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Cyber Community-based Facilities Management: A Conceptual Framework for Improving Sustainability in Higher Education Institution

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Abstract

The paper proposes a conceptual framework for improving sustainability in higher education institutions (HEIs) through cyber community-based facility management. The conceptual framework of the paper is based on facilities management (FM), the diffusion of innovation, and human development theory. The principles adopted for the conceptual framework are community-based FM, technological innovations, and capabilities approach. The framework is based on the idea that FM can be improved by utilising technology and the community's capabilities through HEIs characteristics to promote sustainability. The framework's four essential elements are technology, community capabilities, HEIs characteristics and sustainability. Technology is used to collect data, monitor, and control energy consumption, and improve overall facilities performance. Community capabilities refer to the skills, knowledge, and resources available within a community to engage in sustainable practices and initiatives. Characteristics of HEIs include facility type, public or private designation, location, institution district boundaries, size, student enrolment, age, and infrastructure condition. Sustainability development is achieved through the implementation of green practices, reducing energy consumption, reducing waste, resource efficient and socially inclusive. The framework proposed is appropriate for use by HEIs because they consume a significant amount of energy, emit a significant amount of greenhouse gas emissions, and develop and strengthen students, faculty, and staff capabilities. As a result, they play a critical role in promoting sustainability. The paper concludes by emphasising the importance of further research on the conceptual framework's implementation and effectiveness in promoting sustainability.

1. Introduction

The global emphasis on sustainable development has raised awareness and commitment to environmental, social, and economic responsibilities in various sectors, including higher education institutions (HEIs) (Lozano et al., 2013; Žalėnienė & Pereira, 2021). These institutions play an essential role in shaping society's future by fostering knowledge, research, and innovation, all of which contribute to long-term development (Bauer et al., 2021; Caeiro et al., 2020; Fadeeva & Mochizuki, 2010). As a result, there is a growing need for HEIs to incorporate sustainability principles into their operations, infrastructure, and curricula (Bukhari et al., 2020; Kaleem et al., 2021; Stephens et al., 2008). One of the most critical aspects of achieving sustainability in HEIs is effective facility management (FM) practices (Aceves-Avila & Berger-García, 2019). FM is the maintenance, operation, and development of an organisation-built environment and infrastructure to improve people's quality of life and support the core business's primary activities and objectives (Alexander, 1996; Atkin & Brooks, 2014; IFMA, 2017; ISO, 2018). Traditionally, FM has focused on increasing efficiency and lowering costs; however, with increased sustainability awareness, FM practices must evolve and include environmentally friendly and socially responsible initiatives (Michell, 2012; Nielsen et al., 2016; Okoro, 2023). Technological adoption and community engagement can transform FM practices and achieve sustainability goals (Adama, 2019; Kim & Kim, 2020; Michell, 2010; Moghayedi, Le Jeune, et al., 2022).

This paper documents a synthesis of the literature to establish a theoretical and conceptual framework for cyber community-based facilities management (CCbFM) to enhance sustainability within HEIs. Despite existing theoretical and conceptual frameworks and methods to improve sustainability, the unique impact of integrating CCbFM approach on HEI sustainability remains unexplored, warranting further investigation in this domain.

This paper has the following sections: an outline of the literature review, research method, findings and discussion, and the conclusion to the paper.

2. Literature review

Facilities Management (FM) is critical in ensuring that the built environment meets the diverse needs of its residents. FM, as defined by the International Facility Management Association, encompasses a wide range of disciplines that work together to ensure the functionality, safety, and comfort of built structures by balancing people, place, process, and technology (IFMA, 2017; ISO, 2018; Lindkvist et al., 2020; SAFMA, 2016). FM's value extends beyond financial metrics to include social and environmental contributions that promote global population well-being by addressing core needs and legitimate user concerns (Price et al., 2002; Grimshaw, 2004). Furthermore, public organisations are encouraged to invest in urban-scale community facilities, fostering long-term economies that prioritise societal welfare (Roberts, 2004; Kasim & Hudson, 2006).

Deeper exploration of FM yields the concept of Community-based Facilities Management (CbFM), which focuses on the intertwined relationship of communities with FM. CbFM, as defined by Alexander and Brown (2006), Michell (2010), and Michell et al (2016), is about stakeholders working together to create environments in which local economies can thrive, resources can be preserved, and quality of life can be improved. With its multifaceted aspects, CbFM not only strengthens the socioeconomic fabric but also prioritises the essence of community well-being (Roberts, 2004; Grimshaw 2004).

