SUSTAINABLE DEVELOPMENT AND ELEGANCE IN INDOOR AND OUTDOOR DESIGNS: CONCEPTS FOR DEVELOPING ENVIRONMENTALLY FRIENDLY AND VISUALLY ATTRACTIVE CONDITIONS.

Zhong Shengbiao[1], Muralitharan Doraisamy Pillai[1]

[1]Lincoln University College, Petaling Jaya, Malaysia.

ABSTRACT

This research aims to find solutions to improve the aesthetics and sustainability of building exteriors and interiors. Strategies that create aesthetically pleasing and environmentally sustainable landscapes are the ones that this research is focused upon. As environmental concerns rise, so does the pressure on the design profession to provide aesthetically pleasing spaces while simultaneously reducing the negative impact on the natural world. The design method, the materials employed, and the quantity of energy all contribute to this difficulty. Sustainable materials and energy-efficient technologies are covered, along with important ideas like biophilic design and cradle-to-cradle principles. On top of that, it delves into the perceived costs of sustainable design and the difficulties of sourcing environmentally advantageous materials. To provide designers with actionable advice for striking a balance between sustainability and aesthetics, the project looks at successful case studies and new trends. Sustainable design does not have to sacrifice aesthetics for the sake of environmental friendliness; on the contrary, it may inspire new ways of thinking about design that are both functional and beautiful. By looking forward to how interior and exterior design will evolve in an increasingly eco-conscious society, this research hopes to add to the continuing conversation on sustainable design.

Keywords: Environmental Sustainability, Healthy Environments, Ecologically Sustainable, Beautifully Attractive.

INTRODUCTION

Interior and external design have seen significant changes in recent years due to the entwined concerns of sustainability and beauty (Ferreira et al., 2023). This change has happened in both directions. An ever-increasing awareness of environmental issues and a shared goal of creating ecologically conscious but visually beautiful spaces are propelling this trend forward. The incorporation of eco-friendly practices into design is more than just a passing trend; it heralds a sea change in how the researchers approach the construction of homes and offices. Demand for ecologically conscious design has been on the rise in tandem with societal awareness of the impact of human activities on the natural world. This shift is indicative of a societal and cultural trend towards sustainability, which is putting more focus on reducing venues' negative effects on the environment without sacrificing their aesthetic value. As a result, many in the design industry are beginning to see the

value of this dual strategy, seeing sustainability and aesthetics as complementary qualities that, when combined, may provide significant and enduring environments. This new way of thinking about design prioritises thinking about how materials, energy use, and overall choices will affect the environment in the long run. Venues are under growing pressure to be both environmentally friendly and visually pleasing, thus designers are under increasing pressure to find innovative solutions that do just that. Without a shadow of a doubt, the level of success in combining aesthetics and sustainability will decide the fate of design in the future. As momentum builds for this strategy, this is starting to stand out more (Dong et al., 2021).

BACKGROUND OF THE STUDY

Using eco-friendly materials, energy-efficient technologies, and design principles that promote longevity and adaptability are all part of sustainable design, which aims to lessen the environmental impact of built environments. Given the current state of affairs on a global scale, this approach is crucial in addressing issues such as pollution, resource loss, and climate change. Nowadays, designers have a heavy load: to make spaces seem good while still meeting environmental standards (Huang et al., 2020). To achieve this goal, they must design environments that are aesthetically pleasing while also contributing positively to the planet. To achieve this balance in interior design, strategies including using renewable and recycled materials, letting in plenty of natural light, and using energy-efficient appliances and fixtures are used. Environmentally conscious building materials, landscaping practices that increase biodiversity, and the creation of green spaces that are aesthetically pleasing and functionally beneficial are all aspects of exterior design that are carefully considered. Creating a design that is both aesthetically pleasing and environmentally friendly is no easy feat. Sustainable design solutions are in high demand despite these challenges. The growth of eco-conscious customers and developments in sustainable technologies contribute to this need. This research aims to fill a gap in the researchers understanding of how to create places that are good for the environment and beautiful to look at simultaneously. In order to shape the design of the future, this research seeks to uncover sustainable methods, innovative approaches, and best practices (Hasik et al., 2019).

