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An Environmental Study on Development of Refurbishment Assessment Themes for Heritage Non-domestic Buildings in Malaysia

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Abstract

In this study a conceptual framework will allow design teams to have an appropriate balance between economic, social and environmental issues, changing the way construction practitioners think about the information they use when assessing building projects, thereby facilitating the sustainability of building industry. In view of the increasing significance of greenhouse gas (GHG) emission reduction required by various countries, heritage buildings serve an important target in mitigating energy consumption through refurbishment. Information on the performance assessment of heritage buildings during refurbishment is rare in current literature. Hence, the aim of this study is to explore possible applicable assessment themes for heritage building refurbishment. A literature review was conducted from various assessment tools to develop a generic assessment framework. Four focus group discussions with 32 research and industry experts were carried out, and the applicable assessment themes and sub-themes were determined. Five main assessment dimensions relevant to heritage buildings refurbishment was identified - heritage, environmental, economic, social, and process. However, the process dimension was found to be unaddressed by currently assessment tools. This research can facilitate the identification of appropriate assessment themes and sub-themes for the refurbishment and improvement of heritage buildings. The findings can also be used by policy makers, conservators, designers, and building owners when refurbishing heritage buildings.

Keywords: assessment themes, assessment scheme, heritage buildings, non-domestic building, refurbishment, environmental sustainability

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INTRODUCTION

The European Union has targeted to reduce its greenhouse gas (GHG) emissions by at least 20% by 2020 (European Commission 2012), 40% by 2030 (European Commission 2014), and 60%–80% by 2050 to reduce global warming (European Commission 2009). In this regard, the Malaysian government has set an objective of reducing CO_2 emission of the building sector by 45% by the year 2030 (INDC 2015). The Eleventh Malaysia Plan (2016–2020) focuses on sustainable growth and solutions for GHG emission reduction to strengthen resilience against climate change and natural disasters (EPU, 2016–2020). In Malaysia, increase in the number of construction and infrastructure projects is attributed to economic growth. These projects consume substantial energy and resources and thus have some adverse effects on the environment. Therefore, various national imperatives were formulated for the reduction of GHG emission in the country and attainment of global sustainability targets.

Energy use in buildings has increased over the past 20 years (Filippi 2015, Mazzarella 2015), thus, energy efficiency in buildings is targeted for improvement (Berg et al. 2017). For energy reduction, considerable changes are essential in the built environment sector,

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especially the existing building stocks. Current stocks are expected to increase owing to new constructions, and existing buildings generate a considerable amount of GHG emission. Meanwhile, major attention should be dedicated to existing buildings as new construction has low annual growth rates. Older buildings consume more energy than modern structures and provide poor user comfort because of several factors, such as age of the buildings, these buildings are not built sustainability when they were constructed, types of materials used and have no maintenance plans (Cairns et al. 2009, Filippi 2015, Yazdani et al. 2018). Thus, balancing energy efficiency measures on existing buildings has become a critical issue and Kylili et al. (2016) proposed the refurbishment of existing buildings as a viable and low-cost option to reduce GHG emission.

LITERATURE REVIEW

Heritage buildings are unique because of their intrinsic heritage values, where these buildings require specific care, treatment and protection. Their existing features, such as location, orientation, building fabric, and form, cannot be altered. For instance, the existing materials and finishes must match the building's original construction (Balson et al. 2014). Nevertheless, many researchers claimed GHG emission and energy consumption in heritage buildings can be considerably reduced through refurbishing (Bromley et al. 2005, Bullen 2007, Phoenix 2015, Roberti et al. 2017, Vieites et al. 2015, Webb 2017) and by using energy-efficient components, such as insulation and double glazing (Power 2008). Mickaityte et al. (2008) reported that refurbished heritage buildings consume 23% less energy than new buildings. As a result, the heritage building stocks can reduce the environmental burden of a built environment and they could also respond to global environmental concerns such as reducing energy consumption and carbon emissions (Webb 2017).

Ding (2013) highlighted that research on how green initiatives can be incorporated into heritage buildings remains poor. Improved efficiency of new buildings and refurbishment of existing buildings has been the main focus of research (Fabbri 2013). However, heritage buildings have not been at the forefront of initiatives and little work has been conducted (Ding 2013). Therefore, this study focuses on the refurbishment of heritage buildings. As highlighted by Watson (2014), heritage buildings bring adverse effects to environmental footprint when they are neglected in sustainability plans or actions. Furthermore, formulating effective policies for the refurbishment of existing buildings is important, especially heritage buildings (European Commission 2012). In tandem with this, this study examines the refurbishment of heritage buildings, with primary aim of identifying the applicable list of assessment themes and sub-themes which integrate the important assessment dimensions for sustainability.

