

Analytical Review of Organisational Factors Affecting the Usage of Sustainable Building Materials in Sri Lankan Construction Industry

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Abstract

Sustainable development has been continuously emphasising globally, while Sri Lankan construction industry is debatable whether it is moving toward a sustainable future. This can be considered a topic worth rigorous investigation. Sustainability does not impose a constraint to the construction industry, the building sector has a strong global potential to help protect the environment which is lacking in Sri Lanka. The existing literature reveals a deficiency in theoretical and empirical knowledge in the use of sustainable building materials (SBM) in the construction industry. Accordingly, the objective of the paper is to fill this knowledge gap by pursuing to recognise the organisational factors that influence the use of SBM in the Sri Lanka construction industry from the perceptions of the facilities managers. Methodology used to achieve the objectives of this research were by literature review, content analysis and Interview survey (conducted by using purposive sampling method for data collection with twenty highly experienced facilities managers who are registered members of the Institute of Facilities Management Sri Lanka - IFMSL). Findings, indicated prominent three organisational factors (awareness and knowledge, top management commitment and local authority governance) that militate the use of SBM, out of twenty-two identified factors.

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Keywords: Sustainable Developments (SD), Sustainable Building Materials (SBM), Facilities Management (FM)

Introduction

The construction industry consumes around 40% of global raw materials and contributes to 40–50% of greenhouse gas emissions (Kasai, 1998; Huang et al., 2017). Therefore, it is important to understand the environmental issues surrounding the removal and extraction of raw materials, construction materials manufacturing, and how it effects in usage, is significant to ensure sustainability (Ofori, 2000; Ofori, 2007; Ranaraja et al, 2019). Sri Lanka, similarly as other countries, is focusing on achieving sustainability in the construction industry (Munasinghe, 2018), since the building sector is critical to the country's economic and physical growth, playing the fourth most important industry in the economy (CBSL, 2017). However due to the activities of the construction industry and other sectors, the state of achieving sustainability needs improvements and Sri Lanka is behind all expectations (Athapaththu and Karunasena, 2016). Further, the impact of the COVID-19 epidemic on the building industry has been unparalleled, which directly influences the national economy (Marwah and Ramanayake, 2021). It is critical to restore the sector's fallen pillars as a result of the COVID-19 pandemic, as well as to align with global construction industry trends to ensure long-term growth in the local context

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(Athapaththu and Karunasena, 2018). Therefore, the focus of this evaluation on the use of SBM in the construction industry, will be aided. Although the possibility is there for it to be achieved, its actualisation is confronted with lots of challenges by both internal and external organisational factors within the industry (Abisuga and Oyekanmi, 2014). Further, the practice of sustainability in the construction industry depends on the decisions taken by a number of people in the construction process as governments, owners, managers, professionals and so on (Abidin, 2010). As a professional having expertise in the management of buildings, the facilities manager can contribute to the achievement of sustainable buildings (SB) while implementing the use of SBM (Aaltonen et al., 2013; Olaniyi and Smith, 2015; Shah, 2007). This paper will be beneficial to identify the organisational factors affecting the usage of SBM in construction industry, which will help the professionals in Sri Lanka with adequate knowledge to mitigate economic aspects which obstruct going towards sustainable developments.

In the limited literature on use of SBM in the construction industry does not have strong analytical and theoretical frame works to support the knowledge obtained by the scholars through systematic research work in this field expect few, and also there is no literature on organisational factors affecting the usage of SBM in relation to Sri Lankan construction industry. This paper has considered above considerations in deciding the objectives. The objective of this paper is to establish analytical and theoretical basis to identify organisational factors that militate against the use of SBM in economic aspects in Sri Lankan construction industry.

Research Questions and Objectives

Hence, there is a need to address questions to achieve the above statement: What constitutes sustainable building materials and sustainability standards? What is the role of facilities managers in achieving sustainable buildings in Sri Lanka? What are organisational factors that affect against the use of sustainable building materials in the construction industry in Sri Lanka?. Therefore, research objectives were designed to answer the aforementioned questions as below:

1. To identify SBM and their internationally recognised standards, sustainable developments, sustainable building constitutes, sustainable construction and sustainable buildings in economic aspects in relation to SBM.
2. To identify the role of facilities manager in relation to economic aspects in sustainable building constitutes in focus of use of SBM in sustainable building life-cycle.
3. To evaluate the organisational factors that affect against the use of SBM in economic aspects in Sri Lankan construction industry in perception of FM and to propose the need for implications of the findings that will contribute theoretically and practically.

