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Significant Sustainable Facilities Management (SFM) Practices in the Health Care (HC) Sector

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Abstract. Health Care (HC) is identified as one of the most polluting industries. HC is recognised as the second energy intensive sector emitting 8% out of total 40% of CO₂. HC is also ranked among the top 4 sources in spreading harmful substances in affecting health and wellbeing of the society. Facilities Managers are identified to be in a unique position to manage the building's operations and hence integrating sustainability in the current practice of Facilities Management (FM) in HC sector. However, identification of sustainable FM practices is challenging as FM practice differ in terms of facility type, building engineering system, organisation's business sector and culture. In this regard, the paper investigates the significant FM services and practices in integrating sustainability in HC sector.

The study used a two round Delphi survey involving 10 experts who are specialised in FM and sustainable practices in the HC sector to identify the most significant FM services and sustainability practices. The results identified 8 FM services and 44 sustainability practices as significant. Building services (BS) was identified as the most significant FM service, whilst practices such as "identifying applications for energy saving measures" and "ensure appropriate onsite, off-site storage, transport of wastes" were identified as the most important sustainability practices. The results of the study will be further carried forward to a questionnaire survey to rank and assign scores for each significant sustainability practices in order to develop an assessment framework to evaluate the SFM practice in HC sector.

1. Background

Facilities Management (FM) is one of the emerging, multi-disciplinary professions that covers a variety of FM services [1]. It has evolved and witnessed a rapid development [2,3] from being a non-core function to delivering strategic decision making process [4]. In today's context, adaptation of sustainability into the FM practice enables to deliver effective strategic support to organisations [5]. This is emphasised by Ikediashi, Ogunlana and Ujene [6] stating that embracing sustainability in FM practice is recognised as a strategic response. However, integrating sustainability into FM practices are not the same for all organisations rather, it is firm specific and differs in terms of facility features, organisational scale, business sector, organisation characteristics, context of operation and culture [7]. For example facility types such as; residential, educational, institutional, business, industrial, HC and storage buildings require different types of services as these facilities, vary in terms of its building engineering system, building ownership, scale, location and building type. The varying nature of sustainability practices in terms of



different facility types are identified in the following studies. For example, the study of Nielsen, Jensen and Jensen [8] identified sustainability practices such as green accounting, individual metering, energy management and energy labelling etc., for housing sector. In another study by Shari and Soebarto [9], eliminating sick building symptoms, accessibility to public transport, energy efficient facilities, water efficient facilities and 3Rs in waste management practices, are listed for office buildings. Furthermore, using high quality and long lasting material (linen), recycling waste water, installing low-flow sinks, toilets, showers and designing to preserve views were highlighted in hotels [10]. This showcases that, different types of buildings demand different types of FM sustainability practices.

In recent years integrating sustainability in Healthcare (HC) sector has taken much importance as it is identified as the second energy intensive sector emitting around 8% out of total 40% of CO₂ emissions [11]. It is also ranked amongst the top 4 sources in polluting and spreading harmful substances to air, land and water [12]. Even though HC is recognised as “caring for the healthy” it undermines the population by being a threat to their health and wellbeing [29]. Thus, there is a general push to bring the HC sector to incorporate sustainable practices. This creates a demand for FM to adopt sustainability practices in the HC sector as they are identified to be in a unique position to deliver real differences in retrofitting sustainability practices in buildings [13, 14]. In this context, Sustainable FM (SFM) is defined as “delivery of sustainability within FM” [15]. The general idea of SFM is to incorporate sustainability practices into the operations of FM [16]. In essence, Nielsen and Galamba [17] assert that, SFM does not create totally new practices, but rather incorporating practices concerning the social, economic and environmental principles of sustainability into the existing FM practice.

