

EXPLORING SUSTAINABILITY IMPACT ON INTERIOR DESIGN SOLUTIONS

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Abstract

The interior design industry consumes significant amounts of natural resources, making designers morally obligated to the planet and its inhabitants. Designers must consider sustainable solutions to avoid the depletion of fragile ecological systems; they must employ different strategies to adjust all aspects of interior design to incorporate sustainable solutions, despite the many obstacles. This paper aims to explore the barriers preventing the implementation of sustainable design. This study focuses on sustainable practice within the context of interior design solutions.

Keywords: Interior Design, Sustainability, Sustainable interior barriers, Sustainable interior solutions

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1 INTRODUCTION

Human evolution has been accompanied by increases in natural resource consumption. This relationship between evolution and consumption changed dramatically with the advent of the industrial revolution, which coincided with significant population growth fueling the need to develop a lot of technological solution to meet their needs. This modern technological lifestyle needs called for the mass production of engineered materials, resulting in high annual consumption of natural resources. The consequent mass destruction of natural resources threatened to destroy the planet's environment assets. Many studies and extensive evidence warned that humanity's ecological footprint had exceeded the carrying capacity of the Earth's resources (Wackernagel and Rees, 1996). These discoveries urged people to embrace a paradigm to sustain natural resources, and inspired thousands of people to change their beliefs, attitudes, and methodologies to deal with environment resources responsibly (Jones, 2008).

The growing awareness of the importance of conserving environmental resources has social and cultural implications, as well as physical and economic impacts such as sustaining life style requirements, healthy economic, minimized global warming and reduced toxic gas emission. This has created dialogues with the aim of curing our planet by controlling consumption and sustaining natural resources. Currently, the term "sustainability" has been developed and accepted as a significant issue across a variety of fields.

Current design forms consume natural resources at an alarming rate. Building construction materials, operations, and equipment are using nearly 50% of the world's natural resources and causing extensive environmental damage. Errors in design practices, such as design modification or detailing mistakes, have a tremendous negative impact on resource consumption (Osmani et al., 2008). The interior design industry contributes to this problem directly by using finishing materials and by manufacturing furniture and accessories. For instance, the total need for building materials over a 50-year lifecycle for the case building is 4960 tones or 1.62 t/m². The total material needs include the initial construction of the building (89%), recurrent replacements and refurbishments (6%), and material losses (5%). The production of the building materials requires a total of 7320 t of abiotic inputs or 2.39 t/m² (Ruuska and Häkkinen, 2014). Energy is also consumed indirectly as materials are transferred from one country to another, and interior environments are controlled through HVAC (Heating, Ventilation and Air Conditioning) and artificial light systems. The design industry must therefore be revisited as a whole in order to integrate sustainable concepts into interior design solutions. Designers are fostering these procedures by interpreting philosophical sustainability concepts for implementation through various strategies and techniques, based on each project's criteria (Ruff and Olson, 2009).

Sustainability in interior design has evolved in different aspects: sustainable resources in human culture and identity became more important, consumption is being rationalized, techniques that support efficient consumption are being used, and the popularity of environmentally friendly design solutions is growing. Designers must be proactive in finding solutions that preserve the environment while still providing people with a modern lifestyle and fulfilling human needs.

The evolution of the design sustainability movement is supported in many ways: first, in raising awareness of environmental sustainability, whether by governments or individuals, to lead communities to accept sustainable design solutions; second, developing several technologies that work on sustaining resources or controlling interior over all consumption, allows designers to suggest options that allow individuals to live as they always have, but lessen their environmental impact (McDonough and Braungart, 2002); and third, in the integration of sustainability concepts to interior design curriculum so that students may be encouraged to stimulate new ideas to inform the practice and pedagogy of interior design. This raises a new generation of designers who believe in sustainable solutions and are able to convey the sustainability message to their communities.

2 SUSTAINABLE INTERIOR DESIGN

Interior design concerns the planning and forming of man-made environments, and considers function and aesthetics. These interior environments affect the health, safety, welfare, and performance of users.

