience-building strategies. Together, these foundations highlight that facility management is no longer a narrow technical field but a multidisciplinary arena that influences and is influenced by economic development, environmental stewardship, and social inclusion.

The theoretical foundations for sustainable facility management reveal a layered and interconnected framework that responds to the unique pressures of emerging urban economies. By situating facility management at the intersection of sustainability science, operational theory, and urban systems thinking, a comprehensive approach is established (Pickett *et al*., 2016; Crosby *et al*., 2018). This approach not only addresses immediate operational challenges but also contributes to long-term urban sustainability, resilience, and inclusivity. As cities in emerging economies continue to expand, these theoretical underpinnings will remain critical in guiding facility management practices that align with global sustainability agendas while addressing local development realities.

2.2 Key Drivers of Sustainable Facility Management

Sustainable facility management (FM) is shaped by a confluence of economic, environmental, social, technological, and governance forces. In emerging urban economies, these drivers are particularly salient as they define how facilities can adapt to rapid urbanization, resource scarcity, and evolving societal expectations as shown in figure 1. Understanding these drivers provides the foundation for developing frameworks that align operational practices with long-term sustainability objectives.

Economic imperatives remain at the forefront of FM decision-making. Facility operations account for a significant share of organizational expenditure, often exceeding initial construction costs across the asset lifecycle. Sustainable FM offers pathways to reduce these costs through energy conservation, efficient maintenance practices, and optimized resource allocation (Galamba and Nielsen, 2016; Asmone and Chew, 2016). For example, retrofitting lighting systems with energy-efficient technologies or integrating predictive maintenance systems can lower operational costs while extending asset lifespan.

Beyond immediate savings, sustainable FM supports long-term value creation. By prioritizing lifecycle thinking, facilities can avoid premature obsolescence and costly refurbishments. Investment in sustainable systems—such as renewable energy integration or water reuse technologies—may entail higher upfront costs but delivers substantial financial and resilience dividends over time. Furthermore, productivity gains arise when well-managed facilities enhance occupant comfort, reduce downtime, and foster healthier work environments. In knowledge-driven economies, where human capital is critical, these gains translate directly into organizational performance.

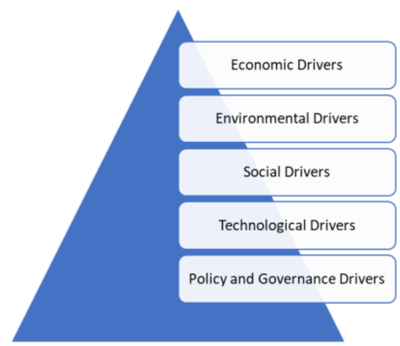

Figure 1: Key Drivers of Sustainable Facility Management

The environmental dimension of sustainable FM is driven by global commitments to climate action and the growing recognition of cities as major contributors to environmental degradation. Facilities consume vast quantities of energy and water, while generating significant waste and emissions. Sustainable FM responds by embedding energy efficiency measures, such as smart HVAC systems, natural lighting, and advanced insulation.

A central goal is carbon footprint reduction, achieved by integrating renewable energy sources, adopting energy storage systems, and transitioning to low-carbon materials in retrofits and upgrades. Equally important is waste minimization, which involves efficient procurement strategies, segregation and recycling systems, and reducing single-use materials. The concept of resource circularity further expands the agenda, emphasizing reuse, remanufacturing, and material recovery across facility lifecycles. For emerging urban economies facing acute resource scarcity, these practices provide both ecological and economic benefits by reducing dependence on imported materials and improving local sustainability.

Facilities are not merely technical assets; they are social environments that shape human interactions, health, and quality of life. Sustainable FM emphasizes health and safety through effective ventilation, indoor air quality monitoring, and safe material use, which are particularly critical in dense urban settings. The COVID-19 pandemic underscored the importance of hygienic, adaptable facilities in protecting public health (Rosen *et al*., 2018; Ahmed *et al*., 2018).

Inclusivity is another core driver, ensuring that facilities are accessible to all, including marginalized groups and persons with disabilities. Stakeholder engagement, meanwhile, enhances transparency and fosters collective ownership of sustainability initiatives. By involving occupants, facility staff, and local communities in decision-making, FM practices become more responsive and context-sensitive. Finally, sustainable FM contributes to community well-being by promoting shared spaces, cultural preservation, and environmental stewardship, positioning facilities as integral components of social sustainability (Galamba and Nielsen, 2016; Ranasinghe, 2018).