Moreover, FM to gain progression in sustainable practice, performance evaluation is identified as one of the essential strategies [18]. Accordingly, Lai and Chui [19] and Neely, Gregory and Platts [20] have highlighted the importance of adopting a holistic approach i.e. consideration of economic, environment and social principles of sustainability to assess the SFM practice. However, it is identified that the current evaluation of sustainable performance is not focussed on all aspects of sustainability principle. For example, LEED, BREEAM and Green Globes have a specific version for HC facilities focused on the environmental principle, with limited focus to social and economic principle. Moreover, Baaki et al. [16] also recognised the need of assessing SFM in relation to economic, environment and social aspect, yet the research did not state how SFM practices can be evaluated. Similarly, Graubner, Pelzeter, & Pohl [21] highlighted the importance of assessing the performance of SFM practices in German facilities. Nevertheless, this research was generalised to all facility types suggesting 23 sustainable criteria, and emphasising the requirement of having different criteria for different facilities. Further, there is lack of clear evidence to support the research into the performance evaluation of SFM practice in HC. Hence, a gap exists in identifying SFM practices, and to develop a holistic approach focussing on economic, social and environmental aspects to assess SFM in HC sector.

Therein, a critical literature review was conducted in which 11 FM services such as; Building services (BS), Real estate management (RE) [22]; Information technology (IT), Human resources management (HR), Risk management (RM), Quality management (QM), Marketing management (MM), Planning and programming (PP) [7]; Space planning (SP), Operations Management (OM), Finance management (FM) [24] were sighted frequently and identified to be integrated into the current operations of FM in HC sector. In addition, the literature review identified 91 HC specific sustainability practices for example; provision for view out areas to support healing environment [25], provide sustainable ambulatory care [26] and introduce telecare, home care, video and teleconferencing facilities [27] etc. with respect to each individual FM service. Moreover, 33% of these sustainability practices were identified in meeting the social principle, 36% of sustainability practices meeting the environment principle and 31% meeting the economic principle of sustainability. Herein it is evidenced that the FM services and sustainability practices identified cover all 3 sustainability principles and hence provide a holistic view of sustainability in the HC sector.

The aim of this paper is to gain insights into identifying significant FM services and sustainability practices in HC sector from the aforementioned practices. In essence, the paper consist of four main sections. The next section explains the research design and methods adopted. Subsequent section

presents findings of the Delphi technique in which results of the significant FM services and sustainability practices are presented with respect to the HC sector. Finally, discussion of findings, conclusions and recommendations are presented.

2. Research Methodology

This research adopted a Delphi technique consisting of two rounds. This Delphi survey was conducted among 10 experts including (05) facility managers, (03) engineers, (01) medical director and (01) quality manager who possessed more than 10 years of experience in FM practices in HC. These experts were provided with the list of 11 FM services and 91 sustainability practices identified from the literature review to identify the most significant FM services and sustainability practices.

The experts were asked to rank the significant of FM services and sustainability practices according to a five-point Likert scale, where 1 referred to “not at all important” and 5 referred to “very important”. Five point Likert scale was used as that is readily comprehensible, to be less confusing to respondents and enables them to express their views easily [23].

Data analysis was conducted using relative importance index (RII) and only those FM services and sustainability practices received a value of over 0.70 were considered appropriate and significant [6] and the rest were further carried to the subsequent rounds of Delphi technique to attain consensus. Thus RII was calculated using the equation;

$$RII = \frac{\sum W}{A * N} \quad (1)$$

where, W is the weighting given by the respondents from 1 to 5; A is the higher response integer (5); and N is the total number of respondents. With respect an overall ranking was given based on the obtained RII values for each FM service and sustainability practice.

However, as each FM service's significance varied in integrating sustainability the given overall ranking for each sustainability practices were not substantial. Thus, an overall performance weightage (OPW) [28] was calculated using the Equation (2) for each sustainability practices and weighted ranks were provided for all the sustainability practices.

$$X_{i,k} = RII_i * RII_{i,k} \quad (2)$$

where $X_{i,k}$ is the OPW of the kth sustainability practices of the ith FM service; RII_i is the value of the ith FM service; $RII_{i,k}$ is the value of RII for the kth sustainability practices of the ith FM service which is obtained through the equation 1. Then each FM service's, sustainability practice's OPW is added as shown in the Equation 3 to obtain the FM service's weighted rank.

$$W.FSer_i = \sum_{k=1}^n OPW_{k,i} \quad (3)$$

Where, $W.FSer_i$ is the total OPW weight of the ith FM service; $OPW_{k,i}$ is the kth sustainability practice's OPW value of the ith FM service (where $k=1,2,3,\dots,n$)

3. Results and Findings

Table 1 presents the RII values, overall ranking, OPW, W.FSer weights and presents the weighted ranking for each FM service and sustainability practice.