Methodology

The specific nature and the objective of this paper necessarily make the author adopted the sequential approach of the mixed methods strategy, starting with the qualitative method and followed by the quantitative approach. Therefore, in this paper included combination of extensive literature review, content analysis of relevant literature on BREEM-New Construction, LEED-New Construction and Sustainable Building and Civil Engineering Works –Guidelines of Applications of General Principals in ISO (1539): in order to identify sustainable building constituents, sustainable building materials and recognised standards. it also included content analysis of British International Facilities Management Professional standard Handbook; The International Facilities management Association Complete List of Competencies; The Facilities Management Association Australia Skill in facilities Management investigation into Industry Education and Royal Institute of Chartered Surveyors Assessment of Professional Competence Facilities Management Pathway Guide; in order to identify the facilities manager's role in sustainable building (SB), economic aspects in focus of use of SBM in sustainable building life-cycle.

This review process covers the published journals, research articles and papers in SB and SB constitutes, SB constituents in economic aspects and its importance in sustainable development, role of facilities managers in economic aspects in SB construction and organisation factors that affect against the use of SBM in economic aspects in the construction industry with in the period of 1999 to 2022, in order to provide a sound review paper.

Content validation and Face validity of all documents were carried out in order to identify sustainable building constituents in use of SBM and facilities manager's role in achieving them. All questions in the developed questionnaire were adopted from previous studies. By doing so, content validity was thus ensured. The above involves the first stage of the paper. The quantitative method was then adopted by the application of a questionnaire survey in order to confirm and generalise results to a population and to further explore findings of the qualitative method. Reliability was tested next to see whether the items measure the concept and how well/positively correlated together as a set. The finding of first stage were used to analyse the importance of an interview questionnaire on twenty registered members of the IFMSL who are experts in the field, as stage two by full fling objective three. For interviews Digital methods were adopted by the use of purposive sampling method which is usually appropriate in selecting cases that are informative to research (Marshall and Rossman, 2014; Neuman, 2011).

Sustainable Building Materials (SBM)

Sustainability in construction is all about following suitable practices in terms of choosing materials, their sources and construction methodologies as well as design philosophy, so as to be able to improve performance, decrease the environmental burden of the project, minimize waste and be ecologically friendlier, taking into consideration environmental, socio-economic and cultural values (Matar et al., 2008.).

SBM can be defined as materials with overall superior performance in terms of specified criteria's (Kien and Ofori, 2002; Huberman & Pearlmuter, 2008). For Selection of SBM the following criteria are commonly used: Locally produced and sourced materials, transport costs and environmental impact, thermal efficiency, occupant needs and health considerations, financial viability, recyclability of building materials and the demolished building, waste and pollution generated in the manufacturing process, energy required in the manufacturing process, use of renewable resources, toxic emissions generated by the product, maintenance costs (Marwah and Ramanayake, 2021). Further, the Green Building Materials '96 (GBM '96) conference brought building materials and products into the process of defining 'sustainable building materials', exhibiting certain needed characteristics to understand SBM (Kibert and Bosch, 2016; Kibert, 1994). For the last few years many information sources have been created for environmentally friendly building materials with different objectives and different methods of publishing. Therefore, it is necessity to implement sustainable measurement tools in order to assets a SBM performance prior it is built, such as: Cumulative Energy Demand Systems (Pulselli et al., 2007), Life-cycle Analysis (Zabalza et al., 2013), Total Quality Assessment System such as ITEM, BREEM, LEED, SB Tool and CASBEE (Alyami and Rezgui, 2012).

