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UNRAVELING THE INFLUENCE OF BUILDING MATERIALS CRITERIA (BMC) ON HOTEL'S OPERATIONAL SUSTAINABILITY

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ABSTRACT

The core business of hotels lies in the hotel buildings design and its service operation. As the hotels are concentrating more on aesthetics values as one aspect of perceived experiential value, a careful selection of materials is urgently needed for hotel sectors. It is important to identify the crucial criteria in choosing building materials towards the hotel's operational sustainability. Thus, this paper aims to analyze the significance level building materials criteria (BMC) towards hotel's operational sustainability. A quantitative approach was adopted via questionnaire surveys to 116 operation and maintenance manager that worked in 29 green rated hotels throughout Malaysia. The data is analysed using SmartPLS 4, a software with graphical user interface for variance-based structural equation modeling (SEM) using the partial least squares (PLS) path modeling method. Results from the SEM-PLS has supported three (3) hypothesis, that confirmed the manufacturers criteria, health criteria and resource management criteria, as the BMC variables has significance relationship towards hotel's operational sustainability. This study significantly helps the developers, hoteliers, stakeholders, consultants, and designers to be aware of the applicability and suitability to be used in their projects. The findings provide practical insights for hotel operators and managers, offering guidance on selecting building materials aligned with sustainability goals. This operational focus can aid hotels in making informed decisions that enhance their overall sustainability performance.

Keywords: Building materials criteria, green hotels, hotel's operational sustainability, operation and maintenance, SEM-PLS

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1. INTRODUCTION

Hotels are significant for the tourism industry, and it constitute one of pillars in the tourism sector. The viability of the hotel sector, is crucial for upholding the sustainability principles, which incorporate elements of environmental, economic, and social sustainability. While various green building rating systems emphasize the importance of sustainable materials, such as the Green Building Index (GBI) and Malaysian Carbon Reduction and Environmental Sustainability Tools (MyCREST), the hotel industry lags in embracing these green initiatives (Ad, 2017). Hotels, as integral components of the tourism sector, operate uniquely and contribute significantly to the environmental footprint due to their intensive use of energy, water, and other resources. The hotel industry's inclination toward sustainable development is growing, driven by the rising demand for clean and nature-centric tourism experiences (Jovanovic, 2019). The sustainability principles, encompassing social, environmental, and economic elements, underscore the importance of adopting sustainable materials in hotels for the health, safety, and productivity of occupants (Hasim et al., 2020; Sârb et al., 2016). The transition towards "green hotels," defined by the (Green Hotel Association, 2016) as environmentally conscious establishments, aligns with the global movement to conserve energy, water, and reduce solid waste. Certification processes, such as the Green Building Index, serve as benchmarks for evaluating the sustainability of hotels through criteria that include the use of sustainable materials (Green Building Index (GBI), 2009).

However, the hotel industry faces challenges in the form of pollutants from building materials, high energy consumption, and reliance on artificial lighting, all of which impact the health of occupants and operational costs (De Luca et al., 2018; Kamaruzzaman et al., 2016; Qi et al., 2012). These harmful compounds could have both short- and long-term effects on one's health. Sneezing, eye discomfort, throat irritation, and skin allergies are examples of short-term effects. Long-term effects include asthma, cancer, infertility, and a host of other conditions. As a result, it gives impact to hotel's customer as most of them spend their time indoor. In addition, although customers are the focus of the hotel industry, employees who operate the hotels spend most of their working hours in the hotel's building (Bangwal et al., 2022). All of these negative impacts from harmful pollutants may have a long-term effect on them. Andersen et al., (2009) also shows that the building with poor indoor air quality consumes more energy results in giving high operating cost. the adoption of sustainable materials in hotels is hindered by financial concerns, as stakeholders prioritize profitability over environmental considerations (Ametepey et al., 2015). Other than that, usage of conventional materials compared, or energy efficiency materials could result to the higher hotel operation cost. Qi et al., (2012) asserts that one of the main issues is the 30% – 50% energy consumption of conventional air conditioning systems in commercial buildings such as hotels.

Overall, selection of suitable materials for hotel's building is very important for many aspects of hotel's operational sustainability. The performance of materials selected can have impact in terms of economic, social, and environmental. Thus, the growth of the green hotel industry has increased demand for sustainable building materials usage. Ad (2017) mentioned that suitability of materials for hotel industry will help to reduce the environmental impact that has indicated as one of the criteria to be awarded as green hotels in green rating schemes. Addressing these challenges requires a multifaceted approach, including green procurement adoption and aligning government policies, such as the National Sustainable Consumption and Production Blueprint (SCP-GGP) (KASA, 2020). While existing guidelines promote waste management in hotels, there remains a gap in specific criteria for the usage of green and sustainable materials. The article aims to shed light on this gap, emphasizing the need for a more comprehensive approach to green practices in the hotel industry. As the hotel industry grapples with the slow adoption of green solutions, the article endeavors to provide insights into the potential benefits of sustainable materials. By prioritizing these materials during the design and procurement phases, hotels can reduce both their environmental impact and overall operating costs. The exploration of green building materials extends beyond environmental considerations, becoming a pivotal factor in the broader landscape of sustainable hotel development.