The concept of sustainability can be divided into four interconnected domains: ecology, economics, politics, and culture. The term itself has many definitions within each domain. Economically, it can be defined as an approach to economic planning that attempts to foster growth while preserving the quality of the environment for future generations. In terms of environmental science, it is defined as the quality of not being harmful to the environment or depleting natural resources, and thereby supporting long-term ecological balance (Encyclopedia Britannica, 2014). Sustainability is not just a theoretical concept or a professional activity, but a way of life that affects all aspects of individual life. Sustainable design solutions have emerged as a guiding paradigm that supports the creation of a new environment to meet the needs of the present without compromising those of future generations. The term “sustainable design” is used interchangeably with “green design”. However, green design refers to an environmental quality that significantly eliminates or reduces the negative impact of buildings on the environment and occupant health, welfare, and safety; whereas sustainable design refers to the protection of the global environment and future ecosystems. The first generation of sustainable design experiments mainly addressed energy efficiency, alternative building materials, conservation, and recycling. The second generation initiated a synthesis of all the scattered ideas and strategies regarding sustainability in order to create a concrete sustainable design theory and practice (Van Der Ryn and Cowan, 2007).

It is important to define sustainability from different angles due to the influence and impact that different interpretations have on the application of sustainable solutions. The definitions outlined above show that sustainability’s main concerns are saving the environment, reducing one’s ecological footprint, and supporting economic growth in order to save human natural wealth. Interior design is a multi-dimensional profession that has a significant impact on all previous sustainable aspects. Therefore, creating healthy interior spaces with minimum consumption in all aspects of design will result in the successful application of these sustainability concepts. Hence, sustainable interior design can be defined as spaces designed to sensibly address the impact of all their functions, parts, and elements on the global environment. It can also be defined as systems and materials that are integrated into whole design solutions for the purpose of limiting their negative impact on occupants and the environment, and maximizing their positive impact on social, economic, and environmental systems over a building’s life cycle. Sustainable design attempts to create interior spaces that are environmentally sustainable and healthy (Kang and Guerin, 2009; IFI 2011). Sustainable interior design can also be defined as the blending of past solutions with new technologies in order to sustain heritage design elements (Loftness et al., 2007). In summary, interior design may be considered “sustainable” when designers provide responsible environmental solutions that rely on the limited consumption of renewable, local resources and energy; are inspired by heritage solutions; respect new design trends and technologies; and provide healthy indoor environments. A successful sustainable interior project blends sustainability into each phase of the design process. This includes designing flexible spaces to accommodate changing activities, occupants, and technologies, while conserving resources. They should give occupants access to thermal controls and outdoor views, daylighting, installing centralized energy management units and energy-efficient light systems, using efficient materials and equipment, and utilizing durable installation systems (Winchip, 2007).

Interior designers may be motivated to adopt sustainable solutions by various means, such as potential marketability, service learning, conference attendance, formal education, books, articles, or co-workers (Rider, 2005). They may be motivated simply by the environmental benefits achieved from reducing the impact a building’s construction and operations have on air, water, and non-renewable energy resources. There are also the economic advantages that come from improved interior environment performance and reduced operating costs, and improved occupant comfort and health result in wellbeing and safety benefits. Communities then profit when strains on local infrastructure are minimized as a result of overall improvements to quality of life. These sustainable interior design practices and strategies fall into eight categories: conservation, site, water, energy, indoor environmental quality, material selection, waste, and innovation; all of which lessen environmental impacts and benefit the Earth, both presently and in the future. (Kang and Guerin, 2009; Loftness et al., 2007; Rider, 2005).

3 BARRIERS HINDERING SUSTAINABLE INTERIOR DESIGN PRACTICES

The design profession is encountering the need to find creative and desirable solutions for design problems. As such, the design practice plays an integral part in creating new paradigms to develop design solutions that maintain a healthy economy and address environmental issues.

Designers should understand the impact of their activities on natural environment and the social and moral obligations associated with these implications, and still be able to make a personal commitment to environmental sustainability in the face of all obstacles. The choice to embrace sustainable design practices adds another factor to a design mix that makes sustainability difficult, and presents a number of challenges to designers (Stieg, 2006).

Many studies have observed that environmentally conscious lifestyles are stifled by current building infrastructure, and active sustainable design practices are infrequent, despite interest in them (Marchand and Walker, 2008). Designers must identify and understand the barriers to sustainable design practice if they hope to ever put these strategies into action. The following sections discuss the potential barriers to sustainable interior design practices and suggest strategies to overcome them.