PURPOSE OF THE RESEARCH

Finding practical ways to combine ecological friendliness with aesthetic appeal in architectural design is the driving force behind this study. The main purpose of the research is to shed light on how designers may create environmentally friendly places that are also visually beautiful. This research evaluates best practices, innovative materials, and design processes with the goal of providing practical instructions and insights for design industry experts. The researchers want to have

a small but meaningful impact on the development of more sustainable and visually beautiful building practices someday.

LITERATURE REVIEW

It is crucial to integrate environmental considerations with aesthetics, since the subject of sustainability and aesthetics in architecture design has lately attracted a lot of scholarly attention. It holds true for the design of the inside as well as the outside. This survey of the literature summarises a number of seminal studies and concepts that have had a significant impact on sustainable design practices and their aesthetic consequences. The greater framework of specified sustainable development is the basis of sustainable design. Within this framework, the researchers must meet present-day needs without compromising those of future generations. Use of renewable resources, reduction of energy use, and other strategies to mitigate environmental impacts are all part of sustainable design in the built environment. It was academics like who proposed the “cradle-to-cradle” design idea. It promotes the development of spaces and products that may be safely recycled or discarded once they have fulfilled their function (Kong et al., 2021). Aesthetics, rather than environmental considerations, have always been the primary focus of design. Recent studies have shown that sustainability and aesthetics are not mutually incompatible. The practice of “biophilic design,” which involves enhancing environmental sustainability by incorporating natural components and materials into spaces, also fosters a feeling of belonging. This approach is supported by research that suggests that occupants’ psychological and visual health may be improved by incorporating organic forms, natural light, and vegetation. There are a number of approaches that have been proposed in the literature that aim to combine ecological friendliness with aesthetic appeal. Reduce transportation-related pollution, support local businesses, and give any project that extra special touch by making use of renewable resources that are nearby. Using recycled materials is one approach; not only does it help the environment by reducing trash, but it also adds character and history to any space. Solar panels and green roofs are two examples of renewable energy sources that may be creatively integrated into building designs to improve both functionality and visual appeal (Le et al., 2021).

RESEARCH QUESTIONS

What is the impact of recyclability on sustainability in interior and exterior design?

RESEARCH METHODOLOGY

RESEARCH DESIGN

The analysis of quantitative data was conducted using SPSS version 25. The 95% confidence interval and the odds ratio were used to ascertain the direction and magnitude of the statistical association. The statistical significance criterion was

established at $p < 0.05$. A descriptive analysis was used to ascertain the essential properties of the data. Quantitative approaches are defined by objective measurements and the mathematical, numerical, or statistical evaluation of data obtained by surveys, polls, and questionnaires, or by modifying existing statistical data using computing tools.

SAMPLING

Rao-soft software was used to estimate the sample size of 440, 650 questionnaires were distributed, 580 questionnaires were returned, and lastly, 80 questionnaires were rejected owing to incompletion of the questionnaire. In the end, 500 questionnaires were used for the research.

DATA AND MEASUREMENT

The study used a questionnaire as its primary data gathering tool. The survey consisted of two sections: (A) General demographic data and (B) Responses about online and offline channel attributes evaluated using a 5-point Likert scale. Secondary data was acquired from many sources, mostly via online databases.