Technological innovation has transformed the scope of FM, enabling data-driven and predictive management practices. Digital twins, which create virtual replicas of physical assets, allow managers to simulate performance, optimize operations, and forecast maintenance needs. This reduces downtime, extends asset lifespans, and supports sustainability by minimizing resource wastage.

The Internet of Things (IoT) enables real-time monitoring of energy use, water consumption, and indoor environmental conditions, providing granular insights that inform responsive management. Artificial intelligence (AI)-driven optimization further enhances performance by identifying patterns, predicting failures, and recommending sustainability strategies that balance efficiency with occupant comfort. For emerging economies, technological leapfrogging through these tools presents an opportunity to bypass outdated systems and adopt advanced, scalable solutions.

Policy and governance frameworks establish the enabling environment for sustainable FM. Regulatory frameworks mandate energy codes, waste reduction targets, and emission limits, compelling facility managers to integrate sustainability practices. At the same time, green certifications such as LEED, BREEAM, and ISO 41001 provide benchmarks that guide organizations in achieving recognized sustainability standards.

Public–private partnerships (PPPs) are increasingly vital in emerging urban economies, where infrastructure gaps cannot be bridged by governments alone. PPPs mobilize investment, share risks, and enable innovation in facility development and management. Strong governance mechanisms also ensure accountability, encouraging transparency in sustainability reporting and performance evaluation.

The drivers of sustainable FM are multidimensional, interlinked, and context-dependent. Economic imperatives demand efficiency and long-term value, while environmental concerns highlight the urgency of carbon reduction and circular resource flows. Social drivers ensure that FM contributes to inclusivity and well-being, while technological innovation and governance mechanisms provide the tools and structures for implementation (Aerni, 2016; Hetemäki *et al*., 2017). For emerging urban economies, recognizing and harnessing these drivers is essential to transform FM into a strategic instrument for sustainable urban development.

2.3 Core Components of the Conceptual Framework

The conceptual framework for sustainable facility management (FM) in emerging urban economies rests upon six interrelated components that collectively guide the integration of sustainability into practice. These components address the strategic, operational, and governance dimensions of FM, ensuring that facilities deliver long-term economic, environmental, and social value.

A critical starting point for sustainable FM is the integration of sustainability into the mission, vision, and goals of facility management (Galamba and Nielsen, 2016; Lu *et al*., 2018). Historically, FM has been perceived primarily as a cost-control or maintenance-oriented function. However, embedding sustainability into its strategic orientation elevates FM into a driver of organizational resilience and urban sustainability. This requires facility managers to adopt explicit sustainability objectives—such as energy neutrality, carbon reduction, and social inclusion—within organizational strategies.

Strategic alignment also involves ensuring that FM practices correspond with national and municipal urban development strategies. In emerging urban economies, governments are increasingly adopting policies that encourage green infrastructure, climate resilience, and inclusive urban growth. FM strategies aligned with these policy directions not only secure regulatory compliance but also position facilities as contributors to broader developmental goals. For example, aligning hospital facility management with national healthcare resilience strategies ensures continuity of services during environmental shocks.

Resource efficiency forms the operational backbone of sustainable FM. Facilities are resource-intensive, consuming substantial amounts of energy, water, and materials. Energy optimization through efficient lighting, heating, ventilation, and cooling systems reduces both operational costs and environmental footprints. Similarly, water management systems, including low-flow fixtures, rainwater harvesting, and greywater reuse, conserve scarce resources. Material efficiency involves reducing construction and maintenance waste, selecting durable and low-impact materials, and prioritizing local sourcing to minimize embodied carbon (Giesekam *et al*., 2016; Park *et al*., 2017).

Beyond efficiency, the framework emphasizes renewable energy integration and recycling systems. Solar photovoltaics, biogas digesters, and small-scale wind systems can provide reliable energy in contexts where national grids are unstable. Recycling initiatives, including construction waste recovery and closed-loop material use, support circular economy practices and reduce landfill pressures. For emerging economies with limited waste infrastructure, FM-led recycling initiatives can demonstrate scalable solutions.