Hence, this paper aims to delve deeply into the intricate relationship between building materials criteria and hotel's operational sustainability. By scrutinizing the principles of sustainability encompassing social, environmental, and economic elements, the article endeavors to shed light on the paramount importance of adopting sustainable materials in hotels (Sârb et al., 2016). The transition toward green hotels, as defined by the Green Hotel Association (2016), signifies a paradigm shift wherein hotels prioritize environmentally friendly products and services, contributing to energy conservation, water efficiency, and waste reduction. The certification processes, exemplified by the Green Building Index, serve as essential benchmarks for evaluating the sustainability of hotels through specific criteria, including the use of sustainable materials (Green Building Index, 2009).

2. LITERATURE REVIEW

2.1 Building Material Criteria Impacted to The Hotel's Operational Sustainability

The study emphasizes the critical impact of building materials on the sustainability of hotel operations, drawing from sustainability elements in hotel operations and the Theory of Operation Management, published by Federick Taylor in 1911 (Rebecca Mcclay, 2022). It underscores the need to identify specific criteria for building materials that directly influence the sustainability of hotel operations. While green rating certifications provide detailed criteria for materials, such as reused materials, sustainable resources, waste management, and green products, these criteria primarily focus on achieving green ratings during design and construction. The study aims to bridge the gap by examining whether these criteria have a discernible effect on hotel operations, aligning with the insights from the Theory of Operation Management. Based on the sustainability elements in the hotel operations and the Theory of Operation Management, the impact of using the building materials for hotel industry is crucial to make sure that the hotel's operation achieves sustainability. In this study, the devotion of material's criteria towards the hotel's operational sustainability are different from the materials' criteria in the established in green rating certification. Based on several literature for this study (for example: De Luca et al, 2018; Ad, 2017; Rashdan & Ashour, 2017; Sakshi et al, 2020; Sarb et a, 2016; Hsieh et al, 2012; Haruna et al, 2020; Graci & Dodds, 2008), the building materials criteria that impacted the hotel operations sustainability are i) manufacturer's criteria, ii) health criteria, iii) consumption criteria, iv) design component criteria, and v) resource management criteria. The following entails the rationale of those criteria towards the impact on sustainability of hotel operations.

2.1.1 Manufacturer Criteria

Manufacturers play a pivotal role in the selection of sustainable building materials, as highlighted by (Garetti & Taisch, 2012). The criteria for manufacturers encompass three key aspects. Firstly, Sustainable Manufacturers Identification focuses on selecting manufacturers prioritizing sustainability, emphasizing strategies for energy optimization, waste control, and recyclability (Llop & Ponce, 2011; Rashdan & Ashour, 2017). Secondly, Materials Declarations & Certifications involve assessing certifications like MyHIJAU and Eco Labelling Scheme to ensure compliance with environmental standards and sustainable principles (Atan, 2015; Boks & Mcaloone, 2009; Malaysian Green Technology and Climate Change Centre (MGTC), 2020). Lastly, Materials Life Cycle Assessment evaluates a material's entire life cycle, encouraging designers to choose certified materials like Cradle-to-Cradle Certificate and SMaRT Certified Products, ensuring environmental and human health safety across all phases (Cradle to Cradle Products Innovation Institute, 2014; Mah & Al-Hussein, 2008; Malaysia Green Technology Corporation, 2017). In summary, these sub-criteria emphasize the importance of manufacturers' commitment to sustainability, certifications for adherence to standards, and a holistic assessment of materials' life cycles for informed decision-making in projects such as green hotels. Health Criteria

2.1.2 Health Criteria

Selecting materials for eco-friendly hotels centers on health, prioritizing the well-being of guests and staff (Khoshnava et al., 2020). First, indoor air quality performance means checking how materials affect indoor air, impacting human health (Stafford, 2015). Designers should assess materials for emissions during design and construction (Nehr et al., 2017). Second, chemical emission & toxic disposable is about checking for health hazards, considering toxic gas emissions, and using tools like GreenScreen for Safer Chemicals (Mate, 2006; Rashdan & Ashour, 2017). Third, low carbon footprint means measuring greenhouse gas emissions and supporting sustainable manufacturing (Rashdan & Ashour, 2017; Wiedmann & Minx, 2007). Lastly, biodegradable focuses on selecting materials that naturally decompose without harm, using certification programs like the Biodegradable Products Institute (Bonda & Sosnowchik, 2006; Godavitarne et al., 2017). These health criteria ensure materials positively impact indoor air, reduce hazards, cut carbon emissions, and align with eco-friendly practices for a healthy hotel environment.