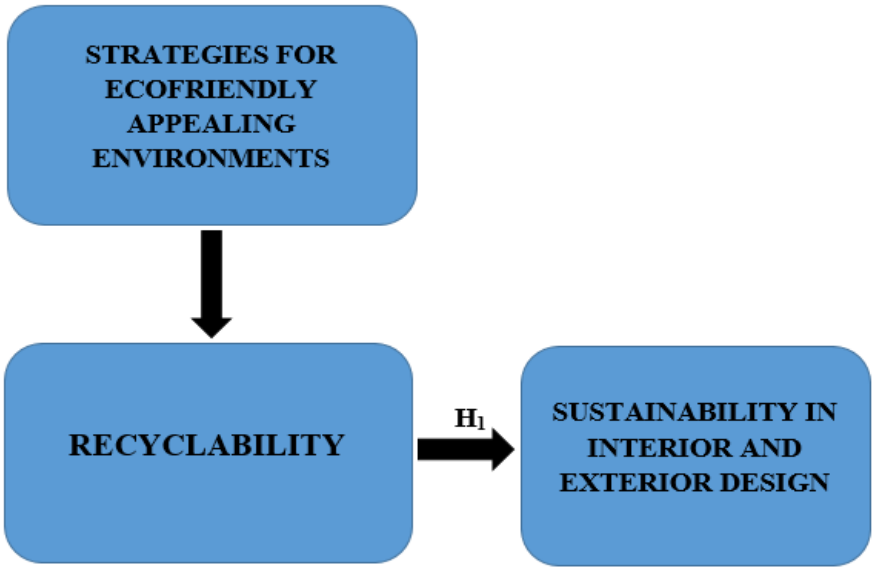
STATISTICAL SOFTWARE

The statistical analysis was conducted using SPSS 25 and MS-Excel.

STATISTICAL TOOLS

To grasp the fundamental character of the data, descriptive analysis was used. The researcher is required to analyse the data using ANOVA.

CONCEPTUAL FRAMEWORK



RESULT

Factor Analysis: One typical use of Factor Analysis (FA) is to verify the existence of latent components in observable data. When there are not easily observable visual or diagnostic markers, it is common practice to utilise regression coefficients to produce ratings. In FA, models are essential for success. Finding mistakes, intrusions, and obvious connections are the aims of modelling. One way to assess datasets produced by multiple regression studies is with the use of the Kaiser-Meyer-Olkin (KMO) Test. They verify that the model and sample variables are representative. According to the numbers, there is data duplication. When the proportions are less, the data is easier to understand. For KMO, the output is a number between zero and one. If the KMO value is between 0.8 and 1, then the sample size should be enough. These are the permissible boundaries, according to Kaiser: The following are the acceptance criteria set by Kaiser:

A pitiful 0.050 to 0.059, below average 0.60 to 0.69

Middle grades often fall within the range of 0.70-0.79.

With a quality point score ranging from 0.80 to 0.89.

They marvel at the range of 0.90 to 1.00.

Table1: KMO and Bartlett's Test

Testing for KMO and Bartlett's

Sampling Adequacy Measured by Kaiser-Meyer-Olkin .960

The results of Bartlett's test of sphericity are as follows: approx. chi-square

df=190

sig.=.000

This establishes the validity of assertions made only for the purpose of sampling. To ensure the relevance of the correlation matrices, researchers used Bartlett's Test of Sphericity. Kaiser-Meyer-Olkin states that a result of 0.960 indicates that the sample is adequate. The p-value is 0.00, as per Bartlett's sphericity test. A favourable result from Bartlett's sphericity test indicates that the correlation matrix is not an identity matrix.

Table 1: KMO and Bartlett's Test.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.960
Bartlett's Test of Sphericity	Approx. Chi-Square	3252.968
	df	190
	Sig.	.000

The overall significance of the correlation matrices was also confirmed by Bartlett's Test of Sphericity. A Kaiser-Meyer-Olkin sample value of 0.960 is appropriate. The researchers obtained a p-value of 0.00 via Bartlett's sphericity test. Bartlett's sphericity test, yielding a statistically significant result, invalidated the correlation matrix.

INDEPENDENT VARIABLE

Strategies for Eco-Friendly Appealing Environments: A wide range of methods, ideas, and approaches to design are together known as "strategies for eco-friendly appealing environments," and they all have one goal: to create places that are good for the environment and look good doing it. Sustainable materials, energy-efficient technologies, and renewable resources are the backbone of these initiatives, which aim to lessen a space's impact on the environment without sacrificing its aesthetic or functional value (Mohsen & Matarneh, 2023). Green architecture is an important part of these kinds of settings; it entails creating structures that make the most of natural light, use energy-efficient insulation, and use renewable energy sources like solar panels. Building gardens or rooftop farms is another great way to increase biodiversity, clean up the air, and provide people a place to rest; it's also a good technique for improving air quality. Another successful method of creating visually appealing and environmentally beneficial landscapes is sustainable landscaping, which involves adopting native plants that need less water and upkeep. Not only does it cut down on waste, but it also gives the room a one-of-a-kind look when recycled materials are used in building, decorating, and furniture making. To make these rooms healthier for people and less harmful to the environment, eco-friendly paints, coatings, and fabrics are used. In addition, these methods often follow the principles of biophilic design, which aims to bring humans closer to nature via the use of natural features such as water features, indoor plants, and textures seen in nature. Planning and smart design can make these techniques a reality, allowing us to build environmentally responsible and aesthetically pleasing environments that promote wellness and a connection to nature (Mengist et al., 2020).