Sustainability in FM cannot be confined to operational stages; it must span the entire asset lifecycle. This lifecycle approach begins with sustainable design and construction, where materials, layouts, and systems are selected for long-term efficiency and adaptability. During the operational stage, proactive maintenance, real-time monitoring, and energy optimization extend asset lifespan and reduce costs.

At the end of an asset's life, sustainable decommissioning ensures responsible dismantling, reuse of materials, and minimal environmental disruption. Coupled with this is the adoption of circular economy strategies, which emphasize repurposing building components, designing for modularity, and encouraging product-service systems (e.g., leasing equipment rather than purchasing). By embedding circularity into FM, facilities become not only efficient but regenerative, contributing positively to resource cycles rather than depleting them (Moreno *et al*., 2016; Hetemäki *et al*., 2017).

Technological innovation underpins the shift to data-driven and responsive FM systems. Smart building systems, such as automated energy management and occupancy sensors, enable real-time adjustments that optimize energy use and occupant comfort. Digital facility management platforms consolidate data on performance, costs, and sustainability indicators, enhancing decision-making and accountability.

The use of predictive maintenance leverages artificial intelligence and machine learning to forecast failures before they occur, reducing downtime, extending asset life, and avoiding unnecessary resource use. Moreover, real-time sustainability metrics allow managers to continuously track energy consumption, emissions, and indoor environmental quality. In emerging economies, technology integration can also enable "leapfrogging"—bypassing outdated systems to adopt advanced, cost-effective digital solutions that are both scalable and context-specific.

Sustainable FM is not solely a technical process; it is inherently social. Effective frameworks require the involvement of occupants, local communities, policymakers, and investors. Occupants influence resource consumption patterns, while communities shape the social legitimacy of FM practices. Policymakers establish enabling regulations, and investors provide capital for sustainable upgrades. Engagement ensures that FM strategies reflect diverse needs, fostering inclusivity and long-term acceptance.

Equally important is the co-creation of sustainable service delivery models. Participatory approaches allow stakeholders to jointly define priorities—whether energy affordability, health and safety, or environmental resilience. For example, community engagement in waste management systems ensures adoption and compliance, while investor involvement in renewable energy projects provides financial sustainability. By fostering multi-stakeholder collaboration, FM evolves from a technical service to a socially embedded practice that contributes to urban resilience.

Strong governance structures and enabling policies provide the institutional backbone for sustainable FM. Compliance with sustainability standards, such as ISO 41001 (Facility Management), LEED (Leadership in Energy and Environmental Design), and BREEAM (Building Research Establishment Environmental Assessment Method), ensures that facilities meet globally recognized benchmarks. These certifications not only validate performance but also attract investment by signaling commitment to sustainability.

However, global standards must be contextualized for emerging urban economies. Thus, the framework emphasizes localized regulations for affordable green practices. National and municipal governments can adapt certification requirements, providing flexible but enforceable pathways for organizations with limited financial capacity. Incentives, such as tax reliefs, green financing, or subsidies, further encourage adoption. Moreover, governance mechanisms that promote transparency in reporting and accountability in performance monitoring strengthen trust among stakeholders and align FM practices with urban sustainability objectives.

The six components of the conceptual framework—strategic alignment, resource efficiency, lifecycle approach, technology integration, stakeholder engagement, and governance—provide a comprehensive structure for advancing sustainable FM in emerging urban economies. Each component is interdependent: strategic alignment ensures coherence, resource efficiency delivers tangible gains, lifecycle thinking embeds long-term resilience, technology enhances performance, stakeholder engagement builds legitimacy, and governance secures compliance. Together, they create a holistic framework capable of addressing the economic, environmental, and social challenges that characterize rapidly urbanizing regions. By adopting this framework, facility managers, policymakers, and investors can ensure that facilities are not only functional assets but also catalysts of sustainable urban transformation (Ferilli *et al.*, 2017; Echeverri, 2018).