This paper is organized into seven sections. Section 2 describes the reviews the literature on the heritage building refurbishment. Section 3 presents the process of developing a list of assessment themes and sub-themes for refurbishment. Research methodology and the process of collecting data are summarised in Section 4. Section 5 presents the results of the data collection. Section 6 discusses the results and findings. A conclusion is drawn in Section 7.

RESEARCH METHODOLOGY

The aim of this study was to identify the applicable assessment themes and sub-themes for assessing refurbished heritage buildings. In order to achieve the aim, this study adopted focus group discussion.

Focus Group Discussion

Focus group discussion was performed for the selection of applicable assessment themes and sub-themes for refurbished heritage buildings. It is a popular data collection method in social science because it facilitates the acquisition of perception about a specific topic from a group of experts in a defined environment (Kruegar and Casey 2014). It allows for a detailed exploration of opinions from multiple participants. Furthermore, in-depth information is acquired from the participants through brainstorming and interactions. This data collection method is more suitable than quantitative approaches as it allows exploration of new ideas rather than limits the participants to a set of factors. A focus group discussion that prevents individual bias was conducted through interactive discussion from knowledgeable and experienced participants, thereby widening the range of opinions on specific topics (Morgan et al. 1998). Thus, the results originated from representative participants rather than individuals. Other studies employed focus group discussion in construction research (Ajayi et al. 2017, Dainty et al. 2003, Niu et al. 2017, Yu and Leung 2015).

Samples

The focus group discussion was organized through a workshop at Penang, Malaysia. Announcement of participation were called via the Internet and community networks. The snowball networking

technique is a common method as evidenced by previous studies (Ajayi et al. 2017, Oyedele et al. 2012). Purposive sampling was adopted and workshop participants were purposively selected based on several criteria, as evidenced by previous studies (Ajayi et al. 2017, Niu et al. 2017, Yu and Leung 2015). The focus group discussion is suitable if the research is exploratory in nature and requires expertise and knowledge from the respondents. The following selection criteria were used: at least 5 years of research experience in the field of sustainability assessment, heritage building conservation, and refurbishment practices; at least 5 years of industry involvement in the field of heritage building conservation and building refurbishment. These criteria ensure the selection of participants who possess sufficient qualification, knowledge, and experience in the field. A total of 32 participants were selected for the workshop. Before conducting the workshop, each participant was requested to choose the dimension (social, economic, environmental, or heritage) based on his/her expertise. Four groups were formed, and each group had eight participants from diverse dimensions, ensuring that each group consists of experts from environmental, social, economic, and heritage aspects. The group sizes were formed as suggested by Kruegar and Casey (2014) with the optimum group sizes of six to twelve participants.

Data Collection and Analysis

The workshop was broken down into the following objectives: (1) to identify and scrutinize the applicable assessment themes and sub-themes, (2) synthesize the existing assessment themes and sub-themes, and (3) propose new applicable assessment themes and sub-themes. The following questions were asked to facilitate the discussion among the participants:

- What applicable assessment themes and sub-themes are suitable for use in assessing refurbished heritage buildings?
- Are there any similar assessment themes and sub-themes that could be combined?
- What are the new assessment themes and sub-themes that are not listed in the existing list?
- Are the terms used to describe the assessment themes and sub-themes clear, unambiguous, and explicit?

Data were collected by audiotapes, worksheets, and immediate note taking. The purpose of audiotaping is to review the discussion in detail after the workshop for data validation (Yu and Leung 2015). This facilitates data analysis by transcribing the recordings through using manual coding. Moreover, the workshop participants were encouraged to use worksheets to write down their views. Flip charts were provided for each group to write down the key points to ease the discussion session. Four researchers were appointed to facilitate the discussion for each group. They only steered the discussion where some participants were dominant or where the discussions strayed from the focus area (Dainty et al. 2003). A designated recorder was assigned to note the important points discussed. The adoption of immediate note taking allowed the researcher to review all ideas, opinions, and discussion points, and crosscheck with the audiotapes to minimize the possibility of data misinterpretation.

A summary list of the assessment themes and sub-themes and an explanation booklet were provided to each participant for facilitating their understanding during discussion. All participants were encouraged to develop and exchange ideas related to the discussion topics, expand and shorten the assessment themes and sub-themes, and organize them if they overlapped. The workshop lasted for one day, and the discussion ended with group presentation from each group. After discussion, the author asked all participants whether they had any other suggestions. Focus groups were complete when no further suggestions were given. This resulted in a substantial list of assessment themes and sub-themes for refurbishment that were described by the participants as associated with heritage buildings.

