Indicators of environmental sustainability in facilities management practices: Experiences of Malaysian universities

M S Hasim¹, A S Ali², L S Safiee¹, F M Halil¹, A S Abdullah¹

¹Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, Shah Alam, 40450, Malaysia
²Faculty of Built Environment, University of Malaya, Kuala Lumpur, 50603, Malaysia

*Corresponding author: moham315@uitm.edu.my

Abstract. Environmental sustainability practices in facilities management (FM) are vital in reducing the impact of buildings on the natural environment, and such practices can provide a significant contribution to university achievement in terms of reducing cost, improving efficiency, and expanding the value of an investment. The present investigation deals with environmental sustainability practices that are concerned with climate change, ecosystem health, biodiversity conservation, and resource consumption. The aim is to determine the extent of environmental sustainability adoption in FM practices for Malaysian universities. An online questionnaire survey was undertaken to key practitioners in the FM office who have essential roles in sustainability implementation. The questionnaires were administered to 18 public universities with a total invitation of 88 participants and 65% response rate. Generally, universities in Malaysia showed some commitment in FM practice towards environmental sustainability with some focused on programs of emission control (3.94), water conservation (3.81), biodiversity preservation (3.79), and energy efficiency (3.71) programs. Specifically, in the three FM phases, namely, in operation and maintenance, in renovation and refurbishment and demolition and rebuild works, the results showed no significant differences. Indeed, environmental sustainability is equally adopted in whole FM phases for Malaysian universities.

1. Introduction

The concept of sustainability generally refers to efforts to adopt or optimise environmental, economic, and social dimensions, as well as practices [1][2]. It is sometimes referred to as the triple bottom line [3]. The focus of these dimensions is to decrease the present-day ecological impacts to preserve the environment for future generations, to provide positive economic growth, and to promote social capital issues for a better quality of life [4][5]. The focus of this research is on environmental sustainability in FM practices for university organisations.

The literature about the advantages of adopting sustainability in FM is growing [6][7][8][9], and the benefits of sustainability practices are well established [10]. In this context, sustainability in FM practices would provide added benefits such as reducing the consumption of resources (such as water and energy), reducing greenhouse gas emissions, minimising operating and maintenance (O&M) costs, and lowering the incidence of ‘sick building syndrome’ [11][12][13].

Universities are regarded as one of the crucial research settings and can play a fundamental role in achieving sustainability goals [14][15][16]. According to the Association of University Leaders for a Sustainable Future (ULSF 1999) cited in Van Weenen [17], ‘universities can be involved in sustainable
development such as in management, planning, development, education, research, operations, community service, purchasing, transportation, design, new construction, renovation and retrofit’ (p. 21). Thus, the findings from these organisations can be used as a benchmark in measuring the commitments of other major building owners and occupiers in adopting sustainability. As cited in Amaratunga and Baldry [18], sustainability practices are essential to universities due to various challenges, for example:

a) Universities have a wide range of different building types which need more diverse operational tasks than those of most other organisations.
b) Universities are trying to improve their efficiency while facing the challenge of rising operating costs and increasing user expectations.
c) The massive expansion has forced universities to achieve more economical use of their facilities.

Environmental sustainability is concerned with ecosystem health, biodiversity, resource consumption, including energy and water usage, climate change, and land use [19][20][21][22]. Goodland [23] argued that it is related to maintaining sustainable levels of both resources and consumption. In this case, resource capacities of the global ecosystem provide raw materials, water, air, and energy, whereas consumption capacities assimilate outputs or wastes. Environmental sustainability is related to ecological sustainability, although the latter is more concerned with the study of relationships between groups of living things and their environments. In the context of the research described in this paper, environmental sustainability is the term more commonly used embracing topics such as energy efficiency, waste reduction, and water conservation. The focus is mainly on the built environment but also, and more generally, on the global environment.

Over the last twenty years, there has been increasing awareness globally about environmental sustainability due to the impact of development [24]. Urgent actions and solutions are required to minimise the detrimental impacts of environmental challenges such as climate change, ozone depletion, pollution, soil degradation, and deforestation [25][26][27]. According to Lele [28], millions of people in the poorer nations are affected by environmental degradation, and this may increase the negative impact on human well-being around the world in the next few generations. From the built environment perspective, environmental sustainability addresses the impact of construction and maintenance activities on the environment by minimising the use of resources, minimising the production of waste and pollution, protecting biodiversity and the natural environment, and using energy efficiently. Indeed, the transition to environmental sustainability is crucial because the deterioration rate of global life support systems that create the environment imposes a time limit for achieving results.