Sustainable Developments (SD), Sustainable Building Constitutes, Sustainable Construction (SC) and Sustainable Buildings (SB)

SD ensures that human beings have a healthy and productive life in harmony with nature (Moldan et al., 2012; Hopwood et al., 2005; Alnaser et al., 2008; Vander-Merwe, 1999; Shah, 2007; Sev, 2009; Jacobs, 1995; Lowe, 1990; and Porritt, 2005; Baker, 2006). Even though SD has many definitions by many authors it is evident that the Brundtland Report gave a worldwide accepted definition of SD as 'meeting the needs of the present without compromising the ability of future generations to meet their own, economy and social issues and aspects improving the quality of

living (Burton, 1987; needs' (WCED, 1987). The Brundtland report points out the interconnecting nature of the environment (Baker, 2006; Ogujiuba et al, 2012, Kang et al., 2015). Below Table 01 highlights 'resource use' under economic aspects in sustainable developments which derives to SBM, captured in this paper.

Table 01: Economic, Environmental and Social Issues Comprising Sustainable Development

Economic	Environment	Social
Profitability, wages and benefits, resource use , labour productivity, job creation, human capital and expenditures on outsourcing	Impacts of processes, products, services on air, water, land, biodiversity, human health	Workplace health, and safety, community relations, employee retention, labour practices, business ethics, human rights, working conditions

Source: Shah (2007)

Oxford Advanced Learner's Dictionary defines a 'constituent' as 'one of the parts of something that combine to form the whole'. The research identifies the constituents that make up SB. 'Constituents' are referred to as a process that contributes to a building's sustainable performance under categories as aspects of SD.

These constituents in economic aspects (Table 1) were derived from literature review (Olaniyi, 2017) and content analysis of building sustainability rating tools as BREEM-New Construction, LEED-New Construction and Sustainable Building and Civil Engineering Works–Guidelines of Applications of General Principals in ISO: 1539, which highlights 'material efficiency' under sustainable building constituents under economic aspects which derives to SBM.

In literature as below Table 02, six constituents in economic aspects were highlighted. However, some constituents occurred in more than one aspect. For example, Ruska and Häkkinen (2014) states that Materials efficiency in relation to scarce use of materials, land use, and environmental impacts which relates to manufacturing and manufacturing of materials of environmental aspect of sustainable building constituents. This research views it from the perspective of economic impact. Therefore, it is categorised under the use of SBM and under economic aspect as material efficiency.

Table 02: Sustainable Building Constituents in Economic Aspects

Author /Year	Definition
Water efficiency	By use of water efficient components and equipment, installation of water recycling system, water consumption monitoring system, water leak detection and prevention systems to reduce consumption of potable water for sanitary use to save for the building owner and user.
Material efficiency	In terms of building material optimisation and replacement and use of recycled materials to save for the building owner and user.
Maintenance	Provision for maintenance of the building and services which ensures the durability and economic value.
Energy efficiency	Which involves minimising operational energy consumption, monitoring energy usage, use of energy display devices and use of energy efficient light fittings and equipment to save for the building owner and user.
Waste Management	Management of construction waste
Building life-cycle cost	which involves provision of economic value overtime and financial affordability for beneficiaries

Source: Olaniyi (2017)

SC involves the integration of the economic, social and environmental aspects into the planning, construction and demolition stages of the building. SC was first defined at the first International Conference (1994) in Tampa, Florida as ‘the creation and responsible management of a healthy built environment based on resource efficient and ecological principles’ (Kibert, 1994; Dickie and Howard, 2000; Sev, 2009; Ibrahim et al, 2013; Al-Yami and Price, 2006). Du Plessis (2002), also defines SC as a process in which the principles of SD are applied to the construction cycle, that is, from the mining of raw materials, to the planning, designing, and construction of buildings and even till demolition. Sustainable construction’s positive impact on the built environment is pushing buildings that are sustainable to the forefront. Hence, the introduction of SB, as it relates to the quality and characteristic of the actual structure created using the principles of SC. The processes of SB design have resulted in SC (Sev, 2009).