In view of the implicit and explicit ideas emanating from the data, this research adopted content analysis. The voice data were transcribed for data analysis. Text was then coded by using content analysis for the identification of core themes in the discussion. In this research, themes and sub-themes were identified as the assessment themes and sub-themes for assessing refurbished heritage buildings. Keywords and phrases were then grouped and arranged according to the themes and sub-themes. The transcripts were read several times such that significant statements and sentences that provide understanding of how participants perceived the phenomenon were identified (Creswell 2013, Kilitci et al. 2018). The list of assessment themes generated was then compared with the current preliminary list for the removal of repetitive assessment themes and sub-themes.

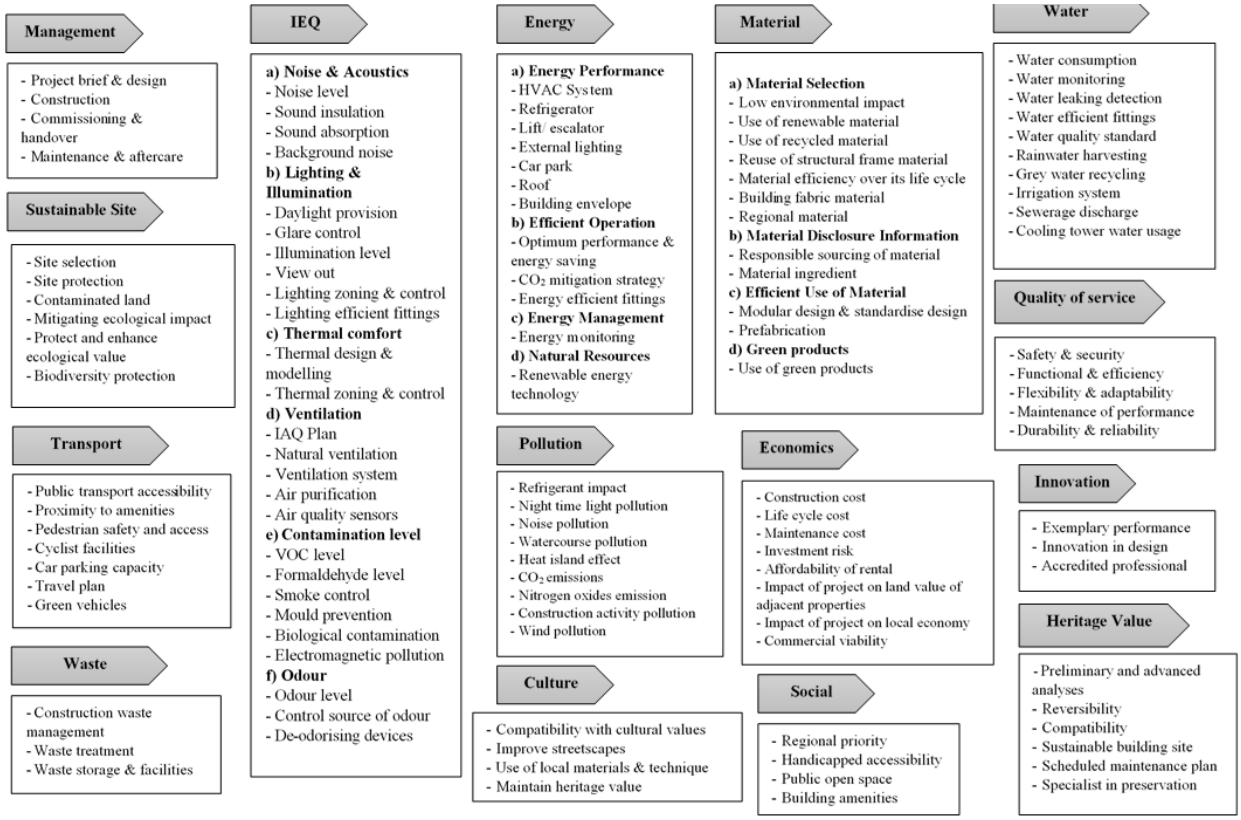

Fig. 1. Assessment themes and sub-themes for refurbishment (adapted from Kamaruzzaman et al. 2018)

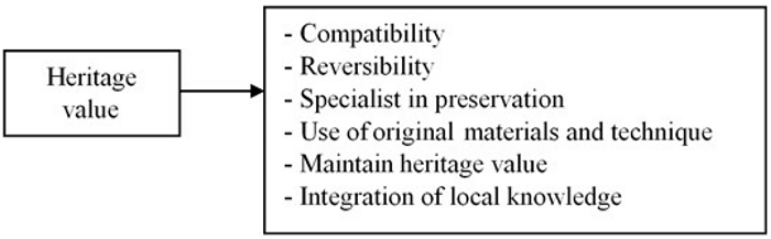

Fig. 2. Assessment themes and sub-themes for heritage value

RESULTS

Previously, the assessment dimension was divided into environmental, heritage, economic, and social aspects, as discussed in Section 3. As a result of this workshop, the assessment dimensions were restructured into five main dimensions - heritage, environmental, economics, process, and social (HEEPS). One hundred and nineteen sub-themes have been reduced to eighty-six as some of the assessment sub-themes were combined and eliminated. **Fig. 1** displayed a list of assessment themes and sub-themes.