2.1.3 Consumption Criteria

Choosing materials for green hotels involves consumption criteria that make them eco-friendly and sustainable, meeting the preferences of eco-conscious travelers and supporting local communities (Green Building Index (GBI), 2009). The first point, design adaptability, emphasizes creating spaces efficiently using smart technologies and multipurpose furniture to reduce material use (Gu et al., 2004; Kang & Guerin, 2009). The second point, regional materials, encourages using local materials within 500 kilometers to support local economies (Green Building Index (GBI), 2009; Kono et al., 2018). The third point, durability, focuses on picking long-lasting materials like concrete to

reduce replacement needs and overall costs (Leadership in Energy and Environmental Design, 2012; Samari et al., 2013; Zega et al., 2020). The fourth point, packaging, promotes sustainable packaging to minimize waste and costs (Dong & Hua, 2018; Marchand & Walker, 2008). These criteria ensure practical, sustainable, and eco-friendly building materials, enhancing the appeal and marketability of green hotels.

2.1.4 Design Components Criteria

Design component criteria ensure that building materials fit seamlessly into the hotel's design, enhancing both aesthetics and functionality while incorporating sustainability principles. Reusable design components highlight the importance of minimizing waste by reusing construction materials, encouraging designers to explore options for recycling or reusing materials and incorporating methods to minimize construction waste. Recyclable design components emphasize the use of materials with recycled content, reducing landfill waste and addressing environmental concerns associated with resource extraction. Designers can consider materials like fly ash concrete to promote sustainability in construction (Green Building Index (GBI), 2009; Hsieh et al., 2012; Marchand & Walker, 2008).

2.1.5 Resource Management Criteria

Resource management criteria play a crucial role in the efficient use of materials, energy, and water for green hotels, contributing to overall sustainability and reducing operating costs. The first sub-criterion, Selection of renewable resources, focuses on using replenishable resources with minimal environmental impact, such as bamboo for flooring (Leadership in Energy and Environmental Design, 2012; Syeda et al., 2014). Effective energy performance, the second sub-criterion, encourages designers to specify materials that optimize energy utilization, including renewable energy sources like solar and wind, and to choose energy-efficient appliances (Aslani et al., 2019; Rashdan & Ashour, 2017; Sozer, 2010). The third sub-criterion, water efficiency, emphasizes the need for responsible water use in hotels, recommending low-flow sanitary equipment and plumbing systems that enable graywater reuse for irrigation and flushing (Cuviella-Suárez et al., 2019; Hall & Murphy, 2010; Rashdan & Ashour, 2017). Adhering to these resource management criteria ensures the conservation of resources, aligning with sustainability goals and regulatory requirements for green hotel projects.

2.2 Sustainability Elements to the Hotel's Operational Sustainability

The hospitality industry uses a lot of resources, impacting the environment. To address this, it's now focused on sustainability, working with environmental groups for eco-friendly solutions (Akadiri et al., 2012; Ghulamrabbany et al., 2013). Sustainability, per the (United States Environmental Protection Agency, 2021), means balancing the environment, the economy, and social aspects. As sustainability highlights three important pillars, therefore the impact from hotel's operation influences the environmental sustainability, social sustainability and economic sustainability. The following entails the rationale of these elements to the hotel operational sustainability.

2.2.1 Environmental Sustainability

Environmental sustainability in hotel operations involves careful resource use for future generations (Abolore, 2012). Key criteria include energy efficiency, crucial for resource conservation and lowering greenhouse gas emissions (Tanaka, 2011). Good indoor air quality (IAQ) not only supports health but also aids energy efficiency (Vatalis et al., 2013). Water conservation reduces demand, connects to energy efficiency, and safeguards ecosystems (Nova, 2023). Proper waste management, encompassing recycling and composting, minimizes landfill waste, and reduces the environmental footprint (United States Environmental Protection Agency, 2021). Each aspect, from energy and water efficiency to waste management, contributes to environmental sustainability, aligning with global eco-friendly goals.

2.2.2 Economic Sustainability

Economic sustainability in hotel operations encompasses profitability, return on investment (ROI), and low maintenance costs. Profitability, closely tied to customer satisfaction and sustainable practices, is essential for a hotel's long-term economic viability (Rhou & Singal, 2020). Achieving a positive ROI requires efficient resource use and can be supported by adopting sustainable initiatives that attract environmentally conscious guests (Abualrejal & Ann, 2017). Low maintenance costs contribute significantly to economic sustainability by reducing overall operational expenses, allowing funds to be allocated efficiently, preserving physical assets, and enhancing a hotel's competitive advantage (Kwon et al., 2020). The economic sustainability of hotel operations relies on a balanced approach to profitability, resource efficiency, and effective cost management (Graci & Dodds, 2008).