Table 1. Significant FM services and sustainability practices

FM services and sustainability practices for HC sector	RII – Eq(1)		Overall ranking		OPW – Eq(2)	W.FSer – Eq(3)	Weighted ranking	
	FM Ser	Sus. Pr	FM Ser	Sus. Pr	Sus. Pr	FM Ser	FM Ser	Sus. Pr
Building Services (BS)	0.94		1			18.368	1	
BS-1 Ensure appropriate onsite, off-site storage and transport of wastes		0.96		1	0.9024			1
BS-2 Identify applications for energy saving measures		0.96		1	0.9024			1
BS-3 Minimise waste		0.94		3	0.8836			3

FM services and sustainability practices for HC sector	RII – Eq(1)		Overall ranking		OPW – Eq(2)	W.FSer – Eq(3)	Weighted ranking	
	FM Ser	Sus. Pr	FM Ser	Sus. Pr	Sus. Pr	FM Ser	FM Ser	Sus. Pr
BS-4 Maintaining differential pressure controls		0.94		3	0.8836			3
BS-5 Conduct energy audits and determine energy usage		0.94		3	0.8836			3
BS-6 Treat infectious wastes before final disposal		0.92		6	0.8648			6
BS-7 Maintain proper directional airflow controls		0.92		6	0.8648			6
BS-8 Use of renewable energy sources		0.92		6	0.8648			6
BS-9 Reduce pollution through sewage and waste water		0.92		6	0.8648			6
BS-10 Reduce carbon emission & fleet-fuel consumption		0.92		6	0.8648			6
BS-11 Execute the HC waste management plan.		0.90		13	0.8460			11
BS-12 Follow appropriate colour coding system		0.90		13	0.8460			11
BS-13 Follow appropriate 3R, 5S system and zero waste		0.88		18	0.8272			13
BS-14 Incorporate suitable filtration		0.88		18	0.8272			13
BS-15 Ensure proper thermal comfort		0.86		23	0.8084			16
BS-16 Deploy Integrated Pest Management strategy		0.86		23	0.8084			16
BS-17 Improve indoor environment quality of HC		0.84		27	0.7896			20
BS-18 Improve the acoustic level of HC		0.84		27	0.7896			20
BS-19 Use of proper infection & dust control measures		0.82		36	0.7708			23
BS-20 Use of alternative supply sources Eg: boreholes, rainwater harvesting		0.82		36	0.7708			23
BS-21 Preserve heritage		0.80		41	0.7520			25
BS-22 Use of sensors in applicable perimeter zones		0.80		41	0.7520			25
Quality management (QM)	0.90		2			3.0240	2	
QM-1 Carry out disease prevention duties		0.88		18	0.7920			18
QM-2 Create awareness on biosafety requirements		0.86		23	0.7740			22
QM-3 Appropriate quality are followed in cleaning process		0.82		36	0.7380			28
QM-4 Monitor water quality standards and safety		0.80		41	0.7200			35
Space planning (SP)	0.90		2			1.5300	7	
SP-1 Use of proper landmark and symbols features		0.80		41	0.7200			35
SP-2 Alignment of proper indoor environment		0.90		13	0.8100			15
Financial Service (FS)	0.88		4			2.2440	5	
FS-1 Consider LCC analysis in all departments		0.90		13	0.7920			18
FS-2 Evaluating and prioritizing capital investments		0.84		27	0.7392			27
FS-3 Avoid supporting and allocating funds against projects that are clearly unsustainable		0.70		40	0.7128			39
Risk Management (RM)	0.86		5			2.1672	6	
RM-1 Conduct environmental infection control		0.84		27	0.7224			30
RM-2 Conduct risk assessment in case of any catastrophic event		0.84		27	0.7224			30
RM-3 Maintain a Proof of notification of hazardous substance released		0.84		27	0.7224			30
Information Technology (IT)	0.84		6			1.428	8	
IT-1 Introduction of HC building management system		0.86		23	0.7224			30
IT-2 Transforming Electronic Medical Records (EMR) systems to Health Information Exchange (HIE) platforms		0.84		27	0.7056			40
Planning and programming (pp)	0.82		7			2.8208	3	
PP-1 Plan for HC waste management		0.90		13	0.738			28
PP-2 Implement a hospital water safety plan		0.88		18	0.7216			34
PP-3 Introduce telecare, home care, video and teleconferencing facilities		0.84		27	0.6888			41
PP-5 Plan for reduction of carbon emission from all operational activities		0.82		36	0.6724			43
Operations management (OM)	0.78		8			2.7768	4	
OM-1 Reduce distance travels from suppliers		0.92		6	0.7176			37
OM-2 Purchase of environment friendly product		0.92		6	0.7176			37
OM-3 Use of less toxic cleaning agents		0.88		18	0.6864			42
OM-6 Provide sustainable ambulatory care		0.84		27	0.6552			44