Heritage

In heritage dimension, the main themes of heritage value and culture were combined into a single criterion and renamed to "heritage value," as illustrated in **Fig. 2**. Three sub-themes were removed, namely, improve streetscapes, sustainable building site, and scheduled maintenance plan. Preliminary advanced analyses were moved to the process aspect. One new sub-criterion, integration of local knowledge, was added. The remaining sub-themes were use of original materials and techniques, reversibility, and specialist in preservation. Compatibility and compatibility with cultural values were combined into one single assessment sub-criterion and renamed as compatibility in terms of designs, structural, and physical.

Environmental

Originally, environmental dimension consisted of eight main themes which were sustainable site, transport, waste, indoor environmental quality, energy, water, material, and pollution. Workshop discussion has structured and grouped the eight main themes, as shown in **Fig. 3**.

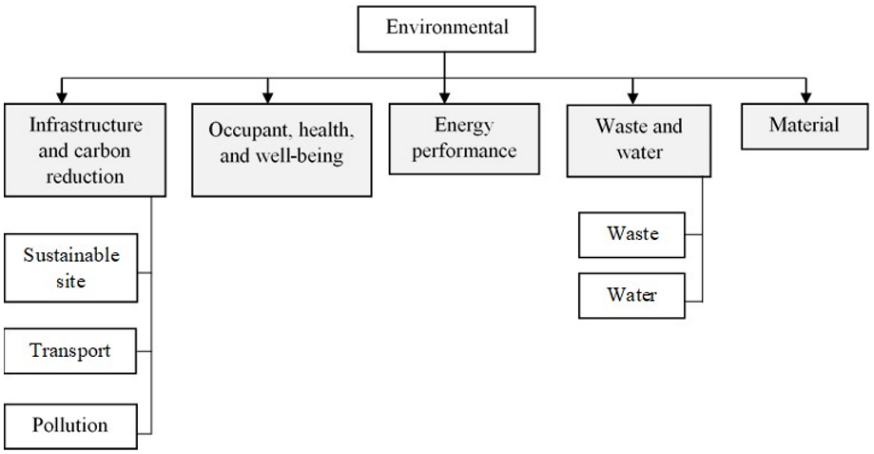

Fig. 3. Assessment themes and sub-themes for environmental dimension

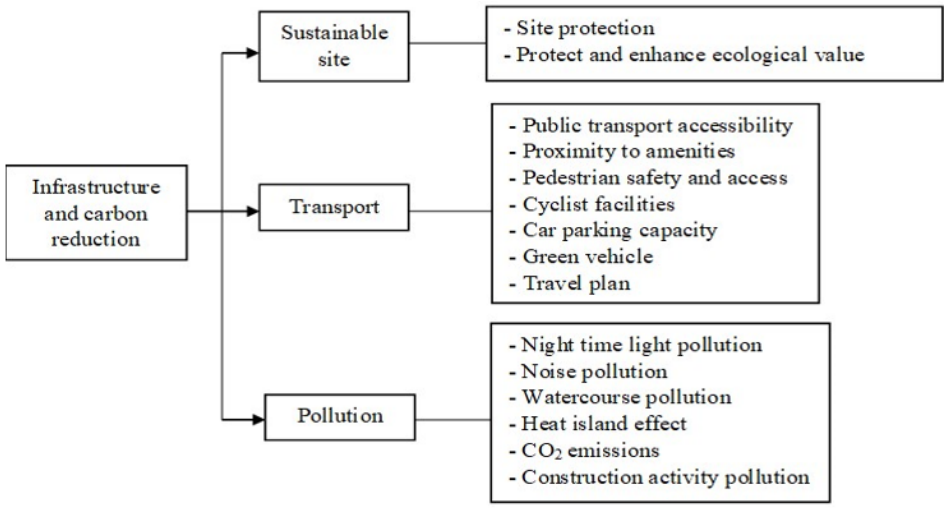

Fig. 4. Assessment themes and sub-themes for infrastructure and carbon reduction

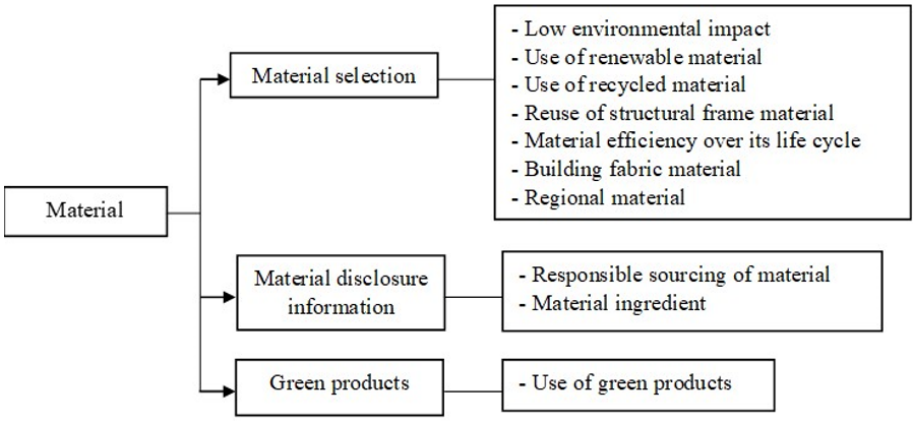

Fig. 5. Assessment themes and sub-themes for material

As illustrated in **Fig. 4**, sustainable site, transport, and pollution are grouped under infrastructure and carbon reduction. In terms of sustainable site, four sub-themes were eliminated, and site protection, protect, and enhance ecological value remain. All transport criteria sub-themes were retained. In pollution theme, refrigerant impact, nitrogen oxide emission, and wind pollution were claimed to be irrelevant to heritage building refurbishment; hence, they were eliminated from the list. For material theme, all sub-themes, except modular design and prefabrication, have been agreed on and were retained by workshop participants, as shown in **Fig. 5**.