2.2.3 Social Sustainability

Social sustainability in hotel operations revolves around ensuring guest satisfaction, promoting health and safety, and creating enjoyable experiences. By focusing on making guests happy, fostering positive community relationships, and following ethical practices, hotels contribute to long-term success (Horng et al., 2017). Prioritizing health and safety, including employee training and safety measures, enhances both the workplace environment and the guest experience, aligning with social sustainability principles (Simanihuruk et al., 2022). Moreover, creating enjoyable experiences for guests and staff, combined with responsible practices like sustainability initiatives, attracts environmentally and socially conscious guests, ultimately promoting the social sustainability of hotel operations (Peng & Chen, 2019). In essence, social sustainability means ensuring positive experiences for guests, maintaining health and safety, and fostering enjoyable interactions that benefit guests, employees, and the local community.

Through a comprehensive review and synthesis of the literature, the initial criteria for constructing materials that contribute to a hotel's operational sustainability were refined and extended to develop the research hypothesis for this study. Consequently, an initial conceptual framework for the study was proposed (see Figure 1). It includes the five hypotheses given below:

H1: There is a significant relationship between manufacturers' criteria and hotel's operation sustainability.
H2: There is a significant relationship between health criteria and hotel's operation sustainability.
H3: There is a significant relationship between consumption criteria and hotel's operation sustainability.
H4: There is a significant relationship between design component criteria and hotel's operation sustainability.
H5: There is a significant relationship between resource management criteria and hotel's operation sustainability.

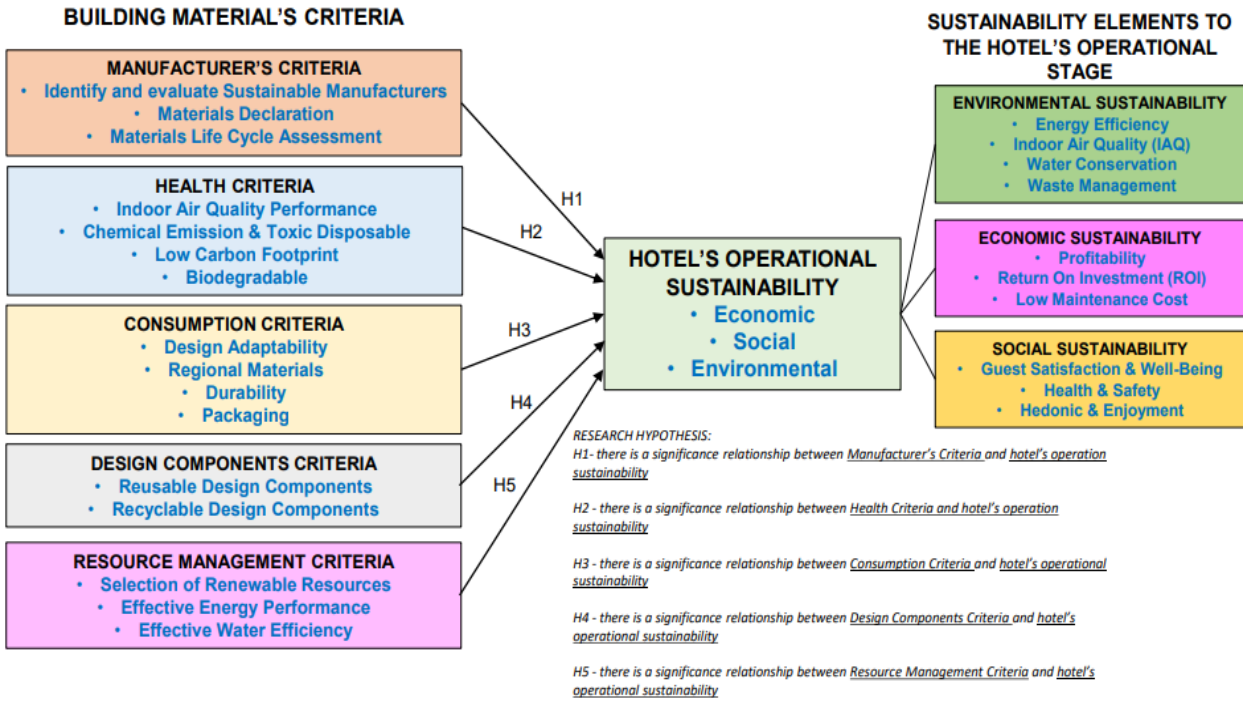

Figure 1: Initial Conceptual Framework (Author's own research).

3. METHODOLOGY

A quantitative research method involved questionnaire survey used to address the study aims and objectives. As depicted in the methodology strategy in Figure 2, literature review is conducted in the early phase of this study, by using secondary data sources such as journal articles, e-books, guidelines, reports, and precedent thesis that were relevant to criteria of building materials for green hotels and sustainability elements in hotel's operational stage. The identified criteria of building materials for green hotels and the sustainability elements were assembled as variables and compiled into questionnaire items. In order to attain appropriate samples for this study, the researcher firstly identified the green hotels in Malaysia rated under GBI, GreenRE and ASEAN Hotel standard which has listed 29 certified green hotels (see Figure 3). The questionnaire were then disseminated to 116 maintenance managers in the 29 certified green hotel projects (physical and online distribution). The targeted population of 116 maintenance managers was narrowed down as the scope of limitation for this study, which is based on the numbers of managers that worked in the certified green hotels. Justification on the selection of maintenance managers as the respondents for this study is due to operational duties in typical organizational structure and division of responsibilities within the hotel industry. Specifically, in the maintenance division, the roles are typically well-defined, with responsibilities distributed among a limited number of managers. For instance, a study published by Durodola et al., (2012) highlights the hierarchical structure in hotel organizations, often featuring a director overseeing both maintenance and operations. This approach aligns with efficient surveying techniques, ensuring that insights are gathered from relevant stakeholders without exceeding the number necessary for comprehensive coverage of the operational and maintenance aspects of green-rated hotels.

