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IMPACT OF FACILITIES MANAGEMENT IN ACHIEVING SUSTAINABLE BUILDINGS

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Abstract: This paper aims to examine FM functions that relate to sustainable building (SB) throughout the phases of the building life-cycle. Many building designers progressively work towards achieving a sustainable environment in order to attain high level of satisfaction of occupants' comfort and safety and to meet the sustainable development (SD) agenda requirements. Facilities management (FM) is described as a practice that ensures effective operational management of buildings and can therefore be said to play an important role in creating this sustainable environment. However, it is imperative to consider if this integrative role helps in achieving SB. There is limited research in FM view in relation to SB. The research methodology adopted is the review of existing literature sources on SBs and the documents produced by BREEAM, LEED and ISO. The research methodology also involves a review of the competencies of FM as stated in FM professional standards. The paper evaluates the role of FM in relation to identified SB constituents at the design, construction and operations phases of the building life-cycle. The findings of the research reveal FM functions in relation to the SB constituents. These FM functions are found to be operative mostly at the design and operations phase. This paper helps FM professionals to identify their role in SBs and a need for them to function at the construction phase.
Keywords: Sustainable building, Sustainable development, Facilities management.

1.0 INTRODUCTION

The creation of sustainable living and workplace environment is the key focus of building designers, contractors and even building users in order to achieve high level of satisfaction of occupants' safety, health and comfort and to meet the SD agenda requirements. FM in its multi-tasking role has an important part to play in creating these sustainable environments and has been defined by many (Becker, 1990; Pearson, 2003; Armstrong, 2002; Alexander, 2003). This FM multi-disciplinary role involves activities within the built environment, which includes maintaining, improving and adapting buildings and assets through time, in the most cost effective way (BIFM, 2008) and is mostly related to buildings of all types (residential, commercial, healthcare, industrial, government, educational, agricultural, religious, and so on). In these buildings FM measures customer satisfaction to improve its services reflecting on the extent to which a building meets the needs of its users; addressing such issues as occupant performance, worker satisfaction and productivity (British Council

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for Offices, 2007; Preiser and Vischer, 2005).FM deals with all aspects of indoor environmental quality (Chan *et al*, 2008; Smith and Pitt, 2011); space management and plays an essential role in healthcare, with the provision of a well-designed and well-maintained good quality environment in hospitals, in order to improve overall healthcare quality (Richardson, 2001). Though FM has contributed immensely to the productivity and profitability of organisations and to the health and well-being of building users, its role in creating SBs is yet to be determined.

2.0 THE CONCEPT OF SUSTAINABLE BUILDING

The SB concept can be integrated into buildings of all types whether commercial, residential, healthcare, sports etc. A SB is a building that minimises the use of resources such as energy and water, unwanted outputs such as greenhouse gas, and maximises the health and wellbeing of users (Eley, 2011). John *et al*, (2005) describes it as the thoughtful integration of architecture with electrical, mechanical and structural engineering resources, considering the whole life of the building and taking environmental quality, functional quality and future values into account.

Buildings are responsible for the consumption of major amounts of energy, water and land usage and are therefore responsible for a great part of the world's environmental problems (Anink *et al*, 1996). A high percentage of non-renewable resources consumed across the world are used in the construction industry, making it one of the least sustainable industries in the world (Edwards, 2010). The built environment has a significant impact on the SD agenda as it accounts for nearly 40% of natural resources consumed, and 40% of waste and greenhouse gases generated (CIOB, 2004). Buildings use as much as 45% of generated energy to produce power for air-conditioning and heating (Wood, 2005; Reed *et al*, 2011). Buildings also account for one sixth of the world’s fresh water withdrawals, one quarter of wood harvested and two fifths of all material and energy flows (Emmanuel, 2004).The need for SBs arose as a result of the negative impact of the construction industry on the environment.