In the initial Delphi round, 8 out of 11 FM services and 39 out of 91 sustainability practices were identified as significant. In the second round, the remaining 3 FM services i.e. marketing management (MM), human resources (HR) and real estate management (RE) remained the same and regarded not significant whilst sustainability practices such as FS-3, SP-1, SP-2, OM-3, OM-6, PP-3 and PP-5 were identified as significant. Hence, following the 2 Delphi rounds, 8 FM services and 44 sustainability practices were identified significant. Amongst the FM services, Building Services (BS) was identified as the most significant FM service in terms of both the overall and weighted ranking. It also comprised of 22 sustainability practices which was the highest among all FM services with W.FSerBS of 18.368. Moreover, among the 44 significant sustainability practices, “identify applications for energy saving measures” and “ensure appropriate onsite, off-site storage and transport of wastes” received the top most important sustainability practices under BS with an OPW of 0.9024. Moreover, the significant 8 FM services and 44 sustainability practices in HC sector were identified in covering the environmental, social and economic principles of sustainability as shown in the Figure 1.

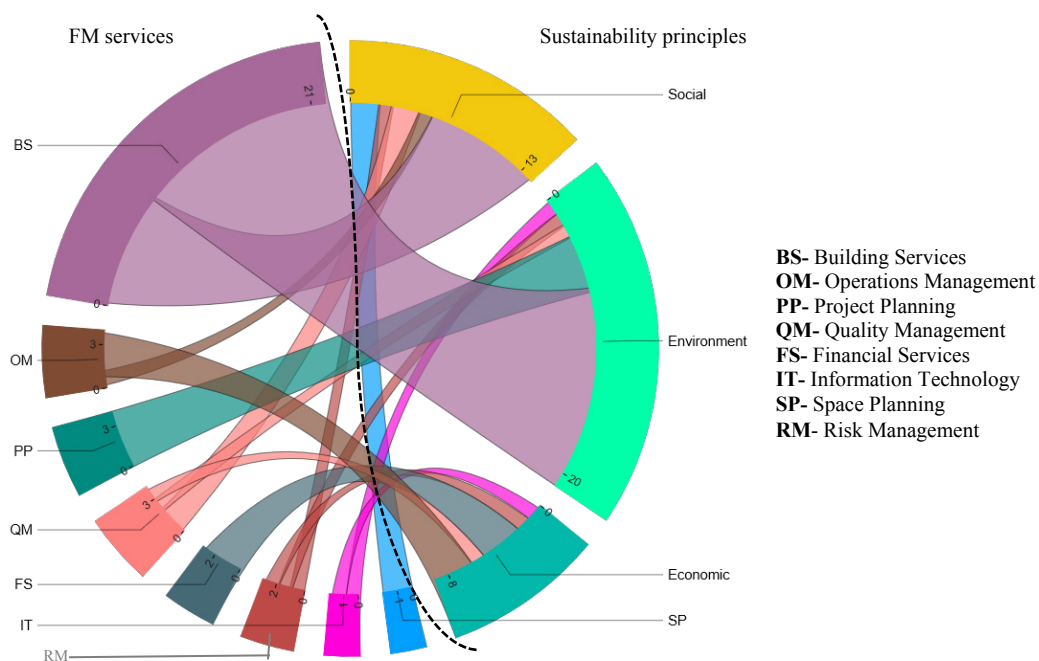


Figure 1. The identified significant FM services and sustainability practices & their coverage of social, environmental and economic principle of sustainability