When a building is designed to achieve the purpose for its use with minimum environmental impact, it will contribute to achieving SB as authors Baldwin (1991); Berardi (2012); Wallbaum, Marcel, Janser and Windlinge (2012); OECD (2003), defines it as a building that involves building practices, which strive for integral quality and which includes economic, social and environmental performance in a broad way. Thereby, leading to the rational use of natural resources and appropriate management of the building stock, and contributing to saving scarce resources, reducing energy consumption, and improving environmental quality. SB involve active processes where policies developed by the government and voluntary organisations support SC (UNEP, 2009). Therefore, it is inevitable to understand the impacts of SD in the construction industry.

Role of Facilities Management (FM) in Economic Aspects in Sustainable Building Construction Industry

There are many definitions describing FM by different authors (FMAA, 2019; EuroFM, 2014; IFMA, 2014). According to Shah (2007) the efforts towards a sustainable built environment, is making facilities managers align their practice with the sustainable development agenda. This is evidenced by how facilities managers play a key role in the environmental performance of buildings by supporting their organisations in efforts to minimise environmental impact (Aaltonen et al., 2013; Shah 2007; Alexandra, 2003).

However, to identify their specific roles in economic aspects in sustainable buildings, this paper looks into the facilities managers roles as highlighted in FM competencies’ documents namely: the Facilities Management Professional Standards Handbook developed by British Institute of Facilities Management (BIFM); the IFMA Complete List of Competencies as defined in the Global Job Task Analysis (GJTA) developed by International Facilities Management Association (IFMA); and the Assessment of Professional Competence Facilities Management Pathway Guide developed by Royal Institute of Chartered Surveyors (RICS) FM group. The research sets out to identify which of their competencies relate to FM roles that relate to economic aspects in sustainable building constituents and the use of SBM in Sustainable Building at Building Stages of Design, Construction and Operation of the building Life Cycle (Table 2).

Further, Table 03 identify the sustainable building through design to construction and operations stages considering economic aspects, to understand the stages that FM will be involved in sustainable constructions. Highlighted areas define relationship on SBM, captured in this paper.

Literature depicts the involvement of facilities managers in use of SBM, throughout building life cycle, giving importance to FM in the use of SBM in the construction industry.

Table 03: Facilities Managers Role in Economic Aspects in Sustainable Building at Design, Construction and Operation of the building Life Cycle.

Facilities Manager's Role at Design	Facilities Manager's Role at Construction	Facilities Manager's Role at Operations
Advises and specifies water efficient fittings	Ensures installation of water efficient fittings	Monitors water consumption and carries out activities that reduce waste of water.
Advises on minimising the frequency of material replacement at design	Ensures use of recycled materials at construction	Carries out maintenance of the building and services which ensures the durability and economic value
Advises on design that ensures energy efficiency	Monitors installation of energy efficient lighting fittings and equipment.	Monitors energy consumption to reduce energy usage
Carries out building life-cycle cost exercises for building material selection.	-	-

Source: Author compiled the table based on BIFM (2015); IFMA (2017); and RICS (2015)

Table 04: Facilities Managers Role in Economic Aspects in Sustainable Building at Design, Construction and Operation of the building Life Cycle.

	FM Role in Sustainable Buildings Economic Aspect: Material efficiency	No. of documents mentioning constituent			
		BIFM	IFMA	RICS	
1	Advises on minimising the frequency of material replacement at design.	✓	✓	✓	3
2	Ensures use of recycled materials at construction.	✓	✓	✓	3

Source: Olaniyi (2017)

The Importance of Economic Aspects in Sustainable Development

The construction industry has led the highest negative impact on the economic aspects and people as in Table 05.

Table 05. The Main impacts of the building construction industry

	Impacts		Environmental	
	Social	Economic		
Raw material extraction and consumption, related resource depletion			●	●
Land use change including clearing of existing flora			●	●
Energy use and associated emissions of greenhouse gasses			●	●
Other indoor and outdoor emissions			●	●
Aesthetic degradation				●
Water use and waste water generation			●	●
Increased transport needs depending on site			●	●
Waste generation			●	●
Opportunities for corruption				●
Disruption of communities including through inappropriate design and materials				●
Health risks on worksites and for building occupants				●

Source: Sev (2009)