3.1 Cost

Cost or feasibility are major barriers in that they prevent clients from committing to sustainable design approaches. Designers and clients may be environmentally responsible, but are held back by the cost of research and development expenses and the fact that sustainable products may not be mass produced or as fashionable as their unsustainable counterparts. Should the popularity of sustainable items rise, suppliers would increase their quantities, stabilizing costs and combating the novelty mark-up currently added onto sustainable alternatives. Even if the only extra cost applied to sustainable products is the additional 6% of construction costs in making them, many people would still choose immediate savings over long-term savings (Fujii, 2006). It may be necessary to conduct studies to show the economic efficiency and potential savings provided by sustainable solutions in order to encourage clients to invest their money.

3.2 Time and research

Designers should conduct personal research to obtain knowledge and understanding of sustainable design solutions, systems, materials, technologies, and integration processes. Such research requires time, which in most professional practices is both limited and costly. Some designers have expressed difficulty in finding time to do research, while their clients voiced concern about the additional cost such research would bring (Jensen and Elle, 2007; Fujii, 2006). As such, the time and cost needed to conduct research present a barrier to the implementation of sustainable interior design. Even so, many designers invested their time and capital expenditure in sustainability research; these studies were done in collaboration with project stakeholders, such as developers, contractors, and environment professionals. This increased the acceptance and significance of sustainable design in many countries. In such circumstances, designers are then able to develop suitable assessment criteria, such as guideline codes and standards, for building sustainable environments. Many associations around the world, such as the Leadership in Energy and Environmental Design (LEED) and the Building Research Establishment Environmental Assessment Method (BREEM) also establish international standards. These codes offer alternatives solutions and better management of the decision making process. Codes backed by local authorities then motivate design firms to adopt sustainable solutions (Jensen and Elle, 2007).

3.3 Sustainable interior design education

Due to the efforts of many local and international educational bodies and authorities, sustainable design has recently become a major component in many interior design curriculums. However, few of these curriculums have adequately incorporated the concepts and principles into all design aspects. At the post-graduate level, sustainable design research could expand knowledge and provide important insight into environmental issues. The Council for Interior Design Accreditation (CIDA) demands the inclusion of sustainability concepts for any design curriculum seeking its accreditation (CIDA, 2014). These procedures are improving both student and faculty knowledge of environmentally sustainable design solutions. Minimal faculty awareness and experience, as well as the lack of real experiments in many countries, are major obstacles to the integration of sustainability in design education, but may be

solved through seminars, workshops, and conferences that consistently address these topics. Such efforts generate an awareness of sustainability and build a new generation of designers with positive attitudes toward sustainable solutions (Arbuthnott, 2008).

Client education is another important facet that can accelerate the acceptance of sustainability concepts. While clients may express interest in sustainable design solutions, few actually insist on their use. Interior designers should therefore work to educate their clients in the importance and benefits of sustainable design alternatives in their projects. Educated, well-informed clients are the most likely to accept sustainable solutions (Arbuthnott, 2008; Fujii, 2006).

3.4 Lack of sustainable design experience in the profession

Efforts to increase awareness of sustainability must also extend to the professional side of the industry. Interior design firms are beginning to suggest sustainable solutions, but many senior designers lack enthusiasm due to market demand, education, and negative experiences with sustainable solutions because of the shortage of such projects. It should be the obligation of professional interior design bodies to continually provide professional development courses and workshops for sustainable practices. An additional barrier that requires more effort is that current infrastructure does not always allow for sustainable behavior. One way to combat this is for governments to issue policies and regulations that encourage the adoption of sustainable design solutions by offering important knowledge and guidelines to inexperienced designers. The forced implementation of these regulations would have an immediate impact on design practitioners; they would have no choice but to improve their knowledge in order to comply with national regulations. Leaders should also consider legislation that provides financial rewards and incentives for those that exhibit sustainable behavior (Fujii, 2006).

3.5 Sustainable materials availability

Three concerns have been identified regarding material selection. First is the reliability of information from product suppliers and manufacturers about their sustainable materials. As these materials are relatively new and are often manufactured by small, new businesses, very few of these products are commonplace in the industry. As such, all sustainable material must be certified by a trusted local or international association to ensure that the product is authentically environmentally responsible.