Similarly, Mahbub Ul Haq's Human Development Theory, later refined by Sen, emphasises growth as the enhancement of human capabilities. This theory emphasises expanding individuals' opportunities, resulting in healthier, longer, and more fulfilling lives (Costantini & Monni, 2006; Haq, 1995; Ranis & Stewart, 2000). It promotes equity, productivity, empowerment, and sustainability, culminating in Sen's 'Capabilities Approach'. This approach focuses on individuals' abilities to achieve valued goals, emphasising the importance of assessing well-being through personal capabilities (Deneulin & Shahani, 2009; Haq, 1995). The concept of 'Community Capability' is an important component of the capabilities approach, emphasising the collective power of communities to address challenges and expand opportunities. Communities can become more resilient and cohesive by emphasising leadership, collaboration, and inclusive decision-making (Deneulin & Shahani, 2009; Haq, 1995; Anand & Sen, 2000).

The diffusion of innovations (DOI) has become critical in the evolving societal landscape. According to Everett Roger, innovations spread through various channels and rely heavily on human capital and societal receptivity (Rogers, 2003). Technological advancements have transformed the FM industry, introducing a plethora of tools that have a significant impact on user experience (Branscomb, 2001; Adama & Michell, 2018). The interaction between User Experience (UX) and User Interface (UI) is highlighted here, emphasising the importance of high-quality, relevant content and seamless user interaction, particularly in higher education institutions (HEIs) (Shin et al., 2017; Hernández et al., 2018).

Brundtland's definition of sustainability, emphasising the balanced consideration of economic, environmental, and social pillars, remains a cornerstone concept (Brundtland, 1987). The interdependence of these pillars promotes overall growth (Lehtonen, 2004). Interestingly, HEIs play an important role in sustainability by promoting practises that align with the Sustainable Development Goals (SDGs) (Berchin et al., 2021; Kohl et al., 2022). As a result, by providing HEIs with the necessary knowledge and tools, societies can embark on a path of holistic, long-term development (Žalėnienė & Pereira2021).

Table 1 below summarises a summary of the literature review, organised by section, proposition/definition, supporting authors, and alignment with the main themes. It is a useful tool for quick reference or for gaining a deeper understanding of the main points of the literature.

Table 1: Summary of literature

Topic/Section	Supporting Authors/Associations	Proposition/Key Points
Facilities Management	IFMA, 2017; ISO, 2018; Lindkvist et al., 2020; SAFMA, 2016	Focus on integrating people, place, process, and technology. Value of FM both in financial terms and social/environmental benefits. Emphasis on the role of people and the need for community facilities.
Community-based Facilities Management	Alexander and Brown, 2006; Michell, 2010; Roberts, 2004; Grimshaw, 2004	Definition of CbFM and its potential as a change agent. Dimensions of CbFM including stakeholder interaction and community quality of life. Emphasis on integrated approach for community benefits.
Human Development	Costantini & Monni, 2006; Haq, 1995; Anand & Sen, 2000	Development is about expanding human choices. Focus on social justice, equality, and principles like equity, sustainability, and empowerment.
Capabilities Approach	Robeyns, 2006; Nussbaum, 2011; Alkire and Deneulin, 2009	Framework for evaluating human well-being based on functioning, capability, and agency. Emphasis on external environmental changes and organizational capabilities.
Community Capability	Carpenter, 2022; George et al., 2016	Definition and domains of community capability. Importance of empowerment, collaboration, and resilience.
Diffusion of Innovations	Rogers, 2003	Process of new ideas spreading through social channels. Importance of mass media, interpersonal communication, and human development. Role of openness to innovation.
Technological Innovations	Branscomb, 2001; Adama and Michell, 2018; Hernández et al., 2018; Shin et al., 2017	Impact of technology on business and FM practice. Role of user experience (UX) and user interface (UI) design in shaping technology adoption.
Sustainability	Brundtland, 1987; Lehtonen, 2004; Nielsen, Sarasoja, and Galamba, 2016; O'Brien & Sarkis, 2015	Definition of sustainability. Emphasis on economic, environmental, and social pillars. Role of innovation tied to education for sustainable progress.
Higher Education Institution Sustainability	Berchin et al., 2021; Žalėnienė & Pereira, 2021; Bauer et al., 2021; Filho et al., 2020	Role of HEIs in achieving Sustainable Development Goals (SDGs). Importance of governance, community involvement, and imparting knowledge on sustainability.

3. Research method

The research method adopted is a literature synthesis. To examine and analyse an extensive theoretical and conceptual framework, the study searched from scientific databases (WoS and Scopus), official reports, journals, articles and conference papers, books, newspapers, master and doctoral research publications and conference proceedings. Despite existing frameworks and methods, the unique impact of integrating the CbFM principle, TIs, and capabilities approach on HEI sustainability remains unexplored, warranting further investigation in this domain. Sustainability has become increasingly crucial in facilities management, with organisations recognising the need to minimise their environmental impact and contribute to a greener future (Nielsen et al., 2016; Opoku & Lee, 2022).