Further, there is enough evidence to conclude that the construction industry is one of the most resource-intensive and high impactful sectors in any economy. The quota on global material resources, energy, and water uses as well as waste generation due to the construction industry is highly significant: it is responsible for 33.33% of material consumption, 11% of global energy-related CO2 emissions, and 54% of landfills due to lack of proper end of life cycle management methods. The building materials have an environmental impact at every life cycle stage: extraction of raw materials, processing, manufacturing, transportation, construction, demolition, and disposal at the end of the building's useful life (Herath et al., 2021). In spite of this, the creation of the built environment remains vital to any country's economic development (Sev, 2009; Hategan and Ivan-Ungureanu, 2014; Strong and Hemphill, 2008). Therefore, this paper captures the economic aspect concerning use of SBM in the construction industry.

Organisation Factors that affect against the use of Sustainable Building Materials in the Construction Industry

The use of SBM in the construction industry still faces a lot of challenges for its implementation, relating issues which influence the organisational environment and how the management of such organisations respond to it. Based on literature, they noted the factors militating against the use of SBM as in Table 06.

Table 06. Organisational Factors Affecting Against the Use of Sustainable Building Materials in the Construction Industry

Organisational Factors	No	Reasoning	Author(s)
Challenges faced in implementation of sustainable building materials used in the construction industry.	1	The real or perceived financial cost and risks which include the problem of the upfront cost and the ongoing costs usually coming from separate budgets, if not separate organizations	Landman, 1999; Anderson et al, 2000; Rao and Brownhill, 2001; Athapaththu et al., 2016; Abeyesundara et al. 2009; Egab, 2004; Edward, 2006; Lam et al., 2010; Kibert and Bosch, 1998; Abidin, 2010.
	2	The lack of information and training of designers, contractors and clients.	
	3	Lack of demand from the clients.	
	4	Lack of support from subcontractors.	
	5	Regulation	
Challenges faced in implementation of sustainable building materials used in the construction industry in internal organizational factors within construction organisation system.	6	Lack of awareness and knowledge of construction personnel	Abidin, 2010; Athapaththu and Karunasena, 2016; Anderson et al., 2000; Baldwin and Malcolm, 1991; Landman, 1999; Rao and Brownhill, 2001; Abisuga and Oyekanmi, 2014; Jayalath and Gunawardhana, 2017.
	7	Size of developers organization	
	8	Top management commitment	
	9	Lack of awareness and knowledge of Cost versus economic viability	
	10	Target buyers	
	11	Passive culture	
	12	Organisational goal and objectives	
Challenges faced in implementation of sustainable building materials used in the construction industry in external organizational factors within construction organization system	13	Research and development	Landman, 1999; Anderson et al, 2000; Abidin 2010; Baldwin and Malcolm, 1991; De Silva and C.S.,2006; GBCSL, 2010; Jayalath and Gunawardhana, 2017.
	14	Knowledge and skill of personnel	
	15	Learning period	
	16	Public interest and Buyers demand	
	17	Local authority and governance	

External challenges refer to challenges not within the organization in implementation of sustainable building materials used in the construction industry	18	Public interest and Buyers demand	Abidin (2010); GBCSL(2010); De Silva and C.S.(2006); Emmanuel (2004); Landman, (1999) and Anderson et al, (2000).
	19	Status quo in rules and regulations	
	20	Availability of green materials	
	21	Learning period	
	22	Associating sustainable concept with luxury living	

Source: *Abisuga and Oyekanmi.(2014)*

Literature states, the use of SBM in the construction industry still faces a lot of challenges for its implementation. Based on the studies of Landman (1999), Anderson et al, (2000), Rao and Brownhill, (2001), Abidin (2010) they noted the factors militating against the use of sustainable building materials as in Table 05. All these factors are more of organisational considering macro and micro environments, related issues which influence the organisational environment and how the management of such organisations respond to it. Internal factors relate to the strength within the construction organisation system which indicates its readiness and capability to pursue or practice sustainable construction by employing SBM in construction purpose. The external challenges refer to challenges not within the organisation, beyond the direct control of the construction industry organisations that impose certain restrictions or limitation towards the development of sustainable material usage implementation in the industry.