In the literature, environmental sustainability has been much discussed through topics such as the ‘culture of environmental sustainability’ [29]; ‘drivers and barriers for environmental sustainability’ [30]; ‘environmental sustainability in housing’ [31]; and ‘environmental sustainability in the construction industry’ [32]. Indeed, the literature on environmental sustainability was growing and indicated the importance of this topic in achieving the sustainability goal.

2. Method

In order to determine the extent of environmental sustainability practices in facilities management (FM), a questionnaire survey was undertaken by using an electronic (online) approach. The investigations sought to learn about the perspectives of professionals involved in FM activities. Thus, to provide the data required for this study, appropriate key participants were selected consisted of the Head of Department in the asset/facilities management office and higher management personnel. The latter was directly involved and dealt with operational activities, such as the managerial positions in the planning and design department, engineering department, procurement department, building department, property department or maintenance department. The specific participants’ professions were targeted, such as asset and facilities managers, engineers, project managers, architects, quantity surveyors, planners, and sustainability managers.

These participants can view the whole asset life cycle process. They would provide relevant information that was needed for this research as they were all qualified personnel in the sense that they
have relevant experience and often have a significant influence in decision making on asset creation and maintenance [7][33]. With this experience and exposure to these activities, they would have the skills to answer the questionnaires. Besides, by targeting all these managers, the study would gain a balanced perspective and a range of opinions and points of view from a broad range of professionals involved in the asset life cycle. This view is in line with the statement by Hodges [13], who argued that facilities managers have essential roles in sustainability implementation as they can link all asset life cycle stages from planning, design and construction, operation and maintenance, renewal through to disposal.

The participants were invited by email to complete the online questionnaire [34] via ‘SurveyMonkey’ with an additional questionnaire attached as a ‘pdf’ soft copy as an alternative, and an information sheet was included. Overall, two (2) to five (5) participants from each university were invited to participate in this survey based on the availability of their contact details on the universities' websites. From the whole list, a few potential participants were excluded due to invalid email addresses. The questionnaires were administered to 18 Malaysian public universities with total invitations to 88 participants. Almost all universities (more than 80% of the total universities) were invited to participate in this survey. Having large numbers in the sample of universities provided more reliable and more valid results (with a higher level of confidence and accuracy). A total of 57 questionnaires were returned, representing a 65% response rate, including 18 (20%) partial responses. Generally, the response for questionnaire surveys is relatively low, and it is considered fortunate if 20% of participation is achieved [35][36]. Therefore, with the above responses, the rate for this study was considered satisfactory.

The questionnaire survey has previously been recognised as the most suitable approach for observing the perception of facilities managers concerning sustainability matters with this technique, having been used to investigate the FM profession in several industries in the UK [37]. Moreover, many other researchers such as Lee and Kang [11], Islam and Siwar [38], Nielsen, Jensen [6], Adewunmi, Omirin [39], and [Abigo, Madgwick [40] used similar methods while researching the same area. For these reasons, it was considered that this technique was relevant. Figure 1 outlines the flow chart for the questionnaire survey process.

![Figure 1: Flow chart for the questionnaire survey process](image)

The survey was used to determine the extent of environmental sustainability practices, and for this research, 40 questions were developed consisting of yes/no questions and five (5) Likert scale rankings (1=strongly disagree to 5=strongly agree). Specifically, the intent of the questionnaire was to obtain data at the macro level on the basis of the frequency of the occurrence of the phenomena being observed that related the degree of environmental sustainability adoption with consideration of the objective's achievement and the initiatives were undertaken. The mean technique and standard deviation were used
to measure the extent of sustainable practices and to calculate the level of spread from the mean score of each of the individual values, respectively.

3. Result and Discussion

The following results determined the extent of environmental sustainability practices in facilities management (FM) for Malaysian universities.