Out of the 44 significant sustainability practices identified for the HC sector 48% of them were found to address the environment principle, 32% of them addressing social principle and 20% meeting economic principle of sustainability. Accordingly, the majority of the sustainability practices were seen towards meeting the environment principle of sustainability. Moreover, 32% of sustainability practices were identified in meeting the social principle and only 20% of sustainability principle were identified in meeting the economic principle. This shows that the respondents were well aware of the need of meeting social responsibility in the context of HC sector. Thus, this shows that the identified SFM practice for HC meets the holistic view of sustainability principle.

4. Discussion

Delphi survey results revealed that BS, as the most important FM service in integrating sustainability in the context of HC sector while receiving an individual RII of 0.94 and a total weight (W.FSerBS) of 18.368. Similarly, in literature review, BS was frequently reported and considered important [7, 14, 15]. Out of the 30 total sustainability practices of BS, 22 sustainability practices were identified as

significant. Amongst these practices, “ensure appropriate onsite, off-site storage and transport of non-hazardous, hazardous waste and medical wastes” and “identifying applications for energy saving measures” obtained the highest OPW of 0.9024 and considered the most important of sustainability practices. Moreover, out of the total 22 sustainability practices under BS it is identified that 64% of sustainability practices intend to attain environmental principle and 36% of sustainability practices benefits in attaining the social principle of sustainability. Thus BS plays a major role in achieving sustainable HC in terms of both environmental and social perspectives.

Further, Quality Management (QM) and Space Planning (SP) were identified as equally important by receiving a RII value of 0.90 and an overall rank of 2 and identified as the second significant FM services in integrating sustainability in HC sector. However, in weighted ranking QM remained the same whilst SP obtained the 7th ranking as it received a least W.FSerSP value of 1.5300. QM consisted of 8 sustainability practices in which 4 sustainable practices (i.e. carry out disease prevention duties, create awareness on the biosafety requirements, follow quality standards in the cleaning process and monitor water quality standards and safety) were regarded as significant. Identically in literature, QM was acknowledged repeatedly and recognised as an important FM service because if QM is left unattended it is more vulnerable in spreading diseases [30]. Moreover, 25% of the sustainability practices under QM, enables to attain both economic and environment principle whilst 50% allows meeting the social principle of sustainability. In literature under FM services second highest number of 10 sustainability practices were identified under SP. However, according to the expert’s opinion, 8 sustainability practices were identified as not significant in integrating sustainability in the HC sector. The reason behind this findings maybe that these sustainability practices contribute only attaining the social principle of sustainability, thus the respondents shows less importance. This evidenced the article on Sunday Times [31] in which the editor highlighted the ignorance of HC sector in meeting social responsibility in the context of Sri Lanka.

Furthermore, Project Planning (PP) and Operations Management (OM) received the least RII values of 0.82 and 0.78 in integrating sustainability in HC sector while receiving an overall ranking of 7th and 8th place. However, in the weighted ranking both these FM services obtained the 3rd and the 4th place with W.FSerPP and W.FSerOM values of 2.8208 and 2.7768 respectively. This shows that these FM services were less significant in integrating sustainability yet the individual sustainability practices under these FM services are regarded as significant. Thus, it is evidenced that the individual practices carry a remarkable value in achieving sustainability. Further 100% of PP’s sustainability practices were identified as relevant for attaining the environmental principle whilst OM’s 75% of sustainability practices enables attaining the economic and 25% enables to attain social principle of sustainability.