The second is that the limited selection of sustainable materials and products does not always accommodate a client's needs. While clients may theoretically support environmentally responsible materials and systems, they are less likely to compromise on the aesthetics or comfort offered by unsustainable materials and products. Clients cannot be depended upon to choose from a limited range of sustainable materials when there are so many other unsustainable options. If, however, designers persist in recommending sustainable solutions, the demand for environmentally friendly projects will increase. This should motivate manufacturers and suppliers to invest in research and development, provide a wider range of alternative materials and systems, and offer products at more reasonable costs, thus yielding positive results for sustainable practitioners.

The third barrier experienced by designers is the inability to source locally produced sustainable products. Importing products does not comply with the general concept of sustainability because it increases their carbon footprint (Mate, 2006). A suggestion to overcome this obstacle, designers and manufacturers should find local or regional renewable resources to develop new sustainable products.

4 PRACTICAL SOLUTIONS FOR SUSTAINABLE INTERIOR DESIGN

Sustainable interior designers should understand the impact of their work on their local and global environments. The ideal solutions for interior environments should reflect a concern for both natural ecological systems and people's quality of life (Sassi, 2006). In the context of interior design, the most important goals of sustainability are to minimize the consumption of environmentally harmful construction materials, recycle natural resources, improve thermal comfort, reduce indoor pollutants, and enhance the quality of interior natural lighting (Kang and Guerin, 2009). Designers should analyze interior materials from their inception to their disposal, and work to reduce adverse effects on the environment by using renewable, locally manufactured, and long-lasting, durable materials. They should study the potential of recycling or repurposing processes, and approach a cradle-to-cradle concept that recognizes the environmental consequences of a building's entire life cycle (McDonough and Braungart, 2002). The following sections explore some practical solutions for sustainable interior

design by examining the major relevant interior design domains (Figure 1). These domains were selected based on the criteria and measurements required in the LEED Certification Policy Manual to certify a building as a sustainable project (LEED, 2010).

4.1 Sustainability and interior air quality

This dimension of sustainable solutions concerns human health, safety, well-being, and productivity. Interior designers can enhance indoor air quality by taking precautions with construction and renovation procedures, such as providing adequate air ventilation, maintaining acceptable temperature and humidity levels, and controlling airborne contaminants such as toxic gas emissions from some manufactured materials, finishes, furnishings, and equipment (Spiegel and Meadows, 2010).

Designers can be proactive in controlling air quality in three areas. First, source control minimizes cracks and crevices and specifies nonporous materials to prevent mold growth and reduce energy leakage. Second, separation and filtration by utilizing air-lock entrances, air pressure differences, mechanical filters, and transitional spaces (e.g., vestibules) eliminate or reduce a variety of pollutants. Thirdly, designers should ensure a proper ventilation ratio of natural and mechanical air movements. Natural ventilation can be facilitated by using cross-ventilation and negative air pressure to reduce a building's energy consumption. Mechanical air conditioning systems can sustain a high quality environment by ventilating indoor air with appropriate controls for pressure and humidity (Jones, 2008).

4.2 Sustainable interior material

Interior material selection can support healthy environments, reduce transportation energies, and control thermal performance, air quality, out-gassing, toxicity, and mold. Interior materials include flooring, paints and coatings, adhesives and sealants, wall coverings, equipment, wood products, textiles, insulation, and cleaning products (Spiegel and Meadows, 2010).

Interior material selection can be based on features of function, such as specific needs for thermal comfort, interior aesthetics, sterilization, or strength, as well as installation time and effort required. Designers should select sustainable materials that follow local and international sustainability standards, such as those that are made from rapidly renewable resources, are highly durable, recyclable, reusable, and low emitting (LEED, 2010). Renewable resources are defined as those naturally replenished or grown at a rate greater than human consumption (Speigel & Meadows, 2006). Selected materials should include durable, adaptable finishes and products with minimal environmental impact throughout all stages of life: extraction, production, transport, use, and post-use. Designers should also reduce the usage of materials depending on innovative solutions such as splitting the interior spaces with limited number of partitions.

In addition, designers should consider the amount of energy required to produce these materials. Natural materials such as stone and timber have lower amounts of embodied energy, while synthetic materials such as concrete, steel, and acrylic require higher levels (Winchip, 2007).