FACTOR

Recyclability: In order to lessen the impact on the environment and the need to replenish depleted natural resource stocks, it is desirable for materials, products, and items to be recyclable, meaning they can be broken down into their component parts and used again. This theory is fundamental to sustainable practices since it suggests that old objects may be gathered, sorted, cleaned, and reprocessed into new products instead of being thrown away in landfills or incinerators. This way, their life cycle can be extended and precious resources can be conserved (Wang et al., 2021). Recycling helps reduce energy consumption, carbon emissions, and resource depletion by repurposing waste like metals, plastics, glass, and paper into new goods with reduced raw material and energy requirements. Each step of the recycling process—collection, sorting, cleaning, and manufacturing—is essential for the effective reuse of resources. There is a strong correlation between recyclability and product design; items that are made to be easily disassembled and recycled tend to have better recycling results. Recyclability, in a wider sense, is an aspect of the growing trend towards a circular economy, which aims to promote sustainability by decreasing the need for raw material extraction and increasing the rate of material reduction by continuous reuse in a closed-loop system. In order to lessen the negative effects of waste on the environment, preserve natural resources, and build a more sustainable future, it is important for people, corporations, and governments to support and promote recyclability (Sahlol et al., 2021).

DEPENDENT VARIABLE

Sustainability in Interior and Exterior Design: Creating places that are ecologically responsible, resource-efficient, and socially equitable from their inception and construction all the way through to their daily usage and ultimate destruction is what the researchers mean when the researchers talk about sustainability in interior and exterior design. Prioritising the health and well-being of inhabitants while minimising the ecological imprint of the built environment and its surrounding landscape is the goal of this approach. Using long-lasting, eco-friendly, and sustainably sourced materials, products, and finishes is key to sustainable interior design. Additionally, it highlights water conservation measures like low-flow fixtures and rainwater collecting systems in addition to energy efficiency measures like natural lighting, insulation, and energy-saving appliances. An important aspect of eco-friendly interior design is creating floor plans that maximise ventilation and air quality. Green roofs, environmentally friendly construction materials, and landscapes that mitigate the heat island effect, enhance storm water management, and promote biodiversity via the employment of native plants and sustainable landscaping practices are all examples of exterior design that prioritises sustainability. Additionally, sustainable design approaches promote creating long-lasting and versatile outdoor spaces and structures that can be easily adjusted to meet future demands. This way, they may be used for a longer period of time without frequent maintenance or reconstruction. This method also stresses the need of effective waste management systems, material reuse and recycling, and

minimising waste throughout construction and operation. Environmental health, responsible resource management, and the development of places that benefit humans and the earth are all outcomes of designers' efforts to include sustainability principles into their work, whether it's for the inside or the outside of a building. These plans not only make buildings less harmful to the environment, but they also aid in making places that are aesthetically pleasing, practical, and built to endure, all while balancing human demands with those of the natural world (Wenzlaff et al., 2020).