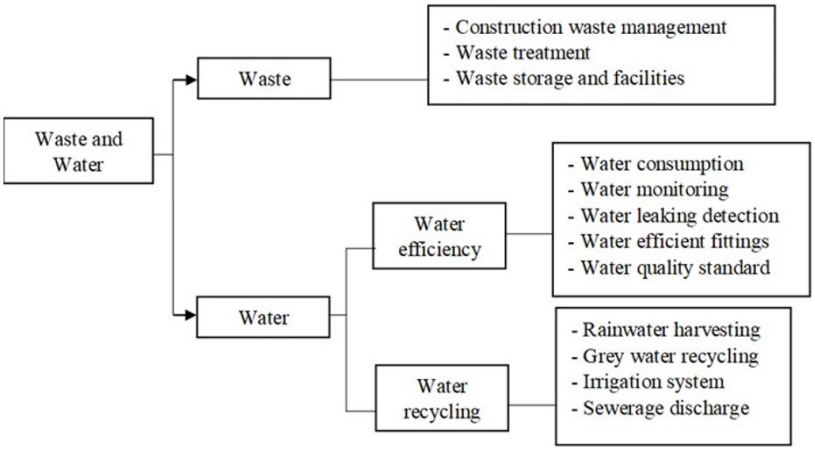

Fig. 6. Assessment themes and sub-themes for waste and water

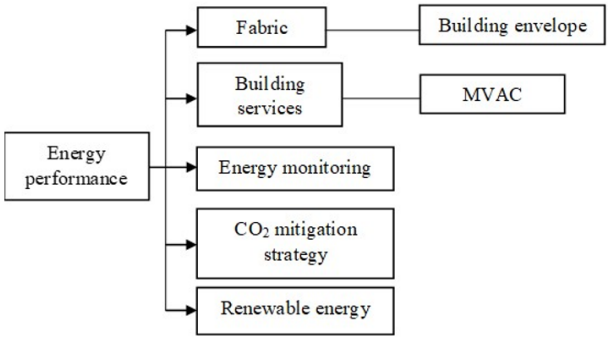

Fig. 7. Assessment themes and sub-themes for energy performance

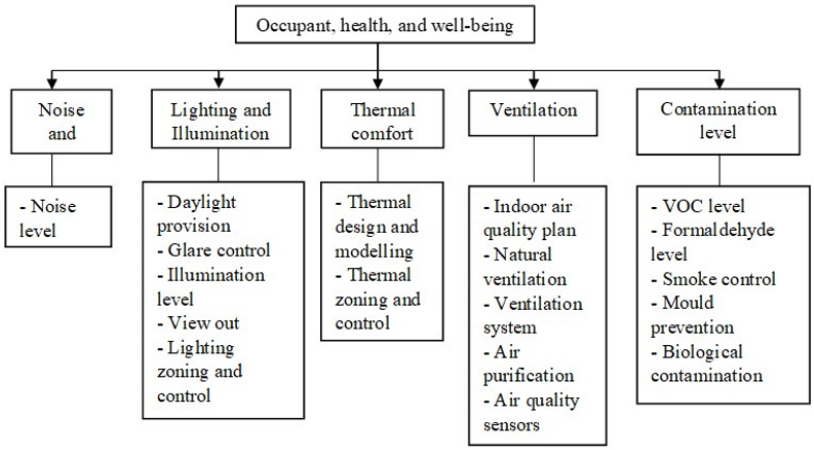

Fig. 8. Assessment themes and sub-themes for occupant, health and well-being

Workshop participants have grouped water and waste as indicated in **Fig. 6**. All sub-themes under waste were retained, whereas for water theme, cooling tower water usage was eliminated from the list. **Fig. 7** demonstrates the remaining sub-themes for energy theme. Workshop participants have agreed that only building fabric (building envelope) and building services performance are applicable for heritage buildings. However, the energy performance of heating, ventilation, and air-conditioning (HVAC) were changed to mechanical, ventilation, and air-conditioning (MVAC). CO_2 mitigation strategy, energy monitoring and use of renewable energy are also relevant for energy theme. **Fig. 8** denotes the theme of indoor environmental quality are renamed to occupants, health, and well-being. Odor sub-themes were eliminated, and five sub-themes remain: noise and acoustics, lighting and illumination, thermal comfort, ventilation, and contamination level. Only noise level assessment remains under theme of noise and acoustics, whereas others were removed. In terms of contamination level, workshop participants deemed that electromagnetic pollution was not applicable in the Malaysian context.

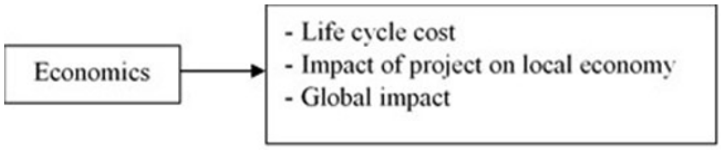