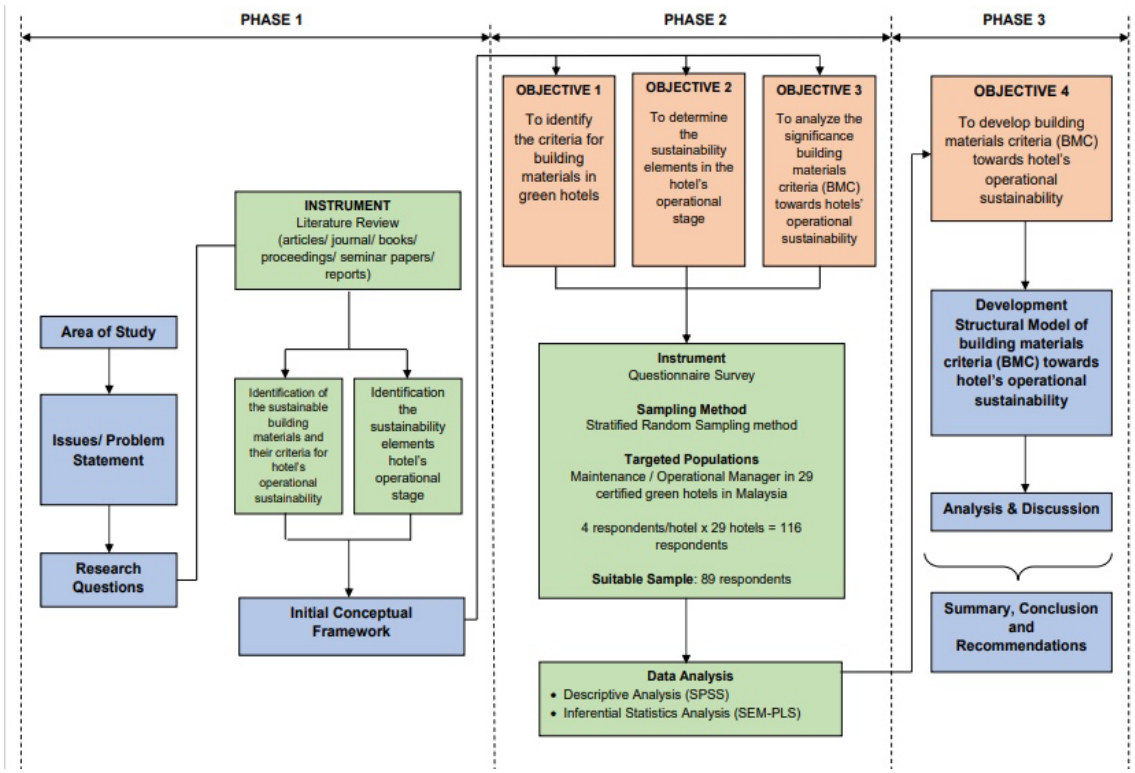

Figure 2: Methodology Strategy Chart (Author's own research).