Financial Services (FS) received W.FSerFS value of 2.2440 and obtained the 5th weighted rank in achieving sustainability in HC sector. Out of the 5 sustainability practices identified from literature review under FS three was identified as significant. Amongst the three that was identified as significant, The findings were not contrasting in both literature and empirical results as FS’s 100% of the sustainability practices were identified in meeting economic principle of sustainability, thus these were highly valued by the experts as it directly influences in benefiting the shareholders.

Risk Management (RM) and Information Technology (IT) were recognised as the subsequent significant FM services in integrating sustainability by obtaining weighted ranks of 6th and 8th respectively. RM comprised of 4 sustainability practices out of which 3 were identified as significant in which all these 3 were enabling to achieve economic, environment and social principle of sustainability equally. On the other hand, IT comprised of 7 sustainability practices from literature findings and it was regarded as an important FM service as it enabled to meet social, environment and economic principles of sustainability.

FM services such as Real Estate Management (RE) and Human Resource (HR) were highly referred in literature [7,15,22] but according to the experts, these services were regarded not significant in integrating sustainability in the context of HC sector. In addition to these two services, Marketing Management (MM) was sighted very rarely in literature and in the view of experts as well it was regarded as not important in integrating sustainability in the HC sector. Further, sustainability practices of these FM services were also identified as not significant, thus, RE, HR and MM services and their

relevant sustainability practices were regarded not significant in integrating sustainability in the HC sector. Therefore out of the total 11 FM services and 91 sustainable practices 8 FM services and 44 sustainability practices were regarded significant in integrating sustainability in the HC sector.

5. Conclusions

This study identified the following Eight (8) services as the most significant in FM services for integrating sustainability in the HC Sector: Building Service (BS), Quality Management (QM), Project Planning (PP), Operations Management (OM), Financial Services (FS), Risk Management (RM), Space Planning (SP) and Information Technology (IT).

Amongst these services BS was identified as the most important FM service with W.FSerBS value of 18.368. BS also comprised the highest number of sustainability practices totalling 22. However, MM, HR and RE services were regarded as not significant. Moreover, 44 out of 91 sustainability practices were identified significant in HC sector in which “identifying applications for energy saving measures” and “ensure appropriate onsite, off-site storage and transport of non-hazardous, hazardous waste and medical wastes” obtained the highest OPW of 0.9024 and were considered the most important sustainability practices. In addition 48% of significant sustainability practices were identified in meeting environmental principle, 32% of significant sustainability practices meeting social and 20% identified meeting economic principle of sustainability. Thus, the identified SFM practice for HC sector is identified as a holistic view in meeting sustainable development.

Moving forward in the study, the findings will be carried forward to a questionnaire survey to identify the relevancy of sustainability practices to the classified FM services, to rank and assign appropriate scores for the sustainability practices in developing an assessment framework to evaluate the SFM practice in HC sector. This will enable the industry practitioners to evaluate and benchmark their sustainability practices and achieve sustainable development in HC sector. However, this study recommends further work to be carried upon in identifying KPI's for each sustainability practice, so that the results of the assessment framework will not be relied solely on the evaluator's experience.

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References

- [1] Barrett P and D Baldry D 2003 *Facilities Management: Towards Best Practice* (Oxford: Blackwell) 2nd Ed p. 298
- [2] Meng X 2014 The role of facilities managers in sustainable practice in the UK and Ireland *Smart and Sustainable Built Environment* **3** 23–34
- [3] BIFM 2016 *Sustainability in Facilities Management Report [online]* (Hertfordshire: The British Institute of Facilities Management (BIFM)) p 1–25. Available at: <http://www.bifm.org.uk/bifm/knowledge/sustainabilityinfm/2016>
- [4] Alexander K 1994 A Strategy for Facilities Management *Facilities* **12** 6–10
- [5] Chotipanich S and Lertariyanun V 2011 A study of facility management strategy: the case of commercial banks in Thailand *Journal of Facilities Management* **9** 282–99
- [6] Ikediashi D I, Ogunlana S O and Ujene A O 2014 An investigation on policy direction and drivers for sustainable facilities management practice in Nigeria. *J.Facil. Manag.* **12** 303–22
- [7] Chotipanich S 2004 Positioning facility management *Facilities* **22** 364–372.
- [8] Nielsen S, Jensen J and Jensen P 2009 Delivering Sustainable Facilities Management in Danish Housing Estates *Int Conf on Sustainability Measurement and Modelling* Barcelona 1–18.
- [9] Shari Z and Soebarto V 2014 Investigating sustainable practices in the Malaysian office building developments *Const. Inn.* **14** 17–37