Fig. 9. Assessment themes and sub-themes for economic dimension

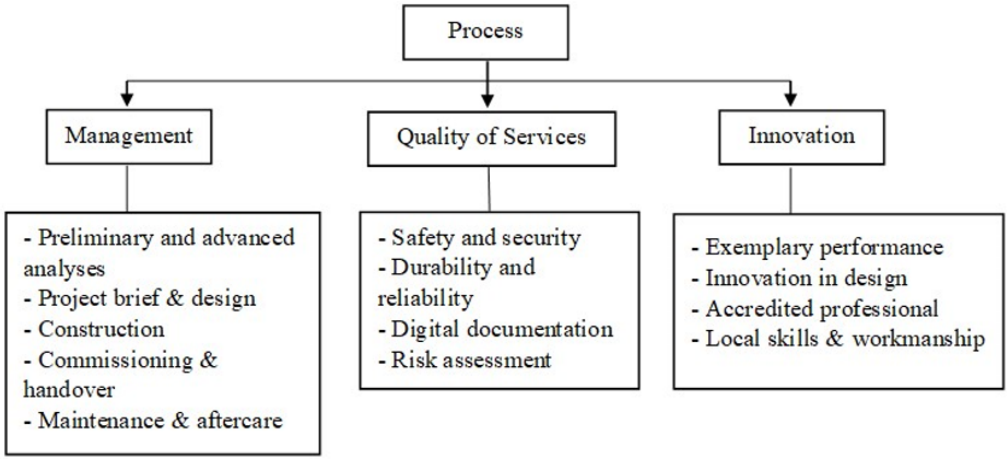

Fig. 10. Assessment themes and sub-themes for process dimension

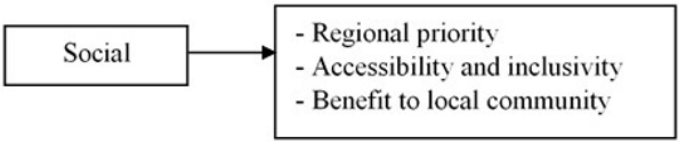

Fig. 11. Assessment themes and sub-themes for social dimension

Economic

In economic dimension (**Fig. 9**), six sub-themes were removed, namely, construction cost, maintenance cost, investment risk, affordability of residential rental, impact of project on land value of adjacent properties, and commercial viability. Global impact was added as new sub-criterion. Life cycle cost and impact of project on local economy remain in this dimension.

Process

This new dimension emerged after the workshop discussion, and it consists of three main themes which are management, quality of services, and innovation. Four sub-themes in management which are project brief and design, construction, commissioning and handover, and maintenance and aftercare remain. A new sub-criterion, preliminary and advanced analyses, was added. In quality of services, three sub-themes, functional and efficiency, flexibility and adaptability, and maintenance of performance were removed. Two new sub-themes which are digital documentation and risk assessment were added. The remaining sub-themes are safety and security and durability and reliability. In innovation theme, one new sub-criterion, integration of local skills and workmanship, was added. The other three sub-themes, exemplary performance, innovation in design, and accredited professional, remain.