The significance of integrating place factors and characteristics, technological innovations, process procedures and guidelines, and people capabilities attributes in enhancing the sustainability agenda in FM practices. These places, processes, people, and technologies have been categorised into sub-categories, including:

- People: Individual and Community.
- Place: Budlings, ground and surroundings, other structures and other factors.
- Process: Business and strategic management, resource management, risk and compliance management, stakeholder and performance management, and project and programme management.
- Technology: Technological Innovations, Energy Efficiency and Conservation, and Digital Technologies and Data-Driven Decision Making

An essential aspect of achieving this goal is the people involved in facilities management, who possess the knowledge, skills, and attitudes necessary to drive sustainable practices (George et al., 2016; Sarpin et al., 2016). One critical aspect of sustainable facilities management is the consideration of place factors, which encompass the physical characteristics, locations, and types of facilities being managed (Alexander, 1996; Chen, 2015; Opoku & Lee, 2022). Considering place factors, such as buildings, grounds and surroundings, other structures, and additional factors, is crucial in promoting sustainability in facilities management (Opoku & Lee, 2022; Shah, 2008; Turvey, 2019).

Organisations should continuously monitor and evaluate their progress in achieving sustainability goals to identify areas for improvement and drive continuous development (Bumberová & Milichovský, 2019). Integrating sustainable practices into FM processes is essential for organisations to minimise their environmental impact, enhance occupant well-being, and ensure long-term operational efficiency (Alexander, 2008; Tucker & Masuri, 2018; Wan-Hamdan et al., 2011). Technology innovation in facilities management has evolved rapidly, providing new opportunities for enhancing sustainable practices. According to Hafez et al. (2023), strategic space planning tools can help optimise space within a building, reducing energy consumption and greenhouse gas emissions (McDonald, 2022).

Wearable technology, such as smartwatches and fitness trackers, can help monitor employee health and well-being, increasing productivity and a healthier work environment (Shei et al., 2022). Touchless workplace technology can minimise the spread of germs and reduce waste by automating lighting, temperature control, and access control (Leygonie et al., 2022).

4. Findings and discussion

HEI has an internal and external community. Students, staff, administration, and management comprise the internal community, while alumni, research communities, businesses, social movements, consumer organisations, governments, and professional associations comprise the external community (Jongbloed et al., 2008). The term "community" for this research refers to the social context of the internal community and its HEI characteristics. The characteristics of these HEIs include the following (Benneworth & Jongbloed, 2010; Knox et al., 1992):

- A high concentration of talent among both staff and students;
- Abundant resources to support a rich learning environment and conduct advanced research; and
- Constructive governance features encourage strategic vision, innovation, and flexibility, allowing institutions to make autonomous decisions and manage resources without excessive bureaucracy.

These characteristics are depicted in Figure 2.

Figure 2: HEI Characteristics (Berchin et al., 2021; Caeiro et al., 2020; Fernandes & Singh, 2021; Findler et al., 2019; Knox et al., 1992; Sassen et al., 2018; Wiese et al., 2009; Yeon et al., 2021)

Globally, HEIs are slow to adopt practices that are good for the environment (Kaleem et al., 2021). Also, embedding sustainability in HEIs' functions has been a variable phenomenon (Chalkley and Sterling, 2011; Savanick, Strong, and Manning, 2008; Yáñez et al., 2019) that

has created an imbalance among the three aspects of sustainability (Kaleem et al., 2021). The impact of sustainability depends on three pillars: economic, environmental, and social.

The study's conceptual framework is based on FM, Diffusion of Innovation (DOI) and Human Development theory. Alexander (1996) says that FM theory is how an organisation ensures that its buildings, systems, and services support its core operations and procedures and help it achieve its strategic goals, even when things change. According to Roger (1962), DOI theory explains how innovations spread through a population. DOI is crucial for any organisation, especially for HEIs. Haq (1995) describes human development as the process of enlarging a person's choices and opportunities and improving their well-being by examining what they have the freedom to do and be in society.

Researchers have tried to find ways to make HEIs more sustainable by using different frameworks and methods (Tumbas et al., 2015; Findler et al., 2019; Geng et al., 2020; Leal Filho et al., 2021). However, to date, none of the existing studies has specifically examined the impact of the integration of the CbFM principle, TIs, and capability approach on the sustainability of HEIs. Figure 3 illustrates the theoretical and conceptual CCbFM framework for HEIs sustainability.