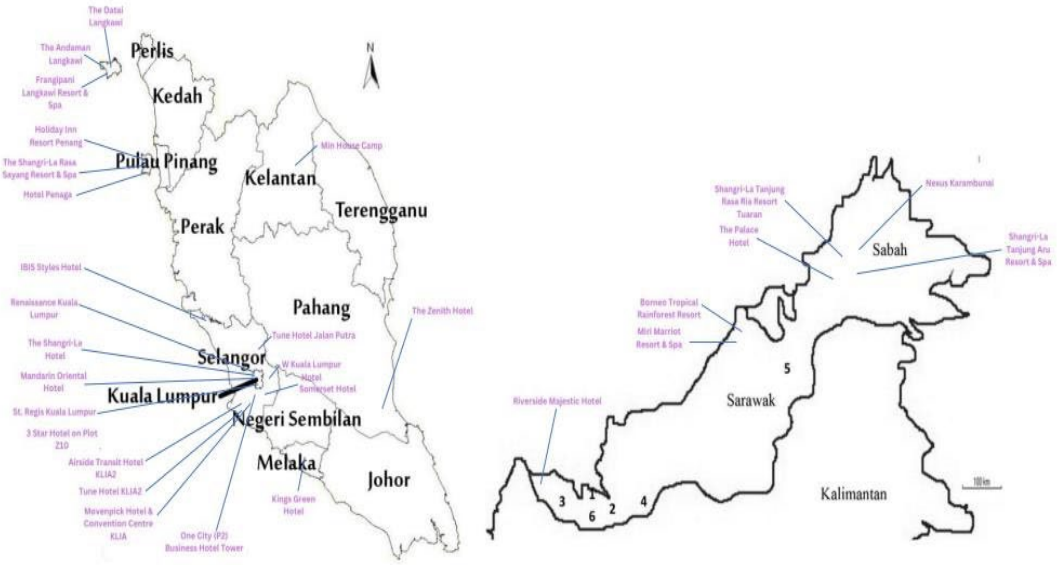

Figure 3: Certified Green Rated Hotels in Malaysia by GBI, GreenRE and ASEAN Green Hotel Standard (Author's own research).

Out of 116 respondents, the researcher had received 107 responses for the questionnaire survey. Thus, the data was analyzed based on the 107 valid data responses. The research employed inferential statistics, specifically Structural Equation Modeling using Partial Least Squares (SEM-PLS), to analyze the significance level of building materials criteria (BMC) in relation to hotel operational sustainability. This method involved three modeling steps: developing a framework to model BMC for green hotels, conducting a Measurement Model Analysis to assess construct reliability and validity, and performing Structural Model Analysis to examine relationships between latent variables. SEM-PLS was chosen for its capability to analyze complex cause-and-effect models with latent variables and assess construct reliability, composite reliability, and indicator reliability. The analysis utilized Smart PLS 4, involving steps such as developing a framework for modeling BMC, assessing construct validity, and evaluating the structural model using metrics like coefficient of determination (R2) and path coefficients. The use of bootstrapping and t-statistics helped determine the statistical significance of path coefficients. This robust methodology aimed to provide a comprehensive understanding of the relationships between building materials criteria and sustainable elements in hotel operations (Mohd et al., 2019).

4. RESULTS AND DISCUSSION

4.1 Significance Level Building Materials Criteria (BMC) Towards Hotel's Operational Sustainability

The final section of the analysis is the significance level building materials criteria (BMC) towards hotel's operational sustainability (HOS). This involves the correlation analysis between two variables which BMC as exogenous variables and HOS as endogenous variables. The variables have been confirmed and validated through questionnaire survey disseminated to experts in this study area. The questionnaire survey results being imported from SPSS software to Smart PLS 4 software for correlation analysis using resampling technique by bootstrapping procedure (Kock, 2018). It involves the calculation of path coefficient (used resampling technique in PLS-SEM), confidence interval (T-Statistics) (by dividing the path coefficient by the estimated standard error) and significance score (P-values) as tabulated in Table 4.10. This analysis is conducted to perceive the hypothesis developed in early stage of study.

Employing P-values as measure for significance level between the variables, (Kock, 2016) stated that if $P \leq 0.05$ the hypothesis is accepted, otherwise it is rejected. The significance level is set to 0.05 to compare with the significance probability value, p-value. If the p-value is less than 0.05, it is judged as "significant," and if the p-value is greater than 0.05, it is judged as "not significant." (Kwak, 2023). In addition, the hypothesis would be accepted, if the t-value is more than 1.96 with p-values is less than 0.05 (Muttaqin et al., 2020; Zahrawati et al., 2021). As presented in Table 4.11, correlation that have p-values less than 0.05 and t-value more than 1.96 is considered significant. The bootstrap function results in smart PLS show that three hypotheses mentioned in Table 4.10 are significant since the p-value less than 0.05 and t-value exceeds 1.96.

4.1.1 Significance Relationship Between Manufacturers' Criteria and Hotel's Operation Sustainability (H1)

H1 investigated the relationship between manufacturers' criteria for building materials and hotel operational sustainability across environmental, economic, and social dimensions. To put in another way, according to the data presented in Table 3, H1 are supported by a significant relationship between manufacturers' criteria and environmental sustainability in hotel's operation (ß=0.257, t-value=2.179, p-value=0.029) but there is no significant relationship between manufacturers' criteria and economic sustainability (ß=0.228, t-value=1.868, p-value=0.062) and social sustainability (ß=0.195, t-value=1.288, p-value=0.198) in hotel's operation. The analysis revealed a positive association between manufacturers' criteria and environmental sustainability in hotel operations, emphasizing the significant role these criteria play in determining a hotel's environmental impact (Haruna et al., 2020; Ishak et al., 2017). The alignment with manufacturers' criteria, including sustainable identification, materials declarations, and certification, was found to reduce resource consumption, decrease waste disposal, and lead to cost savings (Pereira-Moliner et al., 2021; Thorneloe et al., 2007). Moreover, engagement in collaborative initiatives with manufacturers focused on sustainability resulted in innovative practices promoting waste reduction, energy efficiency, and water conservation, contributing positively to overall sustainability efforts (Hariastuti & Lukmandono, 2022; Sanz et al., 2017). However, a negative relationship was observed between manufacturers' criteria and economic sustainability, potentially influenced by upfront costs associated with eco-friendly materials and a focus on environmental rather than economic goals. Similarly, the relationship with social sustainability was weaker, emphasizing the need for additional efforts beyond material selection to address social aspects in the hotel industry (Ilgin et al., 2015; Sakshi et al., 2020). In summary, manufacturers' criteria positively impact environmental sustainability but may present challenges in achieving economic and social sustainability goals due to the specific focus of sub-criteria.