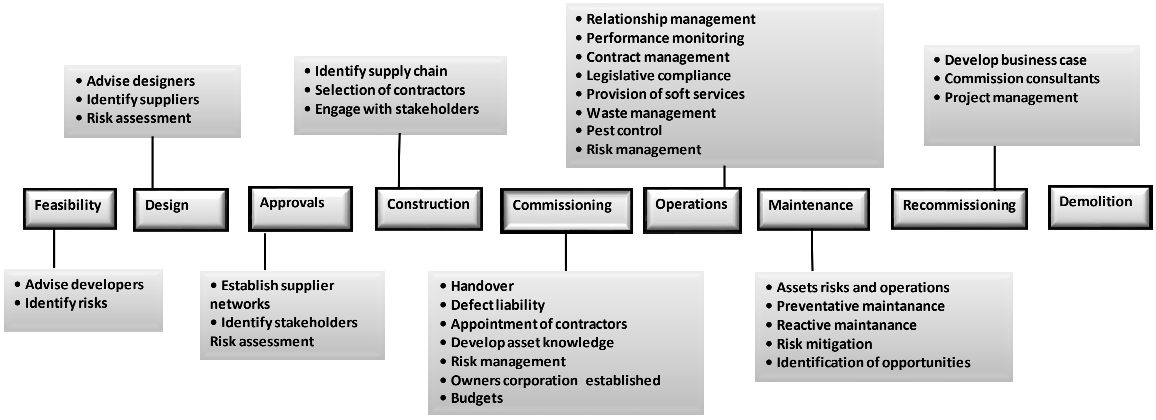
Though the construction industry has a history of negative impact on the environment such as being responsible for the consumption of major amounts of energy, water and land usage, yet it has a vital contribution towards achieving SD (Gibberd, 2002; Anink *et al*, 1996). It addresses basic human needs in terms of provision of housing and social infrastructure (Sinha *et al*, 2013). It also determines the quality of housing and access to services and recreation, promoting healthy living and socially cohesive communities (Shah, 2007). It is increasingly becoming a key consideration for building practitioners in the construction industry to achieve the aim of increasing economic efficiency, protect, and restore ecological systems and at the same time, improve human well-being with the development of SBs (Sinha *et al*, 2013). This according to BIFM (2014), RICS (2014), IFMA (2014) and FMMA (2012) is the sole aim of the FM practice. However, in order for FM practitioners to support the SB concept, there is need to understand the FM function in the phases of the building life-cycle.

3.0 FACILITIES MANAGEMENT AND PHASES OF THE BUILDING LIFE-CYCLE

According to Hodges (2005), facilities managers are specialised in the knowledge of the entire life-cycle of a building and manage the different phases as shown in Figure 5.1 in order to derive optimum value of the building at the most economical cost over its life-cycle (Then and Hee, 2013). The building life-cycle from a facilities manager's view does not start at the building handover but at the design phase and in particular, the initial briefing (Shah, 2007). At the design phase, according to Erdener, (2003) the early engagement of FM can contribute to reducing major repairs and alterations that will otherwise occur at the operational phase. However, few efforts have been made in the construction industry to involve FM in the design phase (Nutt and McLennan, 2000). To ensure from the very beginning that building facilities meet the objective of supporting core business and to reduce cost of major repairs and alterations, the facilities manager has to be involved in the entire design process(Kelly *et al*, 2005).

According to Preiser (1995), facilities managers when consulted in the design phase of a project, are able to highlight problems early and provide valuable information on building performance and operating costs. At the operations phase FM deals with the management of built assets and incorporates controlling services necessary for successful business operations of an organisation and for the ultimate satisfaction of the building users (Lavy *et al*, 2010). These built assets start to age from the moment they are completed and put in use and consequently needing maintenance throughout the life time of the building in order to achieve its effective and economical usage (Fakhrudin *et al*, 2011). This paper sets out to determine FM functions in creating SBs. However, in order to determine this, there is need to identify SB constituents and then determine if FM carries out its functions in line with these constituents.

Figure 1: FM Role and the Building Life-Cycle. FMA Australia (2012) as cited in Shiem-Shin and Hee, (2013).



4.0 Research Methodology

The research methodology used in this study involves an in-depth study and review of existing literature sources on SBs and the documents produced by the Building Research Establishment Environmental Assessment Method(BREEAM), the Leadership in Energy & Environmental Design (LEED) and the International Organization for Standardization (ISO). According to Yuhui (2013) BREEAM and LEED are the two most representative building sustainability assessment organizations in the world due to the wide coverage of building types, and environmental, social and economic issues.