- [10] Ahn Y H and Pearce A R 2012 Green Luxury : A Case Study Of Two Green Hotels *Journal of Green Building* **8** 90–119
- [11] Kras I 2011 *Sustainable Hospital Buildings* MSc thesis Technical University of Delft Netherlands.
- [12] Buffoli M, Gola M, Rostagno M, Capolongo S and Nachiero D 2014 Making hospitals healthier: how to improve sustainability in healthcare facilities *Ann. Ig.* **26** 65–77.
- [13] Elmualim A, Valle R and Kwawu W 2012 Discerning policy and drivers for sustainable facilities management practice *International Journal of Sustainable Built Environment* **1** 16–25
- [14] Hodges C P 2005 A facility manager's approach to sustainability *Facilities* **3** 312–24
- [15] Shah S 2007 *Sustainable Practice for the Facilities Manager* (NY: John Wiley Amp Sons) 1st Ed p. 295
- [16] Baaki T K, Baharum M R and Ali A S 2016 A review of sustainable facilities management knowledge and practice 4th *Int Bldg Control Conf, KL Malaysia* 1–10
- [17] Nielsen S B and Galamba K R 2010 *Facilities Management – when Sustainable Development is Core Business* EuroFM Research Symp, Madrid Spain 1–19
- [18] Junnila S 2006 Alternative Scenarios for Managing the Environmental Performance of a Service *J. Ind. Ecol.* **10** 113–32
- [19] Lai D and Chui N 2012 *Sustainable facilities management framework for assessing performance of existing office buildings* MSc thesis University Of Singapore
- [20] Neely A, Gregory M and Platts K 2005 Performance measurement system design: a literature review and research agenda *International Journal of Operations & Production Management* **25** 1228–63
- [21] Graubner C A, Pelzeter A and Pohl S 2016 A new approach to measure sustainability in German facility management *Facilities* **34** 28–42
- [22] Thomson T 1990 The essence of facilities management *Facilities* **8** 8–12
- [23] Dawes J 2008 Do data characteristics change according to the number of scale points used *Int. J. Mark. Res.* **50** 61–78
- [24] Manjula N H C, Dissanayake D M P P and Rajini P A D 2015 *Facilities Management Approaches for Sustainability* ICSECM Colombo Sri Lanka.
- [25] An S and Lee H 2010 The sustainable space planning of hospital design towards the healing environment *Proc SB10 Seoul: The Int. Conf. on Sustainable Buldg Asia* Korea 199–204
- [26] McCain M 2011 *Ambulatory care of the future optimizing health service and cost by transforming the care* The Chartis Group 55
- [27] Lindberg B Nilsson C, Zotterman D, Söderberg S and Skär L 2013 Using information and communication technology in home care for communication between patients, family members, and healthcare professionals: A systematic review *Int. J. Telemed. Appl* **2013** 1–31
- [28] Nazeer S F and De Silva N 2016 TBPE scoring framework for tropical buildings *Built Environment Project and Asset Management* **6** 174–86
- [29] Dauner K N, Lacaille L J, Schultz J F, Harvie J, Klingner J, Lacaille R and Branovan M 2011 Implementing Healthy and Sustainable Food Practices in a Hospital Cafeteria: A Qualitative Look at Processes, Barriers, and Facilitators of Implementation *Journal of Hunger & Environmental Nutrition* **6** 264–78
- [30] Steenhuizen D, Flores-Colen I, Reitsma A G and Branco L P 2014 The road to facility management *Facilities* **32** 46–57
- [31] Sunday Times 2012 *Hospital standards, doctors' ethics and profits* 6