4.1.2 Significance Relationship Between Health Criteria and Hotel's Operation Sustainability (H2)

H2 investigated the relationship between health criteria for building materials and hotel operational sustainability across environmental, economic, and social dimensions. The analysis revealed significant positive relationships between health criteria and both environmental sustainability (ß=0.279, t-value=2.142, p-value=0.032) and economic sustainability (ß=0.291, t-value=2.326, p-value=0.020) in hotel operations. These findings are supported by studies emphasizing that health criteria, including indoor air quality, chemical emissions control, and low carbon footprint, contribute to enhancing environmental sustainability by reducing the environmental impact of hotel operations (Prakash et al., 2023; Yu & Crump, 2010). The positive relationship between health criteria and economic sustainability is underscored by the potential for cost savings, revenue generation, and improved brand reputation through initiatives promoting a safe and hygienic environment (Olya et al., 2021; Sembajwe et al., 2020). However, there was no significant relationship found between health criteria and social sustainability (ß=0.128, t-value=0.882, p-value=0.378), possibly due to the narrow focus of health sub-criteria on environmental aspects, overlooking social dimensions essential to social sustainability. To fully address social sustainability, additional initiatives beyond health criteria may be required, emphasizing the need for a comprehensive approach in hotel operations. In summary, health criteria positively impact environmental and economic sustainability but may require broader considerations to address the social sustainability dimensions effectively.

4.1.3 Significance Relationship Between Consumption Criteria and Hotel's Operation Sustainability (H3)

Hypothesis 3 explored the relationship between consumption criteria, focusing on design adaptability, regional materials, durability, and packaging, and hotel operational sustainability across environmental, economic, and social dimensions. H3 are not supported as there is no significant relationship between consumption criteria and hotel's operational sustainability in terms of environment sustainability (ß=-0.003, t-value=0.038, p-value=0.970), economic sustainability (ß=0.119, t-value=1.085, p-value=0.278) and social sustainability (ß=0.129, t-value=0.952, p-value=0.341). It may be attributed to the specific focus of consumption criteria on resource management and efficient material usage, which might not directly impact broader sustainability dimensions. Elements like design adaptability, durability, regional materials, and packaging, while crucial for resource efficiency, may not singularly determine a hotel's overall environmental, economic, or social sustainability. Additionally, the lack of significant relationships underscores the complexity of sustainability, suggesting that a multifaceted approach beyond consumption criteria is necessary to achieve comprehensive sustainability goals in hotel operations. In summary, achieving holistic sustainability requires a combination of strategies that go beyond consumption criteria to address the multifaceted nature of sustainability comprehensively.

4.1.4 Significance Relationship Between Design Component Criteria and Hotel's Operation Sustainability (H4)

Hypothesis 4, investigating the relationship between design component criteria and hotel operational sustainability across environmental, economic, and social dimensions. H4 also are not supported as there is no significant relationship between design component criteria and hotel's operational sustainability in terms of environment sustainability (ß=-0.003, t-value=0.023, p-value=0.982), economic sustainability (ß=-0.119, t-value=0.979, p-value=0.088) and social sustainability (ß=-0.013, t-value=0.328, p-value=0.930). The absence of a significant relationship can be attributed to the specific focus of the sub-criteria within design components, namely recyclable and reusable design components (Hagnell & Åkermo, 2019; Vefago & Avellaneda, 2013). While recyclable components contribute to resource conservation, they don't solely determine overall environmental performance, which involves broader factors like energy efficiency. Similarly, reusable components, vital for environmental sustainability, may not comprehensively impact economic and social dimensions. Economic sustainability, including cost-effectiveness, may not be solely determined by material reusability, and social sustainability involves aspects beyond the reusability of design components (Chang & Kuo, 2008; Lebedeva et al., 2021; Mallieswari et al., 2023). This underscores the interconnected and multifaceted nature of sustainability, emphasizing the necessity of a comprehensive approach beyond design components to achieve sustainability goals in hotel operations.