Also to be considered is the potential to recycle or reuse material upon disposal. Waste management can be considered as a recycling example in which waste is collected followed by a separation of the waste construction materials especially from the renovation process then transforming and remanufacture such waste products aiming to produce new construction materials. The life cycle of interior materials should involve frugal use of natural resources and have limited contribution to such environmental issues as global warming, acidification, and nutrient enrichment (Kang and Guerin, 2009; Osmani et al., 2008).

Another important aspect for consideration is the level of toxic gas emissions, whether generated during production or during the use of materials. Traditional natural materials such as mud bricks or wooden furniture are highly sustainable since they emit very low levels of toxic gas.

4.3 Sustainable furnishing

Furniture, fixtures, and equipment (FF&E) are the major elements of interior design. In the context of sustainability, selected furnishings should provide long term use, have controlled production processes, and make use of sustainable materials that follow the same criteria as outlined previously, specifically that of recyclability. Furnishings that are manufactured from natural wood are widely used and considered sustainable (the problem with wood is that it is slow renewable materials that affect

natural environments over the long term), while polymer-based, synthetic materials cannot be recycled and emit toxic gases.

Sustainable furnishing production control prioritizes the reduction of material wastes that generally occur during production processes. Some experimental furnishings and furniture are made entirely from waste materials. Although these products meet functional requirements, they are not always aesthetically pleasing; however, they do contribute to resource preservation. Multi-functional furnishings, especially those integrated with smart technologies, are classed as innovative design solutions that conserve resources without compromising human needs. Interior designers should encourage the use of reused or refurbished furniture whenever possible in order to extend material life (Spiegel and Meadows, 2010; Winchip, 2007).

4.4 Sustainable interior lighting systems

Lighting is one of the most critical interior design elements affecting the quality of an indoor space. Sustainable interior light offers an appropriate solution to two separate issues. First, it offers a high quality indoor by maximizing daylight and the connection to natural environments through glass windows and the size and placement of vegetation, as natural light is one of the physical parameters that most affects occupant performance, productivity, and health. For example, retail stores with more natural light report positive employee and customer satisfaction rates, which in turn increases sales (Winchip, 2007). Natural lighting is defined as the practice of bringing daylight into an interior space, providing illumination that is more desirable and of better quality than artificial light sources (Jones, 2008). In the context of sustainability, Architects in collaboration with interior designers should position buildings and consider what room sizes and depths to maximize daylight in the space. Designers can also use new technological tools that collect sunlight, then reflect the light through the tubes, carrying it to the building's deeper interior spaces. Such technologies include light piping systems, laser cut panels, and horizontal and vertical light pipes.

Another issue is that of reducing the energy consumption of artificial light systems, as they account for 40 to 50 percent of the total energy used in buildings (McDonough and Braungart, 2002). Designers are able to employ many tactics to decrease energy consumption and make the lives of occupants healthier. An example is the use of energy-efficient fixtures, such as the compact fluorescent light bulb and light-emitting diodes (LEDs), both of which offer more sustainable light solutions.

4.5 Sustainable solutions for water management

Several sustainable water management systems have faced problems with implementation due to lack of awareness. Therefore, interior designers should encourage and recommend the use of water-control systems by embedding it in their finishing solutions specifications. The short-term goal is to show the client how these procedures will benefit all building stakeholders. Interior designers can do this by introducing the reuse and recycle water system and convincing their clients of its economic benefits. They should also show them the safety measures to eliminate any confusion. The long-term goal is to change the behavior of the building occupants in terms of their water use. The ultimate target of these practices is to maximize water management efficiency within buildings to the reduce consumption of water and to reuse wastewater, in order to minimize pollution. Interior designers should utilize sustainable sanitary equipment, such as waterless waste disposal fixtures, water-efficient sinks, and smart faucets. Interior designers may encourage reuse water systems, such as the reuse sink and/or washing machine wastewater to fill the flush. Hygienic treatment for sewage water is one of the most efficient solutions for recycling water and for its potential use in irrigation systems (Llopa and Ponce-Alifonso, 2015; Osmani et al., 2008).