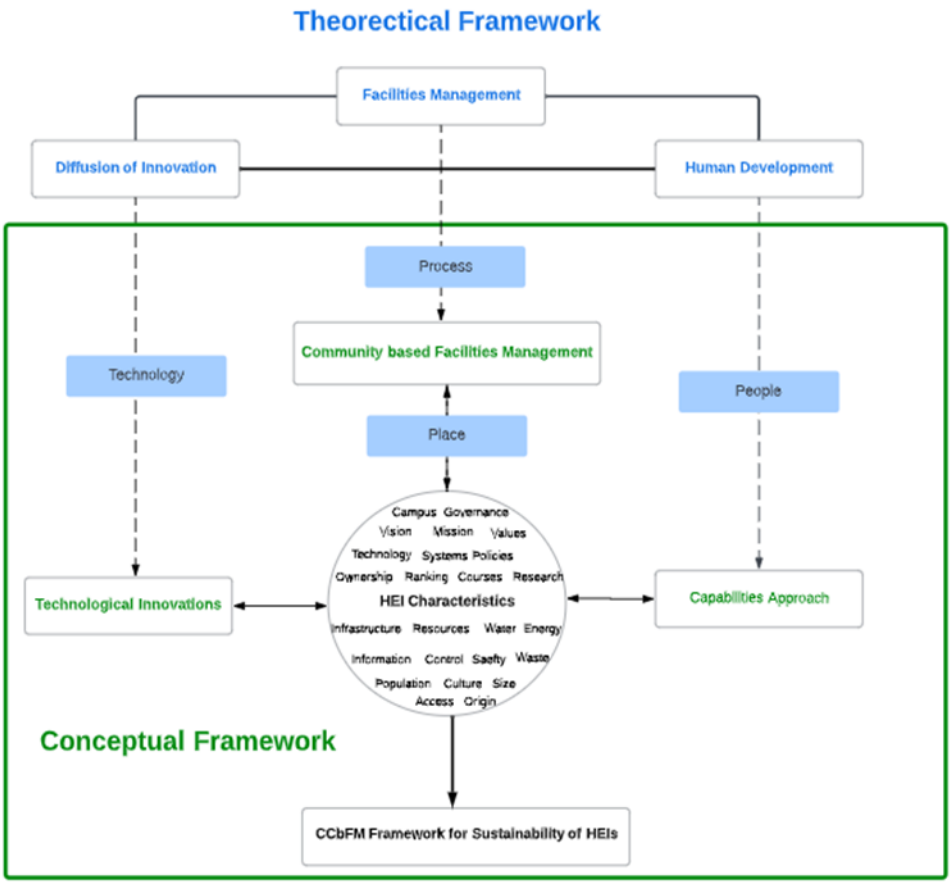

Figure 3: A proposed conceptual framework for the study

The framework is based on the literature reviewed that FM can be improved by utilising technology and the community's capabilities through HEIs characteristics to promote sustainability. The framework's four essential elements are technology, community capabilities, HEIs characteristics and sustainability. The technology collects data, monitors, and controls energy consumption, and improves overall facilities performance. Community capabilities refer to the skills, knowledge, and resources available within a community to engage in sustainable practices and initiatives. Characteristics of HEIs include facility type (e.g., University, College, Technikon, etc.), public or private designation, location, institution district boundaries, size, student enrolment, age, and infrastructure condition. Sustainable development is achieved through implementing green practices, reducing energy consumption and waste, and being resource-efficient and socially inclusive.

The framework proposed is appropriate for HEIs because they consume a significant amount of energy, emit a substantial amount of greenhouse gas emissions, and develop and strengthen students, faculty, and staff capabilities. As a result, they play a critical role in promoting sustainability. The framework can also be used by other organisations promoting sustainability through FM. The proposed framework's many advantages are increased energy efficiency, lower associated costs, and increased community ability to promote sustainability. Furthermore, the framework enables HEIs to meet sustainability objectives while contributing to more considerable social, economic, and environmental efforts. The paper concludes by emphasising the importance of further research on the conceptual framework's implementation and effectiveness in promoting sustainability.

Conclusion

This paper developed the theoretical and conceptual framework of the study, by reviewing and synthesising literature. The framework is based on FM, the diffusion of innovation, and human development theory. The principles adopted for the conceptual framework are CbFM, TIs, and the capabilities approach. The framework proposed is appropriate for use by HEIs because they consume a significant amount of energy, emit a significant amount of greenhouse gas emissions, and develop and strengthen students, faculty, and staff capabilities. As a result, they play a critical role in promoting sustainability. The framework can also be used by other organisations interested in promoting sustainability through facility management. Among the many advantages of the proposed framework are increased energy efficiency, lower associated costs, and increased community ability to promote sustainability. Furthermore, the framework enables HEIs to meet their sustainability objectives while also contributing to larger social, economic, and environmental efforts. The paper concludes by emphasising the importance of further research on the conceptual framework's implementation and effectiveness in promoting sustainability.

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