2.4 Challenges in Emerging Urban Economies

Sustainable facility management in emerging urban economies holds significant potential for improving environmental performance, social equity, and economic efficiency. However, translating theoretical frameworks into practical implementation is fraught with challenges that stem from financial, institutional, cultural, and infrastructural constraints unique to rapidly urbanizing contexts (Sood *et al.*, 2017; Rapport *et al.*, 2018). These barriers not only slow the transition toward sustainable practices but also deepen the disparities between emerging and developed economies in achieving long-term urban sustainability goals as shown in figure 2.

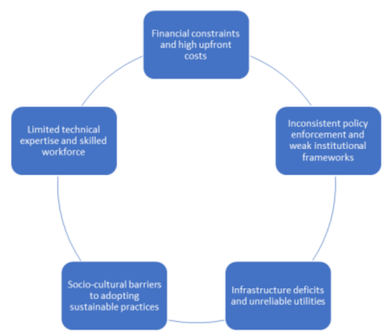

Figure 2: Challenges in Emerging Urban Economies

One of the most pressing challenges is financial constraints and high upfront costs. Sustainable facility management often requires substantial initial investment in technologies such as energy-efficient systems, renewable energy integration, smart monitoring tools, and durable construction materials. Although these investments offer long-term savings through reduced operational costs and extended asset life, the short-term financial burden poses a critical obstacle in economies where capital availability is limited. Public budgets are often constrained by competing demands such as healthcare, education, and housing, leaving little room for investment in sustainable infrastructure. For private stakeholders, limited access to affordable financing mechanisms, high interest rates, and weak credit markets further restrict the adoption of advanced sustainable technologies. This financial gap perpetuates a cycle in which conventional, less sustainable methods dominate due to their lower initial costs, despite being more expensive over the lifecycle of facilities.

Compounding the financial issue is the limited technical expertise and skilled workforce available to design, implement, and maintain sustainable facility management systems. Emerging urban economies often lack sufficient training institutions, certification programs, and professional development pathways to produce the skilled workforce required for advanced facility management practices. This results in a dependence on expatriate expertise or imported solutions, which are often expensive and not fully adapted to local contexts. Furthermore, knowledge gaps at managerial and operational levels hinder the ability to adopt innovative strategies such as lifecycle costing, predictive maintenance, or circular economy approaches. Without a strong human capital base, even when technologies are available, their integration into facility operations remains suboptimal, reducing both efficiency and effectiveness.

Another significant barrier is inconsistent policy enforcement and weak institutional frameworks. While many emerging economies have adopted sustainability-oriented policies on paper, the enforcement of these policies is frequently undermined by inadequate regulatory capacity, overlapping jurisdictions, and corruption. Building codes, environmental standards, and resource efficiency regulations are often inconsistently applied, leading to uneven compliance across projects. This unpredictability discourages investment in sustainable facility management, as stakeholders perceive greater risk in contexts where rules are not reliably enforced. Additionally, institutional fragmentation—where responsibilities for urban planning, facility management, and environmental protection are dispersed among multiple agencies—creates inefficiencies and hinders coordinated action.

Cultural and behavioral dynamics also play a role, with socio-cultural barriers to adopting sustainable practices representing a subtle yet pervasive challenge. In many contexts, awareness of sustainability principles among building users, facility operators, and the general public remains limited. Social norms and cultural expectations often prioritize immediate convenience, low costs, or aesthetic considerations over long-term sustainability benefits (Creutzig *et al.*, 2016; Amatulli *et al.*, 2017). For instance, users may resist behavioral changes such as energy conservation practices or recycling programs, viewing them as inconvenient or unnecessary. Moreover, the perception of sustainable technologies as foreign or elite can foster resistance, particularly when they are seen as incompatible with local traditions or socio-economic realities. Overcoming these barriers requires not only technical solutions but also sustained educational campaigns, stakeholder engagement, and community participation to embed sustainability into everyday practices (Aparcana, 2017; Sisto *et al.*, 2018).

Finally, infrastructure deficits and unreliable utilities exacerbate the difficulty of implementing sustainable facility management in emerging urban economies. Reliable access to electricity, water, waste management systems, and transportation networks is fundamental to supporting efficient facility operations. However, in many cities, infrastructure is either underdeveloped, outdated, or unable to keep pace with rapid urban population growth. Frequent power outages, water shortages, and inadequate waste disposal systems undermine the effectiveness of energy-efficient technologies, green building practices, and resource recycling initiatives. Moreover, the absence of integrated urban infrastructure makes it challenging to connect facility-level innovations—such as renewable energy generation or smart water systems—with broader city-wide networks. This infrastructural fragility not only limits immediate performance but also constrains the scalability of sustainable facility management solutions.