Social

Public open space and building amenities were removed from social dimension, as denoted in **Fig. 11**. Handicapped accessibility was renamed to accessibility and inclusivity. Regional priority was retained, and one new sub-criterion, benefit to local community, was added.

DISCUSSION

As reported in Section 5, the workshop discussion resulted in five assessment dimensions called HEEPS. Numerous researchers studied refurbishment and preservation of cultural heritage from a combination of different aspects such as environmental, economic, social, political, historical, and cultural aspects (Turskis et al. 2017). Sustainable refurbishment of heritage buildings must consider environmental, economic, social, and cultural aspects (Berg et al. 2017, Lucchi 2016). Thus, integrating all dimensions into a single assessment framework is crucial. In addition, this workshop proposed a new assessment dimension in terms of process aspect.

In terms of environmental dimension, all workshop participants underlined that improving the energy efficiency of the buildings is a main focus during refurbishment. According to Kylili et al. (2016), the environmental dimension consisted of land use and ecology, water resources, noise and visual impact, indoor quality, energy performance, waste management, and material. Existing old buildings are claimed to have obsolete mechanical and electric systems, and the building envelopes are not thermally insulated (Filippi 2015). When refurbished, changes in existing buildings lead to the installation of new mechanical systems or the renewal of existing one with consequent energy consumptions (Filippi 2015). Thus, assessing the environmental performance of the refurbished buildings is necessary to ensure compliance with standards and requirements.

Improving energy performance in heritage buildings requires a balance between energy efficiency measures and building conservation as heritage buildings are unique and protected. Workshop participants highlighted that having heritage dimension is essential when assessing the refurbished heritage buildings. Three-point theme, referring to minimum intervention, reversibility, and compatibility, must be incorporated into assessment (Boarin et al. 2014; Boarin 2016, De Santoli 2015, Lucchi et al. 2016). The workshop sub-themes of compatibility, reversibility, and heritage value maintenance are crucial in the assessment of refurbished heritage buildings. As underlined by De Santoli (2015), protecting building historic value, rather than refurbishing or upgrading without considering the conservation requirements, should be a main priority. Berg et al. (2017) pointed that improving energy performance of buildings without considering their heritage value damages the existing building physical systems of these buildings. For example, upgrading or installing windows may have a negative effect on the historic fabric, affecting the architectural expression of the buildings. Many restrictions, such as the need to preserve the layout and appearance of the original buildings and material and finishes chosen, must be matched with those used during the building's original construction. These result in a challenge during heritage building refurbishment to determine suitable refurbish solutions that lead to energy reduction, preserve the aesthetic and historic significance of a building, and provide thermal comfort to building users (Fouseki and Cassar 2014, Lucchi et al. 2016). Tadeu et al. (2015) proved that energy savings can be achieved through refurbishment of heritage buildings without adversely affecting the building's historic character. As a result, refurbishment in terms of environmental dimension and conservation principles must balance against each other to achieve continued and long-term use of the building.

Most of the previous studies focused only on historic values and energy-efficient interventions, whereas other values such as social and economic that relate to heritage buildings were neglected (Fouseki and Cassar 2014). Therefore, the social and economic dimensions for refurbished heritage buildings were retained in the workshop. In terms of social dimension, workshop participants highlighted the local people around the heritage buildings should not be neglected, as they will be greatly affected during refurbishment. As confirmed by Magrini and Franco (2016), assessing the local conditions is crucial in determining the best practices of refurbishment in term of regional priority. Moreover, involving users and residents is important in addressing the social dimension of sustainability as it encourages bottom-up decision making (Berg et al. 2017). As discussed in the workshop, the benefit to the local community must be included in the assessment. Another important sub-criterion is accessibility and inclusivity as confirmed by Kylilit et al. (2016).

In economic dimension, cultural heritage depends on economic development and is often expressed in terms of cost (Ferretti et al. 2014, Kylili et al. 2016, Turskis et al. 2017). Kutut et al. (2014) further highlighted that the necessity of investing in heritage building refurbishment can be associated with the economic value of the heritage buildings. However, most of the existing assessment schemes have not considered the economic dimension in the assessment. Hence, economic dimension has been identified as a fundamental dimension for building refurbishment (Kylili et al. 2016). Bielinskas et al. (2015) have elaborated the economic value as the property cost on the territory of the municipality, location of the property, and its cost on the territory of the neighboring municipality. Hence, it is in accordance with the focus group results, as one of the sub-themes for economic dimension is impact of project on local economy. Kok et al. (2012) further explained that refurbishment of heritage buildings produces a significance increase of market value of the buildings which could lead to a long-term gain if the buildings are maintained in an adequate manner with the most up-to-date energy and environmental standards.