The International Organization for Standardization (ISO) identifies and establishes general principles for SD in building construction. These international standards are set by technical committees made up of governmental and non-governmental international organisations in the UK. Draft international standards adopted by these technical committees are circulated to the member bodies for voting. National standards are set for publication when at least 75% of the member bodies have casted a vote on it. These international standards contribute to the achievement of SD either directly, where they specifically address SD issues, or indirectly, where they relate to testing, products, procedures, services, terminology, management systems or auditing (BSI, 2013).

The documents produced by these organisations are building assessment standards used in assessing a building's sustainable qualities, and these include; BREEAM New Construction UK,LEED New Construction US and the Sustainability in Buildings and Civil Engineering Works — Guidelines on the Application of the General Principles in ISO 15392. These documents address buildings at the design phase on the basis that a building can only be truly sustainable if designed having put sustainable measures into consideration. Through the years, they have contributed to the increase in awareness about the criteria and objectives of SD in buildings and have become a framework of reference to assess the sustainability of buildings. Though they present their assessment of what a SB is in different ways, yet they share a common framework. Therefore the justification in this research as documents that can be used to determine the constituents of SB. The research also includes an in-depth study and review of the competencies of FM as stated in FM professional standards which include Skills in Facilities Management Investigation into Industry Education (FMAA) 2012; the IFMA Complete List of Competencies as defined in the Global Job Task Analysis (GJTA) 2009 defining 11 core FM competencies including responses from facility managers in 62 countries; the BIFM Facilities Management Professional Standards Handbook 2014; and the RICS Assessment of Professional Competence Facilities Management Pathway Guide 2014.

These documents were selected on the basis that; they are produced by the British Institute of Facilities Management (BIFM), the International Facility Management Association (IFMA); and the Royal Institute of Chartered Surveyors Facilities Management Group (RICS FM group) established within the Royal Institution of Chartered Surveyors (RICS) respectively. These associations are globally accepted as bodies that deal with the FM profession and are the leading FM associations in the world. They define what FM is, explicate the scope of FM and elucidate the knowledge, skills, abilities and behaviours needed to perform FM tasks (Awang *et al,* 2011).

These documents are set as standards for facility managers and are relevant to the research study. Hence, the justification for using them to determine FM functions. The documents were studied and the FM functions as stated in each document were identified and examined. The various processes and activities involved in the design, construction and operations phases of the building life-cycle were also examined, in order to map identified FM functions in relation to SB at each phase. This was carried out in order to determine FM function in relation to SB.

5.0 FINDINGS

5.1 Sustainable Building Constituents

A review of BREEAM-NC,LEED-NC and Sustainability in Buildings and Civil Engineering Works — Guidelines on the Application of the General Principles in ISO 15392and of existing literature sources on SBs, has identified25 constituents common to both literature on SB and the above mentioned documents. The SB constituents include: Under the environmental aspect – building material use, energy use (local energy generation from renewable sources and reducing operational GHG emissions), energy use (solar), land use efficiency -previously developed sites, land use efficiency – ecological value of land, land use efficiency – biodiversity, air pollution, water and land pollution, light pollution and waste management; under the social aspect - adhering to ethical standards, adaptability for different uses, conserving local heritage and culture, accessibility, visual comfort, indoor environmental quality, thermal control, acoustic control, water quality and safe access; and under the economic aspect – building life-cycle cost, energy efficiency and management, water efficiency and management, material efficiency, and maintenance and management.