The challenges facing sustainable facility management in emerging urban economies are multifaceted and deeply interconnected. Financial limitations restrict access to the technologies needed for sustainability, while shortages in technical expertise hinder their effective deployment. Weak institutional frameworks and inconsistent policy enforcement further erode progress, while socio-cultural barriers slow behavioral change and acceptance of sustainable practices. Infrastructure deficits create an additional structural constraint, making it difficult to sustain even well-designed systems. Addressing these challenges requires integrated strategies that combine financial innovation, capacity building, institutional strengthening, cultural engagement, and infrastructural investment. Only by confronting these systemic barriers can emerging urban economies fully harness the potential of sustainable facility management as a driver of resilient, inclusive, and environmentally responsible urban development.

2.5 Opportunities and Enablers

Sustainable facility management (FM) in emerging urban economies is not solely constrained by barriers such as limited financing, weak governance, or infrastructure deficits (Curtis *et al*., 2017; Jagarajan *et al*., 2017). Equally important are the opportunities and enabling mechanisms that can accelerate the transition toward sustainable practices. These enablers operate across financial, institutional, technological, and social domains, providing facility managers with pathways to achieve both operational efficiency and long-term sustainability outcomes as shown in figure 3.

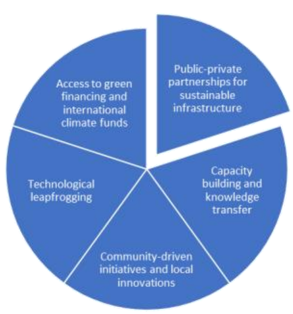

Figure 3: Opportunities and Enablers

One of the most significant opportunities lies in the growing availability of green financing mechanisms and international climate funds. As global recognition of climate change intensifies, multilateral organizations, development banks, and donor agencies are channeling resources into projects that reduce carbon emissions, promote renewable energy, and enhance resilience. Instruments such as green bonds, sustainability-linked loans, and concessional financing offer facilities the chance to invest in sustainable retrofits and energy-efficient technologies with reduced financial risk.

For emerging urban economies, where upfront capital remains a major barrier, these funding streams are transformative. Facilities that align their management strategies with measurable sustainability outcomes—such as reduced energy consumption or improved waste recovery—are increasingly eligible for international support. Additionally, climate adaptation funds create opportunities to strengthen facility resilience against flooding, heatwaves, and other climate-related risks that disproportionately affect urban centers in low- and middle-income regions.

Public–private partnerships (PPPs) serve as another critical enabler of sustainable FM. Given the resource limitations of governments in emerging economies, collaboration with private investors allows for the financing, design, construction, and management of infrastructure projects that incorporate sustainability principles. Through risk-sharing and contractual innovation, PPPs create avenues for scaling renewable energy projects, sustainable transport systems, and waste-to-energy facilities.

In the context of FM, PPPs can ensure long-term operational efficiency by embedding performance-based sustainability metrics into contractual agreements. For instance, energy performance contracts incentivize private partners to reduce energy use while sharing the financial savings with public entities. Moreover, PPPs mobilize global expertise and technologies, which can be adapted to local contexts. In doing so, they bridge gaps between ambitious policy aspirations and practical implementation on the ground.

Sustainable FM also depends heavily on human capital. Capacity building and knowledge transfer are essential for equipping facility managers, engineers, and policymakers with the skills required to implement and sustain innovative practices. Training programs on energy auditing, sustainable procurement, and digital facility management tools strengthen institutional capacity to manage complex systems.

Knowledge transfer occurs not only through formal education but also via partnerships with international organizations, universities, and industry associations. For example, collaborative research projects or professional exchange programs enable local practitioners to learn from global best practices while adapting them to local socio-economic realities. In emerging economies, where technical expertise is often scarce, building a skilled workforce ensures continuity and scalability of sustainable FM practices (Jabłoński, 2016; Vieira *et al*., 2017).