Turskis et al. (2017) expressed that increased flow of tourists is an indirect economic effect. This explained the sub-criterion of global impact that refers to worldwide impact of the heritage buildings that could attract more tourists to visit the heritage buildings. Workshop participants outlined the importance of carrying out a life cycle cost analysis. Rodrigues and Freire (2017) articulated building refurbishment is costly, but by considering life-cycle cost assessment, it could achieve a balance between initial investments, energy cost savings, and minimization of environmental impacts. The authors conducted an analysis for a historic building in Portugal and demonstrated that eco-efficiency assessment can be used to assess different refurbishment strategies to ensure great annual net savings while minimizing environmental impacts. Thus, when selecting different refurbishment strategies, both economic and environmental aspects must be considered (Rodrigues and Freire 2017, Tadeu et al. 2015).

The workshop participants concluded that considering process dimension is crucial in the assessment to ensure an effective refurbishment practice. When planning for refurbishment in heritage buildings, selecting appropriate measures by conducting investigation, analysis, and documentation of the building itself and its heritage significance are vital (CEN 2017). As explained by Berg et al. (2017), a detailed understanding of the building's character and structure is crucial when intervening with heritage buildings. The acquisition of preliminary knowledge on the building structures, energy, and material is essential (Boarin 2016) to understand the behaviour and profile of a heritage building and allow for proposing suitable refurbishment strategies for improving its performance (Lucchi et al. 2016). For criterion of quality of service, safety and durability of buildings should consider ensuring buildings could operate in the event of any accident, fire, or disaster. However, this criterion is often overlooked in most assessment schemes (Kamaruzzaman et al. 2016).

Heritage buildings would be targeted worldwide. Through refurbishments, carbon emission and energy consumption could be reduced, indoor thermal comfort improved, and the heritage value of the buildings maintained (Martínez–Molina et al. 2016). Performance assessment is crucial to govern the performance of the refurbished heritage buildings. Environmental assessment tools or rating systems cannot continue to ignore heritage buildings. Bos (2013) stressed how to sustainably assess the heritage buildings in the absence of standard and tools. A sustainable building assessment approach with a set of relevant performance themes for national and international building policies is still lacking (Kylili et al. 2016). A risk is seen in improving the performance of refurbished buildings without indicators, as determining the performance level is difficult. As underlined by Magrini and Franco (2016), evaluating the performance of heritage buildings is crucial for environmental sustainability assessment. It allows for better understanding the refurbishment practice while respecting all the limitations from cultural, architectural, and historic features. It could help to recognize potential ways of enhancement through assessment of the environmental sustainability of heritage buildings (Magrini and Franco, 2016). Thus, the proposed assessment themes and sub-themes could provide useful guidelines for the governments, especially the policy makers. In Malaysia, especially GBI and MyCREST, a refurbishment assessment scheme for heritage buildings is lacking. The guidelines referring to the heritage buildings must match both energy efficiency enhancement and heritage conservation and consider economic, social, and process. The themes and sub-themes developed in this research could be implemented by the other rating systems to offer a wider perspective of sustainability refurbishment assessment.

CONCLUSION AND POLICY IMPLICATIONS

The promotion of sustainable building practices is to pursue a balance among economic, social, and environmental performance in implementing construction projects. Various initiatives and strategies have been taken to combat GHG emissions, targeting building stock to achieve national and international carbon reduction targets. Refurbishment of heritage buildings to promote energy efficiency and savings in buildings has become a popular topic among researchers. In view of the great potential of heritage buildings, sustainable refurbishment of heritage buildings must be included in the solution of the country's carbon reduction vision. However, it constitutes a great challenge in refurbishment, especially in terms of performance assessment, because of specific characteristics of the heritage buildings. Most of the attention has been paid to the environmental aspect such as enhancement of energy performance and indoor comfort of heritage buildings, but the sustainability assessment in other aspects such as economic and social is limited. Uncertainty exists as to

which assessment themes and sub-themes are suitable to assessing the refurbishment performance of heritage buildings. This study has reviewed the growing of research on refurbishment of heritage buildings, with a focus on the assessment themes and sub-themes.

Literature review conducted has identified fifteen assessment themes and one hundred and nineteen sub-themes from several prominent assessment schemes. Focus group discussion was organized in a workshop that involved 32 academic and industry experts to determine the applicable assessment themes and sub-themes. At the end of the workshop, fifteen assessment themes and eighty-six sub-themes remained. The workshop resulted in the identification of five main assessment dimensions called HEEPS. Rather than focusing on single assessment dimension, an assessment tool that can consider these few dimensions is crucial to assessing the sustainability performance of refurbished heritage buildings. It is suggested that relevant policy makers and decision makers develop a comprehensive, strategic, integrated, and effective approach to best assess these buildings by integrating the five assessment dimensions as suggested to achieve sustainability.

ACKNOWLEDGEMENTS

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