5.2 FM Functions in Sustainable Buildings

An examination of the FM professional standards as stated in Section 4.0was carried out using key word search of FM functions that are common to at least two of the documents selected above and these were compared to the identified SB constituents. FM functions were found to relate to 14 of the SB constituents as shown in Table 1 and these include under the environmental aspect: building material use, energy use (local energy generation from renewable sources and reducing operational GHG emissions), land use efficiency – ecological value of land, land use efficiency - biodiversity and waste management; under the social aspect: visual comfort, indoor environmental quality, thermal control and acoustic control; under the economic aspect: building life-cycle cost, energy efficiency and management, water efficiency and management, material efficiency, and maintenance and management. This is supported by studies carried out on FM and have shown FM to include supporting organisations to become more environmentally sound and provide environment and energy related services (Hodges, 2005; Roper and Beard, 2006; Wood, 2006; Junnila, 2007; Nousiainen and Junnila, 2008).

6 FM IN SUSTAINABLE BUILDING

6.1 FM in Sustainable Building at the Design Phase

In relation to FM functions in SB, the facilities manager at the design phase has the competence to advise designers and developers on building material use. He creates specification of construction materials with low environmental impact and responsibly sourced materials. He ensures that the designers specify these materials and the developer or the contractor complies with the specified materials (IFMA, 2014; RICS, 2014).

The facilities manager advises on energy use and efficiency, minimising operational energy consumption through good design, monitoring by sub-metering, use of energy display devices and use of energy efficient light fittings and equipment (IFMA, 2014; RICS, 2014;

FMAA, 2012; BIFM 2014). He is in a position to advise on the use of water efficient components and equipment, installation of water recycling systems, water consumption monitoring systems, water leak detection and prevention systems that help to reduce consumption of portable water for sanitary and occupants use from all sources (IFMA, 2014; FMAA, 2012; BIFM 2014). He is also in a position to recommend an appropriate waste management system; provision for reuse of recycled materials; and operational related recyclable waste facilities (IFMA, 2014; RICS, 2014; FMAA, 2012; BIFM 2014).

The facilities manager can give guidance on indoor environmental quality. He ensures a healthy internal environment through the specification of appropriate heating, ventilation and air-conditioning equipment and finishes (FMAA, 2012; BIFM, 2014). He recommends on issues that deal with day lighting, artificial lighting and occupant controls using the client requirement brief at the design stage to ensure best visual performance and comfort for building occupants (FMAA, 2012; BIFM, 2014).The facilities manager using the client requirement brief advises on appropriate thermal comfort levels to be implemented at the design phase and monitors installation of controls to maintain a thermally comfortable environment for occupants within the building (FMAA, 2012; BIFM, 2014). He can also advise on acoustic control, that is, the building's acoustic performance including sound insulation meeting the appropriate standards for the health and safety of occupants (BIFM, 2014; RICS, 2014).

At the design phase of the building life-cycle, the facilities manager carries out building life-cycle cost exercises in order to provide economic value of the building overtime and financial affordability for beneficiaries (IFMA, 2014; RICS, 2014). Though the facilities manager has the competence and ability to carry out the above named functions, he is hardly ever involved in the early stages of the design process (Nutt and McLennan, 2000).