3.1. Analysis of environmental sustainability in FM phases

For overall FM practice, the results showed that universities in Malaysia revealed some commitments towards environmental sustainability. Specifically, the main focuses by universities were programs of emission control (3.94), water conservation (3.81), biodiversity preservation (3.79), and energy efficiency (3.71) initiatives. Table 1 illustrates the results for various environmental initiatives undertaken and the detailed ranking.

| Rank | Environmental Initiatives               | Mean  | SD   |
|------|----------------------------------------|-------|------|
| 1    | Pollution/Emission Control             | 3.94  | 0.683|
| 2    | Water                                  | 3.81  | 0.708|
| 3    | Biodiversity                           | 3.79  | 0.711|
| 4    | Energy                                 | 3.71  | 0.912|
| 5    | Green Transportation                   | 3.67  | 0.671|
| 6    | Waste                                  | 3.62  | 0.862|
| 7    | Green Procurement                      | 3.56  | 0.765|
| 8    | Reuse/Recycling Material               | 3.53  | 0.724|

The study undertook further analysis to measure the extent of environmental sustainability practices in all three (3) phases of FM, namely, in operation and maintenance, in renovation and refurbishment, and in demolition and rebuild works. The results showed that the environmental indicators in all FM phases were equally executed. Table 2 below shows the results for each FM phase in the asset life cycle.

| FM Phases                      | Mean  | SD   |
|--------------------------------|-------|------|
| Operation & Maintenance        | 3.74  | 0.670|
| Renovation & Refurbishment     | 3.76  | 0.683|
| Demolition & Rebuild           | 3.62  | 0.679|

3.2. FM phase – Operation and Maintenance. Specifically, in the ‘operation and maintenance’ phase for Malaysian universities, the total average results for environmental sustainability were 3.74. The main environmental focuses were on programs for emission control (3.97), water conservation (3.87), biodiversity preservation (3.82), and energy efficiency (3.82) programs were dominant. Table 3 shows the detailed ranking of environmental initiatives in the operation and maintenance phase.

| Rank | Environmental Initiatives                         | Mean  | SD   |
|------|--------------------------------------------------|-------|------|
| 1    | Pollution prevention/ emission control           | 3.97  | 0.743|
| 2    | Water conservation/ efficiency                   | 3.87  | 0.767|
| 3    | Biodiversity/ecosystem preservation             | 3.82  | 0.790|
| 4    | Renewable and energy efficiency/conservation    | 3.82  | 0.970|
| 5    | Waste reduction/ reuse/recycling                 | 3.69  | 0.950|
| 6    | Sustainable transportation/travelling           | 3.67  | 0.737|
| 7    | Sustainable/green procurement/purchasing        | 3.54  | 0.854|
8. Reuse/recycling of materials and components 3.51 0.790

3.3 FM phase – Renovation and Refurbishment. The total average environmental sustainability results were 3.76 in the 'renovation and refurbishment' phase. The three environmental focuses were pollution prevention (4.00), water conservation (3.90), and biodiversity (3.79) programs. Table 4 shows the detailed ranking of environmental initiatives in the renovation and refurbishment phase.

Table 4: Rank of initiatives in renovation and refurbishment phase.

| Rank | Environmental Initiatives                                    | Mean | SD   |
|------|-------------------------------------------------------------|------|------|
| 1.   | Pollution prevention/ emission control                      | 4.00 | 0.688|
| 2.   | Water conservation/efficiency                               | 3.90 | 0.754|
| 3.   | Biodiversity/ecosystem preservation                         | 3.79 | 0.864|
| 4.   | Sustainable transportation/Travelling                       | 3.77 | 0.777|
| 5.   | Renewable and energy efficiency/conservation                | 3.72 | 1.050|
| 6.   | Reuse/recycling of materials and components                 | 3.64 | 0.811|
| 7.   | Waste reduction/reuse/ recycling                            | 3.64 | 0.932|
| 8.   | Sustainable/green procurement/Purchasing                    | 3.62 | 0.847|

3.4 FM phase – Demolition and Rebuild. The total average results for environmental sustainability in the demolition and rebuild phase showed a 3.62 mean value. In this final stage phase, the three environmental dominants were emission control (3.85), biodiversity (3.74), and water conservation (3.67) programs. Table 5 shows the detailed ranking of environmental initiatives undertaken in the demolition and rebuild phase.