4.6 Sustainable interior construction solutions

Contemporary mechanical solutions have a significant influence on supporting the sustainability of interior design finishing construction methods that can be summarized in two items. First, it reduces the usage of infrastructure materials, such as plaster and cement, while assembling the interior construction elements. These procedures also minimize the consumption of materials and manufacturing energy. Second, it will facilitate the material disassemble for replacement during maintenance or renovations. Therefore, it will minimize wasted material because the construction can

be dissolved in a suitable condition that allows for materials to be reused in different locations or in different recycling processes. Insulation also plays a crucial role in creating sustainable interior environments. It is estimated that insulation, compared to surfaces without insulation, save up to 500 times more energy over the building's lifetime (Gana et al., 2015; Grace, 2008; Osmani et al., 2008).

4.7 Sustainable and smart interior design systems

Smart interior design is the future language of design. It depends on computerized systems and innovative utilization of material, light fixtures and equipment to support the expansion of sustainability practices. Computer software controls consumption by monitoring and modifying lighting, thermal systems, and ventilation. Smart systems dramatically enhance the environmental and economic efficiency of interior materials, especially after the development of nano systems which are changeable and thus responsive to transient needs. This trend reduces the need for different design components and sustains the interior design mood for longer periods due to flexible capabilities of smart lighting, acoustical and materials in changing design atmosphere.