Table 1. FM Functions in Relation to SB Constituents

		Constituents of Sustainable Building	FMAA
		Environmental Aspect	
1	√	Building material use - The faciliities manager advises, establishes and maintains specification of construction materials with low environmental impact and responsibly sourced materials.	
2	√	Energy - The faciliites manager influences appropriate use of local energy generation from renewable sources, alternative energy sources, reduction of operational GHG emissions resulting from refrigeration systems energy use, reduction of co_2 emissions from refrigeration systems, and energy efficient transportation systems in buildings (lifts, elevators, escalators or moving walks);	•
3		Energy - Maximum use of solar energy.	
4		Land use efficiency - Use of previously developed sites and/or contaminated land, and Non-use of virgin land;	
5	√	Land use efficiency - The facilities manager develops, implements and reviews procedures that protect the ecological value of land during site preparation and completion of construction works.	
6	√	Land use efficiency - The facilities manager introduces processes that encourage preservation and enhancement of biodiversity.	
7		Pollution - Use of systems that reduce GHG emissions, ozone depleting gas emissions, and No_x emissions;	
8		Pollution - Use of rainwater collection systems to reduce water pollution and land;	
9		Pollution - Reduction of night light pollution.	
10	√	Waste management - The facilities manager introduces, encourages and implements effective and appropriate management of waste; Reuse of recycled materials; and Provision of operational related recyclable waste facilities.	•
		Social Aspect	
11		Adhering to ethical standards.	
12		Adaptability for Different Uses - Providing a place that meets needs with a mix of tenure types and ensuring flexibility wherever possible.	
13		Conserving local heritage and culture - A building that contributes to social and cultural attractiveness of the neighbourhood leading to users and neighbours satisfaction.	
14		Accessibility to good public transport network and local infrastructure and services and alternative modes of transportation for occupants to reduce transport related pollution and congestion.	
15	√	Visual comfort - The facilities manager using the client requirement brief advices on daylighting, artificial lighting and occupant controls at the design stage to ensure best visual performance and comfort for building occupants.	•
16	√	Indoor environmental quality - The facilities manager ensures a healthy internal environment through the specification and monitoring installation and maintenance of appropriate heating, ventilation and air-conditioning equipment and finishes.	•
17	√	Thermal control - The facilities manager using the client requirement brief advices on appropriate thermal levels to be implemented at the design phase and monitors installation of controls to maintain a thermally comfortable environment for occupants within the building.	•
18	√	Acoustic control - The facilities manager using the client requirement brief advices on the building's acoustic performance including sound insulation meeting the appropriate standards.	
19		Water quality - Minimising risk of water contamination in building services through design, implementation, maintenance of relevant equipment and the provision of clean and fresh drinking water for building occupants.	
20		Safe access - Effective design measures that promote safe access to and from the building.	
		Economic Aspect	
21	√	Building life-cycle cost - The facilities manager carries out life-cycle cost exercises in order to provide economic value of the building overtime and financial affordability for beneficiaries.	
22	√	Energy efficiency and management - The facilities manager acquires knowledge and advises on energy efficiency principles, advises on minimising operational energy consumption through good design, monitoring by sub-metering, use of energy display devices and use of energy efficient light fittings and equipment.	•
23	√	Water efficiency and management - The facilities manager influences the use of water efficient components and equipment, installation of water recycling system, water consumption monitoring system, water leak detection and prevention systems to reduce comsumption of portable water for sanitary and occupants use from all sources.	•
24	√	Material efficiency - The facilities manager advises on maximising building material optimisation and minimising the frequency of material replacement and use of recycled materials.	
25	√	Maintenance and management - The facilities manager processes that involve the maintenance of the building and its services and minor works and repairs which ensures the durability and economic value.	•

6.2 FM in Sustainable Building at the Construction Phase

The facilities manager in relation to SB constituents has the skill to develop, implement and review procedures that protect the ecological value of land and introduces processes that encourage preservation and enhancement of biodiversity during site preparation and up until completion of the construction works (IFMA, 2014; BIFM, 2014). He also has the ability to identify and advise on suppliers of electrical and mechanical systems with low energy consumption and low co_2 emissions during installation works in preparation for the operations phase of the building (FMAA, 2012).

6.3 FM in Sustainable Building at the Operations Phase

At the operations phase, the facilities manager in relation to SB has the ability to maintain and manage processes that involve the maintenance of the building and its services and minor works and repairs which ensures the durability and economic value of the building (FMAA, 2012; RICS, 2014). He can advise on thermal control and monitor installation of controls to maintain a thermally comfortable environment for occupants within the building (FMAA, 2012; BIFM, 2014). The facilities manager monitors installation and maintenance of appropriate heating, ventilation and air-conditioning equipment and finishes, thereby ensuring indoor environmental quality (FMAA, 2012; BIFM, 2014).

7.0 Conclusion

In creating SBs, the facilities manager at the design phase has the competence to advise the design team on sustainable measures that can be incorporated into the design of the building and adopted at the construction phase in order to target the sustainable operability of the building at the operations phase. At the design phase, he advises on issues such as building material use, energy use and efficiency, water use and efficiency, indoor air quality, thermal and acoustic comfort, and carries out building life-cycle cost exercises in order to provide economic value of the building. The facilities manager monitors the installation works of the various services equipment at the construction phase, in preparation for the operations phase. At the operations phase he maintains and manages the building which he has practically created as a result of his recommendations.

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