Table 5: Rank of initiatives in demolition and rebuild phase.

| Rank | Environmental Initiatives                                    | Mean | SD   |
|------|-------------------------------------------------------------|------|------|
| 1.   | Pollution prevention/ emission control                      | 3.85 | 0.779|
| 2.   | Biodiversity/ecosystem preservation                         | 3.74 | 0.677|
| 3.   | Water conservation/ efficiency                              | 3.67 | 0.806|
| 4.   | Renewable and energy efficiency/ conservation               | 3.59 | 0.880|
| 5.   | Sustainable transportation/travelling                       | 3.56 | 0.754|
| 6.   | Sustainable/green procurement/Purchasing                    | 3.54 | 0.756|
| 7.   | Waste reduction/reuse/recycling                             | 3.54 | 0.913|
| 8.   | Reuse/recycling of materials & components                   | 3.44 | 0.821|

4. Conclusion
This research has identified the extent of environmental sustainability adoption in FM concerning Malaysian universities. Generally, the results indicated that environmental sustainability practices in Malaysian universities were equally adopted in all three phases of the FM cycle, namely, operation and maintenance, renovation and refurbishment, and demolition and rebuild works. Concerning the priorities for environmental consideration, universities in Malaysia were more focused on pollution prevention, water conservation, energy efficiency, and protection of biodiversity.

It is necessary to highlight the limitations of this research as the instrument used was a self-assessment questionnaire, and the answers were based on participants’ perceptions with no other observations or checks of the validity or reliability of their answers. However, the survey answers can be used to make comparisons with other methods, such as interview findings for corroboration and triangulation.
5. References

[1] Hitchcock, D.E. and M.L. Willard, *The business guide to sustainability: practical strategies and tools for organisations*, ed. M.L. Willard. 2006, London, UK: Earthscan Ltd.

[2] Petri, M. and M. Pozzebon, *Integrating Sustainability into Business Practices: Learning from Brazilian Firms*. Brazilian Administration Review, 2010. 7: p. 362-378.

[3] Koukiasa, M., *Sustainable facilities management within event venues*. Worldwide Hospitality and Tourism Themes, 2011. 3(3): p. 217-228.

[4] Ryder, Y. and N. Holman, *Re-evaluating the contribution of social capital in achieving sustainable development*. Local Environment, 2004. 9(2): p. 117-133.

[5] Dempsey, N., et al., *The social dimension of sustainable development: Defining urban social sustainability*. Sustainable Development, 2011. 19(5): p. 289-300.

[6] Nielsen, S.B., P.A. Jensen, and J.O. Jensen, *The Strategic Facilities Management Organisation in Housing: Implications for Sustainable Facilities Management*. International Journal of Facility Management, 2012. 3(1).

[7] Sarpin, N. and J. Yang, *The promotion of sustainability agenda for facilities management through developing knowledge capabilities*, in *Proceedings of APSEC 2012 & ICCER2012*. 2012, Universiti Teknologi Malaysia: Surabaya, Indonesia. p. 602-607.

[8] Meng, X., *Facilities management: tracing its development trajectory*. Property Management, 2015. 33(3): p. 212-223.

[9] Nielsen Susanne, B., A.-L. Sarasoja, and R. Galamba Kirsten, *Sustainability in facilities management: an overview of current research*. Facilities, 2016. 34(9/10): p. 535-563.

[10] Nielsen, S.B., et al., *Realising Sustainability in Facilities Management: a pilot study at the The Technical University of Denmark, in 11th EuroFM Research Symposium (EFMC 2012)*. 2012: Copenhagen. p. 237-249.

[11] Lee, S.Y. and M. Kang, *Innovation characteristics and intention to adopt sustainable facilities management practices*. Ergonomics, 2013(ahead-of-print): p. 1-12.

[12] Williams, D. and M. Sutrisna, *An evaluation of the role of facilities managers in managing sustainability and remedial actions in reducing CO2 emissions in the built environment*, in *RICS COBRA Conference*. 2010, RICS: Dauphine University, Paris.

[13] Hodges, C., *A facility manager's approach to sustainability*. Journal of Facilities Management, 2005. 3(4): p. 312-324.

[14] Wright, T.S.A. and H. Wilton, *Facilities management directors' conceptualisations of sustainability in higher education*. Journal of Cleaner Production, 2012. 31: p. 118-125.

[15] Vagnoni, E. and C. Cavicchi, *An exploratory study of sustainable development at Italian universities*. International Journal of Sustainability in Higher Education, 2015. 16(2): p. 217-236.

[16] Farinha Carla, S., U. Azeiteiro, and S. Caeiro Sandra, *Education for sustainable development in Portuguese universities: The key actors’ opinions*. International Journal of Sustainability in Higher Education, 2018. 19(5): p. 912-941.

[17] Van Weenen, H., *Towards a vision of a sustainable university*. International Journal of Sustainability in Higher Education, 2000. 1(1): p. 20-34.

[18] Amaratunga, D. and D. Baldry, *Assessment of facilities management performance in higher education properties*. Facilities, 2000. 18(7/8): p. 293-301.