4.1.5 Significance Relationship Between Design Component Criteria and Hotel's Operation Sustainability (H4)

Hypothesis 5, exploring the relationship between resource management criteria and hotel operational sustainability, is supported by positive associations across environment sustainability (ß=0.324, t-value=2.282, p-value=0.023), economic sustainability (ß=0.388, t-value=3.002, p-value=0.003) and social sustainability (ß=-0.438, t-value=2.977, p-value=0.003). Specific sub-criteria within resource management, such as selecting renewable resources and ensuring effective energy performance, directly contribute to environmental sustainability by reducing energy consumption and greenhouse gas emissions. This aligns with environmental goals crucial for a sustainable operational footprint. Economically, these practices lead to significant cost savings through reduced energy expenses and efficient resource use, enhancing the hotel's overall economic sustainability (Avellán et al., 2017; Luchkina, 2020; Yazdani-Chamzini et al., 2013). Moreover, the positive relationship with social sustainability is attributed to water efficiency, promoting responsible resource use and community engagement (Akram et al., 2020; Vlad & Lungu, 2022). By optimizing water consumption, hotels demonstrate their commitment to resource conservation, fostering positive community relations. These findings underscore the interconnected nature of sustainability, emphasizing the need for a comprehensive approach to achieve diverse sustainability goals in hotel operations.

Table 1: Correlation between building materials criteria and hotel's operational sustainability

Confidence Intervals (T-Statistics) and Significance Score (P-values)	Building Materials Criteria (BMC)	Hypo-thesis	Correlations	Hotel Operational Sustainability		
				Environment (EVS)	Economic (ECS)	Social (SS)
	Manufacturers Criteria (MC)	H1 Supported	Path Coefficient (ß)	0.257*	0.228	0.195
			T-Statistics	2.179	1.868	1.288
			P-Values	0.029	0.062	0.198
	Health Criteria (HC)	H2 Supported	Path Coefficient (ß)	0.279*	0.291*	0.128
			T-Statistics	2.142	2.326	0.882
			P-Values	0.032	0.020	0.378
	Consumption Criteria (CC)	H3 Not Supported	Path Coefficient (ß)	-0.003	0.119	0.129
			T-Statistics	0.038	1.085	0.952
			P-Values	0.970	0.278	0.341
	Design Component Criteria (DCC)	H4 Not Supported	Path Coefficient (ß)	-0.003	-0.119	-0.013
			T-Statistics	0.023	0.979	0.328
			P-Values	0.982	0.088	0.930
	Resource Management Criteria (RMC)	H5 Supported	Path Coefficient (ß)	0.324*	0.388*	0.438*
			T-Statistics	2.282	3.002	2.977
			P-Values	0.023	0.003	0.003

*** Correlation is significant P ≤ 0.05**

To confirm the proposed hypotheses and validate the structural model of the study, the path coefficients between two latent variables were examined. According to Kock (2016) the path coefficients should be more than 0.100 in order to explain the certain impact within the model and the significant level should be at least 0.05. Overall, only H1, H2 and H5 meet the significant criteria and are supported by p-value ranging from 0.003 to 0.032. Table 2 shows the summary of hypothesis analysis.

Table 2: Summary of Hypothesis Analysis

	Hypothesis	Result
H1	There is a significant relationship between manufacturers' criteria and hotel's operation sustainability	Supported
H2	There is a significant relationship between health criteria and hotel's operation sustainability	Supported
H5	There is a significant relationship between resource management criteria and hotel's operation sustainability	Supported

5. CONCLUSION

The research contributes by developing a comprehensive framework that outlines the relationships between building materials criteria and hotel operational sustainability. This framework serves as a valuable guide for understanding the nuanced interplay between these variables. Furthermore, the findings provide practical insights for hotel operators and managers, offering guidance on selecting building materials aligned with sustainability goals. This operational focus can aid hotels in making informed decisions that enhance their overall sustainability performance. In conclusion, this study achieved the aims in determining the significance of Building Materials Criteria (BMC) towards Hotel's Operational Sustainability (HOS) through correlation analysis and hypothesis testing. The findings revealed a diverse relationship within the hypotheses, emphasizing both positive and negative associations between BMC and environmental, economic, and social sustainability dimensions. Hypotheses 1 and 2 showed positive links with manufacturers and health criteria, respectively, negative associations in economic and social sustainability highlight the need for broader initiatives. While, Hypotheses 3 and 4 indicate no significant correlations, emphasizing the multifaceted nature of sustainability. However, Hypothesis 5 demonstrates positive relationships between resource management criteria and environmental, economic, and social sustainability, underscoring the pivotal role of efficient resource use. Despite potential lack of statistical significance, it is crucial to recognize the existence of relationships, emphasizing the need for a holistic approach beyond specific BMC for enhancing hotel operational sustainability. These nuanced findings contribute valuable insights for researchers and practitioners in the field, guiding future efforts towards a more comprehensive and effective sustainability strategy in the hotel industry.

This study makes noteworthy contributions to national agendas supported by the government, even though the hospitality industry may not be directly under governmental jurisdiction. By emphasizing green procurement practices within the hospitality sector, the research aligns with national environmental policies and sustainability goals. This alignment supports the broader national agenda related to environmental conservation and reducing the carbon footprint. The research contributes to the government's agenda for resource efficiency and conservation. Recommending sustainable building materials for hotels encourages the responsible use of resources, in line with national strategies aimed at promoting efficient resource management. The adoption of sustainable building materials in hotels, as advocated by the research, aligns with national initiatives to mitigate climate change.

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