These aspects of Table 06. will be further analysed by an interview survey. The findings gave an understanding of critical issues in implementation of SBM in organisations with relation to the Sri Lankan construction industry. Analysis of submitted questionnaire findings denoted that; lack of awareness and knowledge of construction personnel (6), top management commitment (8), local authorities' and government's (17) involvement were critical issues in implementation of SBM in Sri Lanka. Further, with reference to literature and interview questionnaire conclusions were discussed.

As below Table 07. three dimensions; Lack of awareness and knowledge of construction personnel, Top management commitment and Local authority and governance were recognised to understand the factors affecting the use of SBM in Sri Lankan construction industry, in perception of facilities manager's.

Table 07. Organisation Factors affecting against the use of Sustainable Building Materials in the Sri Lankan Construction Industry in perception of facilities managers

Dimensions	Definition	Author(S)
<ul style="list-style-type: none"> Awareness and knowledge of construction personnel 	A factor that affects the use of SBM, which indicated a problem at the level of knowledge and skills or both and also the lack of practical understanding of sustainability has hampered the effective implementation of the concept in the construction process	Landman, 1999; Anderson et al., 2000, Rao and Brownhill, 2001.
<ul style="list-style-type: none"> Top management commitment 	It characterised the organisation's decision-making process whether to implement sustainability practice in their construction activities or not. In addition, the reason why the practice of the use of SBM value is geared towards profit-making in accordance.	
<ul style="list-style-type: none"> Local authority and governance 	Enactment and enforcement of law as a factor that affect the practice of sustainability in the construction industry.	

Source: *Author compiled the table based on Landman (1999); Anderson et al.(2000); and Rao & Brownhill (2001)*

Discussion

This paper is a scholarly initiation which has qualitatively substantiated that the existing literature and research works on sustainable developments and sustainable building constituents in economic aspects, sustainable materials and facilities managers' role in achieving sustainable buildings. In this review, an appropriate attempt was made to apply the relevant theory for the study presented by the Brundtland report, pointing out the interconnecting nature of the environment, economy and social issues and aspects improving the quality of living (Burton, 1987). This paper emphasises on economic aspects in sustainable developments, concentrating on SBM.

This review process began with brief introduction which briefly highlighted the current condition of the construction industry and the need for sustainability in material usage in construction, followed with methodology. Next the paper defines sustainable developments, sustainable building constituents, sustainable construction and sustainable buildings in economic aspects in relation to SBM. This paper holds in view of facilities manager's on organisational factors that militate the use of SBM in construction industry. Therefore, the study reveals analysis through literature on the role of facilities manager in relation to economic aspects in focus of use of SBM in sustainable building life-cycle. Main focus curtains on macro and micro-organisation factors affecting against the use of SBM. However, it is not possible to give a comprehensive explanation due to limitations of this paper. Therefore, above themes were discussed in order to fulfil the objectives.

Finally, with reference to literature and interview analysis on organisational factors effecting against the use of SBM in Sri Lankan construction industry, three prominent dimensions were discovered as; lack of awareness and knowledge of construction personnel, top management commitment, local authorities' and governments. Through this finding, ultimately expected that the identification of organisational factors affecting the usage of SBM in construction industry will help the professionals in Sri Lanka to adequate knowledge to mitigate aspects which obstruct going towards sustainable developments.

Conclusion

Based on the review, concluded that Lack of awareness and knowledge of construction personnel, Top management commitment, Local authorities' and governments were curtailed aspects that militate against the use of SBM in Sri Lankan construction industry in view of facilities managers.

The paper has identified 51 sustainable building constituents with 6 under economic aspects. However, there is probably more empirical studies that can be conducted to identify more constituents under this aspect. This paper will be essential in order to expand the scope for further research on sustainable building materials. Further, this paper also identified 44 roles that facilities manager can carry out at the design, construction and operation stages of a building life-cycle in achieving sustainable buildings. More empirical studies can be conducted to identify additional roles in relation to sustainable buildings.

However, this review can be considered as a logical effort within the limitations. It will contribute for a certain extent in establishing strong analytical and theoretical knowledge obtained by the scholars through systematic research work in the above topic.

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