Relationship between Recyclability and Sustainability in Interior and Exterior Design: Because they both aim to encourage ecological consciousness and efficient use of resources, recyclability and sustainability are inseparable in the context of interior and external design. Designing places that gradually lessen the environmental effect of buildings and landscapes is the emphasis of sustainability, while the capacity of materials and products to be processed and reused beyond their original life cycle is known as recyclables. Interior and exterior designers may drastically cut down on raw material use, trash production, and environmental impact by using recyclable materials. For example, by reusing and recycling items like glass, aluminium, and certain plastics, the researchers can cut down on landfill trash and save more of the researchers' precious natural resources for making other products. This is in perfect harmony with sustainability principles, which seek to build places that consume less energy, less non-renewable resources, and help maintain natural harmony in the long run. By decreasing the environmental cost of manufacturing and the requirement for landfill disposal, the use of recyclable materials in furniture, flooring, finishes, and fixtures is in line with sustainable design principles in interior design. Take furniture created from reclaimed wood or fabrics as an example. It's a great way to repurpose resources that would otherwise go to waste, yet the end result is still beautiful, long-lasting, and practical. Another way to lessen a building's impact on the environment is to use recyclable materials instead of virgin ones since their production requires less energy. Reusing and recycling materials for building exteriors, landscaping, and outdoor constructions is one way to promote sustainability in exterior design. Paving and structural components made of recycled concrete are one example; long-lasting outdoor furniture and construction materials may be made from recycled metals. Systems like water and energy efficiency are also part of sustainability, and introducing recyclability into these systems, such employing solar panels made from recyclable materials or rainwater collecting systems, further increases the space's sustainability. When it comes down to it, choosing eco-friendly materials is important, but making sure that interior and exterior design elements can be recycled is a huge step towards sustainability. In addition to promoting material reuse, it promotes sustainable design practices that reduce impact on the environment and make the most efficient use of available resources. Sustainable and recyclable design allows architects and engineers to build places that benefit

nature, cut down on trash, and survive for generations to come. By working together, the fields of interior and exterior design may contribute to a more sustainable future by recycling and reusing materials on an ongoing basis. This idea is known as a "circular economy," and it has the potential to revolutionise the way the researchers live (Wijesooriya & Brambilla, 2021).

Because of the above discussion, the researcher formulated the following hypothesis, which was analyse the relationship between Recyclability and Sustainability in Interior and Exterior Design.

H_{01}: There is no significant relationship between Recyclability and Sustainability in Interior and Exterior Design.

H_1: There is a significant relationship between Recyclability and Sustainability in Interior and Exterior Design.

Table 2: H_1 ANOVA Test.

ANOVA					
Sum					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	37588.430	144	5655.517	755.884	.000
Within Groups	472.660	355	5.356		
Total	40081.390	499			

The results of this investigation will be crucial. The F value is 755.884, attaining significance with a p-value of .000, which is below the .05 alpha threshold. This signifies the **"H_1: There is a significant relationship between Recyclability and Sustainability in Interior and Exterior Design"** is accepted and the null hypothesis is rejected.

DISCUSSION

Sustainability and aesthetics in interior and outdoor design are seen as complementary goals, despite the growing difficulty of creating ecologically responsible and aesthetically beautiful settings. In order to evaluate and optimise these design solutions, quantitative tools are crucial for data-driven decisions that enhance sustainability and aesthetics. Quantitative analysis is widely used in many industries, including energy efficiency. Using metrics like Energy Use Intensity (EUI), designers may compare potential energy-saving options. One way to evaluate the efficacy of energy-efficient lighting, increased insulation, and passive solar architecture is to compare energy consumption levels before and after their installation. With this data-driven approach, the researchers can make sustainable design choices that don't compromise on comfort or aesthetics. Material selection is one of several crucial areas that benefits from using quantitative methodologies. The environmental impacts of materials may be investigated in detail using Life

Cycle Assessment (LCA) from extraction to ultimate disposal. Keeping or enhancing the design's aesthetic appeal is possible with the use of environmental impact assessments (LCAs), which provide numerical values for variables like energy consumption, garbage generation, carbon footprint, and sustainability. Using renewable or reused materials, for example, may reduce the design's environmental impact while simultaneously enhancing its visual and textural aspects. Indoor environmental quality (IEQ) is an important part of sustainable design as it has a direct impact on the health and happiness of building inhabitants. Quantitative metrics like lighting levels, acoustic performance, and air quality may be monitored to ensure that sustainable design does not negatively impact the living area. Air quality, energy consumption, and aesthetics may all be improved with the help of natural lighting solutions and low-VOC paints, for example. When planning landscapes or other outdoor spaces, water efficiency is key. Annual water usage measured in litres per square meter is a useful metric for quantitative evaluation of strategies like rainwater gathering and drought-tolerant plants. By harmonizing form and function, these techniques not only aid in water conservation but also enhance the environment's aesthetics (Huang et al., 2020). Aesthetics is often thought of as a very subjective discipline, however quantitative methods could nevertheless be helpful when assessing it. By implementing systematic surveys and statistically assessing the findings, the researchers may discover how people perceive and appreciate different aspects of the design. By comparing customer preferences with sustainability indicators, design teams may discover solutions that are both environmentally friendly and visually appealing.