Emerging economies face the advantage of technological leapfrogging, whereby outdated systems can be bypassed in favor of advanced, cost-effective technologies. In FM, this includes adopting smart systems such as automated lighting, real-time energy monitoring, and occupancy sensors that improve efficiency and reduce waste. Digital platforms for facility management allow for integrated monitoring of energy, water, and waste flows, enabling data-driven decision-making.

Similarly, renewable energy integration provides opportunities to reduce dependence on unreliable national grids while lowering emissions. Solar photovoltaics, microgrids, and battery storage systems can be deployed at facility level, ensuring energy security and sustainability. By leapfrogging to these technologies, emerging economies avoid the financial and ecological costs of maintaining outdated, resource-intensive infrastructure, positioning themselves at the forefront of sustainable urban transformation.

Finally, community-driven initiatives and local innovations represent powerful enablers of sustainable FM. Facilities exist within social ecosystems, and their sustainability is strengthened when local communities are active participants. Grassroots initiatives, such as community-led recycling programs, green space maintenance, or cooperative energy projects, foster collective responsibility and reduce operational burdens on facility managers.

Local innovations—ranging from low-cost water purification technologies to modular construction techniques—also play a critical role in contexts where imported solutions may be unaffordable or culturally inappropriate. By harnessing indigenous knowledge and locally available materials, facilities can adopt practices that are both sustainable and contextually relevant. Moreover, community engagement enhances social acceptance of sustainable practices, ensuring that initiatives are not seen as externally imposed but as locally owned transformations.

The transition to sustainable facility management in emerging urban economies is bolstered by a range of opportunities and enablers. Green financing and international climate funds alleviate financial constraints, while PPPs mobilize investment and expertise. Capacity building ensures the development of skilled professionals capable of implementing sustainable practices, and technological leapfrogging allows economies to adopt advanced solutions without the burden of legacy systems. Finally, community-driven initiatives and local innovations embed sustainability within the social fabric, ensuring long-term legitimacy and resilience. By strategically harnessing these enablers, facility management can evolve from a reactive operational function into a proactive driver of sustainable urban development (Brown *et al*., 2017; Tate *et al*., 2018).

2.6 Implications for Practice and Policy

The integration of sustainability into facility management (FM) practices within emerging urban economies carries significant implications for both professional practice and public policy. As cities expand and infrastructure demands intensify, facility managers and policymakers must work collaboratively to ensure that sustainability principles are not only conceptual aspirations but also operational realities (Chini *et al*., 2017; Yang *et al*., 2018). This requires embedding sustainability in daily FM practices, creating supportive policy frameworks, and employing robust benchmarking tools to measure performance and guide continuous improvement.

For facility management professionals, the shift toward sustainability means reorienting daily operations around principles of efficiency, resilience, and user wellbeing. Guiding FM professionals in embedding sustainability in daily operations involves translating broad sustainability goals into specific tasks and decision-making processes. This includes implementing preventive and predictive maintenance strategies that reduce resource waste, adopting energy-efficient practices such as optimizing heating, ventilation, and lighting systems, and promoting water conservation measures. Facility managers must also engage with procurement practices that prioritize environmentally friendly materials, recyclability, and life-cycle value rather than lowest upfront cost. In addition, embedding sustainability requires greater attention to occupant engagement and education. By creating feedback systems that monitor energy consumption or indoor environmental quality and communicating these results to users, facility managers can foster behavioral changes that complement technical interventions. Continuous professional development and training are equally critical, ensuring that facility managers stay abreast of innovations in smart technologies, renewable integration, and circular economy applications. Ultimately, FM professionals play a pivotal role in operationalizing sustainability at the micro-level of building systems while aligning with macro-level urban sustainability agendas.

On the policy side, governments have a critical responsibility to create enabling environments for sustainable FM. Policy pathways for governments to support sustainable FM must address regulatory, financial, and institutional dimensions. Regulatory measures, such as green building codes, energy performance standards, and waste management regulations, set clear minimum thresholds for sustainability and create predictable expectations for facility operators. Beyond regulation, financial incentives such as tax rebates, subsidies for renewable energy integration, and concessional financing schemes are essential for overcoming high upfront costs that often deter the adoption of sustainable practices. Governments can also support sustainable FM through capacity-building initiatives, including the establishment of training centers, accreditation programs, and knowledge-sharing platforms that strengthen the technical expertise of facility management professionals. Institutional reforms that promote better coordination across urban planning, environmental management, and facility operations can further reduce fragmentation and ensure cohesive implementation (Healey, 2017; Vu and Hartley, 2018). In emerging urban economies, where resource limitations are acute, governments must also integrate sustainability goals into broader development strategies, ensuring that sustainable facility management contributes to national climate commitments, economic growth, and social wellbeing.