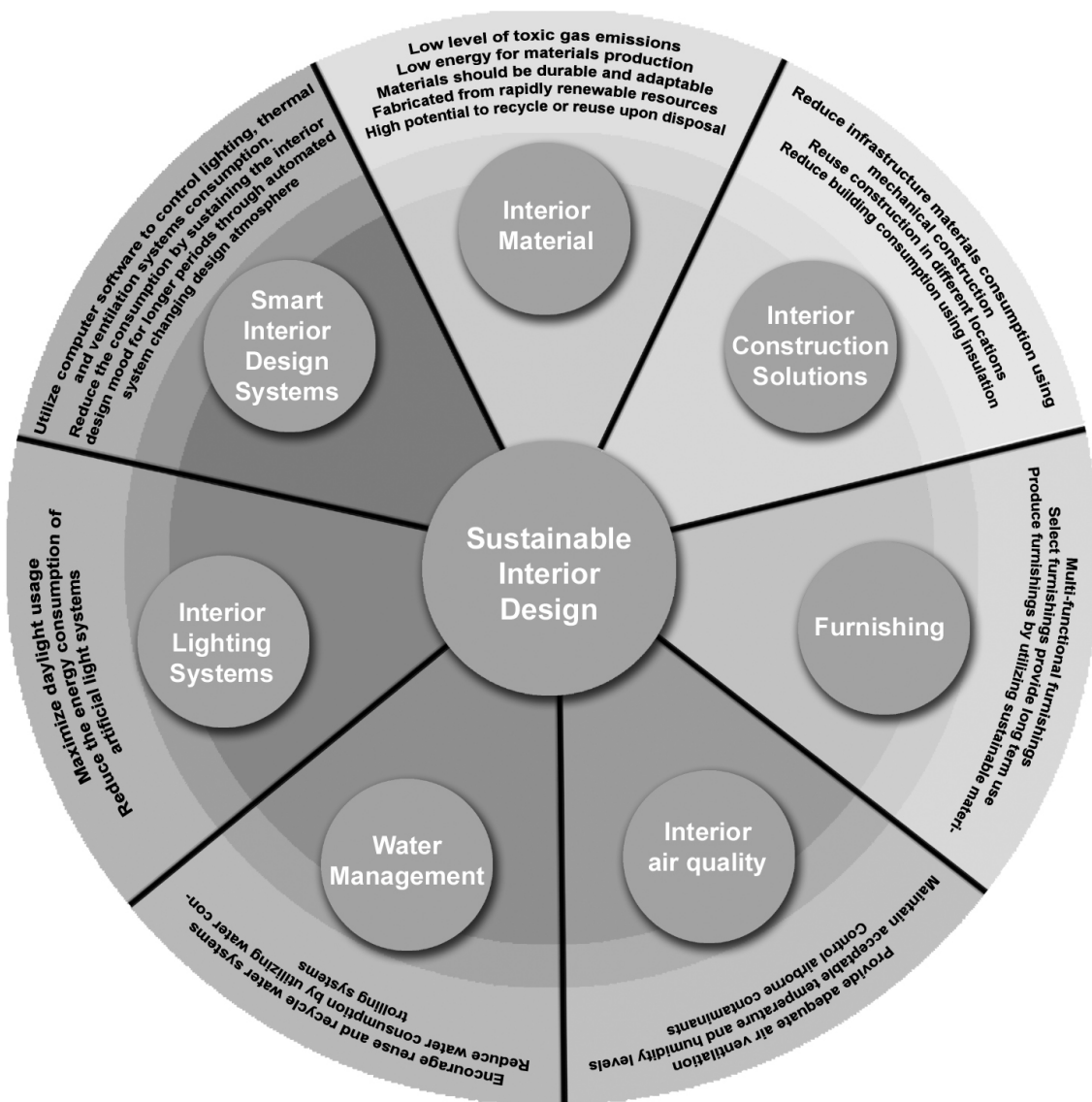


Figure 1. Diagram shows sustainable practical solutions for major interior design domains

5 CONCLUSION

This paper explores the importance of sustainability in interior design and discusses the barriers and methodologies with regards to implementation. This study is not the first of its kind. Rather, it is a step toward raising awareness and showing the potential of sustainable interior design solutions.

Sustainable interior design solutions are no longer optional; they are mandatory to help reduce the human footprint on ecological systems, save resources for future generations, and support the global effort to limit acts that harm our planet.

Interior designers' attitudes toward sustainable design changing moderately that they acting in ways counter normal routines is exhausted and required more effort. Creating sustainable choices in a world not set up to support them requires high levels of self-control and motivation. Design practitioners should believe that their efforts to implement sustainable solutions will both enhance consumer lifestyles and offer natural environment the chance to heal itself.

Sustainable practice is affected by human behavior and hence community behavior, which has deterred the commitment to sustainability approaches. Much effort has been required to bridge the gap between intention and realization.

Cost, limited selection of materials and systems, and lack of experience are the most harmful barriers to the implementation of sustainable interior design. Sustainable concepts must be adopted in politics and economics through the governmental provision of financial support, reward systems, and sustainable design guidelines and standards; the implementation of these concepts must then be enforced by law. Such efforts would prioritize the use of sustainable design solutions in future projects and thus create a sustainable trend, positively changing attitudes toward sustainable interior design practices, encouraging market demand to ensure sufficient financial support for sustainable development research, and support manufacturers to produce sustainable products. Eventually, this will reduce the cost of sustainable design elements and allow them to compete with environmentally detrimental practices. These procedures can help overcome the barriers to sustainability and generate positive support for a sustainable future.

Education systems that employ sustainable design curriculums play an important role in conveying sustainable concepts to faculties and students, and in alerting communities to the environmental and economic benefits of sustainable design. These curriculums will help produce a new generation of designers capable of creating, implementing, and defending sustainable design solutions.

The momentum of the need to conserve our resources has initiated the sustainable design paradigm. Designers have experienced sustainable design practices gradually, from limitations intended to reduce building consumption, to the evolution of experiments designed to offer solutions to the many issues in all design aspects. This experience has been widely implemented, and has been proved reliable and valid in transitioning interior design toward environmental responsibility.

Sustainable design solutions should produce healthy environments. In order to achieve this, interior designers should select sustainable design elements that create natural ventilation systems, reduce pollutants, eliminate the emission of harmful gases, and allow for an appropriate amount of natural light.

The 3Rs concept—recycle, reduce, reuse—is integral in selecting sustainable interior design solutions such as forms, materials, and furnishings. The three Rs reduce energy and raw resource consumption, repurpose waste, and reuse design elements in innovative ways, particularly in interior refurbishment. Researchers could conduct more studies that emphasize the role of smart technology and its potential in supporting the evolution of interior design sustainability.

This study recommends that environmentally responsible interior designers, with the support of associations and design firms interested in applying sustainable solution, should work together to develop more specific standards that cover the different aspects of sustainable interior design.

The importance of sustainability is undeniable. This paper aims to highlight the fact that achieving sustainable solutions requires a multidisciplinary approach. Therefore, interior designers should work closely with other stakeholders from different engineering disciplines to avoid barriers to sustainability. They should encourage applications that develop different design technologies and alternative materials, in order to find new interior design solutions.

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