CONCLUSION

Incorporating sustainability principles into both indoor and outdoor design has been a huge stride towards making environmentally friendly spaces that also look good. Sustainability and aesthetics are not mutually exclusive, as this research shows; in fact, they may complement one another when handled with care. By using strategies that priorities the use of environmentally conscious materials, energy-efficient technologies, and biophilic design principles, architects and interior designers may craft environmentally conscious and visually beautiful environments. Because of considerations like perceived costs and the availability of sustainable materials, striking a balance between the two isn't simple, but it's also not impossible. Sustainable technology and materials are advancing, and there is a growing social need for eco-conscious design, thus there are many opportunities for creativity. Less environmental impact, improved occupant well-being, and reduced running expenditures are just a few of the long-term benefits that sustainable design offers, making it an investment worth considering. Sustainability and aesthetics go hand in hand in well-designed settings; not only do they provide for more desirable long-term spaces, but they also demonstrate that the designers have the future in mind. New possibilities for ecologically responsible and visually beautiful spaces are

emerging as a result of the industry's continuous growth, which is placing a greater emphasis on sustainability in both interior and external design.

REFERENCES

1. Dong, Y.; Ng, S.T.; Liu, P. A comprehensive analysis towards benchmarking of life cycle assessment of buildings based on systematic review. Build. Environ. 2021,204, 108162.
2. Ferreira, A.; Pinheiro, M.D.; Brito, J.; Mateus, R. A critical analysis of LEED, BREEAM and DGNB as sustainability assessment methods for retail buildings. J. Build. Eng. 2023, 66, 105825.
3. Hasik, V.; Escott, E.; Bates, R.; Carlisle, S.; Faircloth, B.; Bilec, M.M. Comparative whole-building life cycle assessment of renovation and new construction. Build. Environ. 2019,161, 106218.
4. Huang, B.; Gao, X.; Xu, X.; Song, J.; Geng, Y.; Sarkis, J.; Fishman, T.; Kua, H.; Nakatani, J. A life cycle thinking framework to mitigate the environmental impact of building materials. One Earth 2020, 3, 564–573.
5. Kong, M.; Lee, M.; Kang, H.; Hong, T. Development of a framework for evaluating the contents and usability of the building lifecycle assessment tool. Renew. Sustain. Energy Rev. 2021,150, 111475.
6. Le, D.-L.; Nguyen, T.-Q.; Huu, K.D. Life cycle carbon dioxide emissions assessment in the design phase: A case of a green building in Vietnam. Eng. J. 2021, 25, 121–133.
7. Mengist, W.; Soromessa, T.; Legese, G. Method for conducting systematic literature review and meta-analysis for environmental science research. MethodsX 2020, 7, 100777.
8. Mohsen, M.S.; Matarneh, R. exploring the interior designers' attitudes toward sustainable interior design practices: The case of Jordan. Sustainability 2023, 15, 14491.
9. Sahlol, D.G.; Elbeltagi, E.; Elzoughiby, M.; Abd Elrahman, M. Sustainable building materials assessment and selection using system dynamics. J. Build. Eng. 2021, 35, 101978.
10. Wang, Z.; Liu, Y.; Shen, S. Review on building life cycle assessment from the perspective of structural design. J. Asian Archit. Build. Eng. 2021, 20, 689–705.
11. Wenzlaff, J.; Page, M.; Moher, D. PNS154 the PRISMA 2020 statement: Development of and key changes in an updated guideline for reporting systematic reviews and meta-analyses. Value Health 2020, 23, S312–S313.
12. Wijesooriya, N.; Brambilla, A. Bridging biophilic design and environmentally sustainable design: A critical review. J. Clean. Prod. 2021,283, 124591.