A crucial component linking practice and policy is the development and application of benchmarking tools for measuring sustainability in facilities. Benchmarking provides a systematic way to assess performance, identify areas for improvement, and compare results across facilities and contexts. Tools such as Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), and local green building certifications offer structured criteria for evaluating sustainability in terms of energy use, material efficiency, indoor air quality, and social inclusivity. In emerging urban economies, the challenge lies in adapting these international benchmarking systems to local contexts, accounting for differences in climate, resource availability, and socio-economic conditions. Developing region-specific indices or hybrid frameworks that combine global best practices with local relevance can enhance applicability and affordability. Benchmarking also facilitates transparency and accountability, enabling facility managers, investors, and policymakers to make evidence-based decisions. Moreover, by establishing clear metrics, benchmarking fosters competition among organizations to achieve higher levels of sustainability, driving innovation and continuous progress.

The convergence of practice, policy, and benchmarking underscores the systemic nature of sustainable facility management. Facility managers must act as change agents within their organizations, embedding sustainability in daily routines and championing long-term value over short-term gains. Policymakers, in turn, must establish the structural conditions that make sustainable practices financially viable, institutionally supported, and socially equitable. Benchmarking tools provide the bridge between these domains, offering the evidence base needed to track progress, evaluate outcomes, and refine strategies. Together, these elements create a reinforcing cycle: policy provides the framework, professionals operationalize sustainability, and benchmarking ensures accountability and learning.

The implications of sustainable facility management for practice and policy highlight a dynamic interplay between micro-level operational decisions and macro-level governance structures. Embedding sustainability in daily FM operations enhances efficiency and occupant wellbeing, while supportive policy frameworks reduce barriers and incentivize adoption. Benchmarking tools serve as essential mechanisms for aligning efforts, measuring impact, and guiding continuous improvement (Ketter *et al*., 2016; Alosani *et al*., 2016). In the context of emerging urban economies, these implications are particularly urgent, as the choices made today will shape the resilience, inclusivity, and sustainability of rapidly growing urban centers for decades to come.

CONCLUSION

Sustainable facility management (FM) is increasingly recognized as a catalyst for resilient and inclusive urban growth, particularly in emerging economies where rapid urbanization intersects with infrastructure deficits and resource scarcity. By embedding sustainability into the management of buildings and public infrastructure, FM moves beyond its traditional operational role to become a strategic enabler of urban transformation. Through resource efficiency, lifecycle-based asset management, technological integration, and stakeholder collaboration, sustainable FM contributes to reducing environmental footprints, enhancing social well-being, and ensuring that urban facilities remain adaptable in the face of climate and demographic pressures.

The realization of this potential, however, requires collaborative, adaptive, and context-specific strategies. Emerging economies are characterized by diverse socio-economic conditions, governance structures, and cultural practices. Sustainable FM frameworks must therefore be tailored to local realities, balancing global best practices with affordability and accessibility. Collaboration between governments, private investors, facility managers, and communities is vital to ensure financial viability, technological innovation, and social legitimacy. Adaptive strategies, informed by continuous feedback and monitoring, allow facilities to evolve with shifting urban priorities and environmental challenges.

Looking forward, a robust future research agenda is needed to empirically validate the conceptual framework across varied urban contexts. Comparative studies of facility management practices in different regions can illuminate context-specific enablers and constraints, while longitudinal research can track the long-term impacts of sustainable FM on economic, social, and environmental outcomes. Furthermore, quantitative modeling of cost–benefit trade-offs, as well as qualitative insights into stakeholder engagement, will enrich the evidence base for policy and practice.

Sustainable FM represents not only an operational necessity but also a transformative pathway for achieving inclusive, resilient, and sustainable cities in emerging urban economies.

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