[19] Boyle, C., *Sustainability assessment: Assessing the sustainability of business activities*, in *10th International Conference of the Greening of Industry Network*. 2003: Göteborg, Sweden. p. 23-26.

[20] Curran, M.A., *Wrapping Our Brains around Sustainability*. Sustainability, 2009. 1(1): p. 5-13.

[21] Di Maria, E., V. De Marchi, and K. Spraul, *Who benefits from university-industry collaboration for environmental sustainability?* International Journal of Sustainability in Higher Education, 2019. 20(6): p. 1022-1041.

[22] León-Fernández, Y. and E. Domínguez-Vilches, *Environmental management and sustainability in higher education: The case of Spanish Universities*. International Journal of
Sustainability in Higher Education, 2015. 16(4): p. 440-455.

[23] Goodland, R., *The concept of environmental sustainability*. Annual Review of Ecology and Systematics, 1995: p. 1-24.

[24] Woodruff, A. and J. Mankoff, *Environmental Sustainability*. Pervasive Computing, IEEE, 2009. 8(1): p. 18-21.

[25] Banerjee, S.B., *Organisational strategies for sustainable development: developing a research agenda for the new millennium*. Australian Journal of Management, 2002. 27(1 suppl): p. 105-117.

[26] Hansen, J., *The threat to the planet*. New York Review of Books, 2006. 53(12): p. 12.

[27] Masia, T., K. Kajimo-Shakantu, and A. Opawole, *A case study on the implementation of green building construction in Gauteng province, South Africa*. Management of Environmental Quality: An International Journal, 2020. 31(3): p. 602-623.

[28] Lele, S.M., *Sustainable development: a critical review*. World development, 1991. 19(6): p. 607-621.

[29] Brett, L.M.L. and R.W. Marans, *Towards a campus culture of environmental sustainability*. International Journal of Sustainability in Higher Education, 2012. 13(4): p. 365-377.

[30] Mittal, V.K., et al., *Drivers and Barriers of Environmentally Conscious Manufacturing: A Comparative Study of Indian and German Organisations*. Leveraging Technology for a Sustainable World, 2012: p. 97-102.

[31] Ofori, G., *Clients' Role in Attainment of Sustainability in Housing: The Case of Singapore and Lessons for Developing Countries*. Journal of Construction in Developing Countries, 2007. 12(2).

[32] Wong, K.T.T., *Strategies for Environmental Sustainability in Hong Kong's Construction Industry*, in *the International Graduate School of Business*. 2006, University of South Australia: Adelaide. p. 225.

[33] McAuley, B., et al., *The Economic Case for Early Adoption of Facilities Management*, in *International Conference on Facilities Management, Procurement Systems and Public Private Partnership: Delivering Value to the Community*. 2012: University of Cape Town, South Africa.

[34] Fricker, R.D. and M. Schonlau, *Advantages and disadvantages of Internet research surveys: Evidence from the literature*. Field Methods, 2002. 14(4): p. 347-367.

[35] Denscombe, M., *Good Research Guide: For small-scale social research projects*. 4th ed. 2010, Berkshire, GBR: Open University Press.

[36] Denscombe, M., *The good research guide*. Buckingham, Open University, 1998.

[37] Elmualim, A., et al., *Barriers and commitment of facilities management profession to the sustainability agenda*. Building and Environment, 2010. 45(1): p. 58-64.

[38] Islam, M.M. and C. Siwar, *A Comparative Study of Public Sector Sustainable Procurement Practices, Opportunities and Barriers*. International Review of Business Research Papers, 2013. 9(3).

[39] Adewunmi, Y.A., M. Omirin, and H.A. Koleoso, *Developing a sustainable approach to FM Practice in Nigeria*. Facilities, 2012. 30(9/10): p. 1-1.

[40] Abigo, A., et al., *Embedding sustainable facilities management in the management of public buildings in Nigeria*, in *EPPM 2012* 2012: University of Brighton, Brighton, UK.

Acknowledgements
The authors gratefully acknowledge the support grant in producing this paper under the Geran Penyelidikan LESTARI (Project Code: 600-IRMI/MyRA 5/3/LESTARI (056/2017) funded by Universiti Teknologi MARA, Malaysia. I would like to extend the appreciation to Associate Professor Dr Stephen Pullen and Dr Alpana Sivam from University of South Australia (UniSA), Adelaide, Australia, for their advice and guidance for this research.