

**A HYBRID ASSESSMENT MODEL FOR  
BARRIERS HINDERING THE ADOPTION OF  
SUSTAINABLE INTERIOR DESIGN PRACTICE  
IN MALAYSIA**

**MOJTABA ASHOUR**

**UNIVERSITI SAINS MALAYSIA**

**2021**

**A HYBRID ASSESSMENT MODEL FOR  
BARRIERS HINDERING THE ADOPTION OF  
SUSTAINABLE INTERIOR DESIGN PRACTICE  
IN MALAYSIA**

by

**MOJTABA ASHOUR**

**Thesis submitted in fulfilment of the requirements  
for the degree of  
Master of Science**

**September 2021**

## ACKNOWLEDGEMENT

Writing this thesis would not have been possible without the support from many wonderful people. First, I would like to express my greatest appreciation to my inspiring supervisor Dr. Amir Mahdiyar, who has guided me patiently throughout this journey. With an attitude of adventure within the realm of scholarship, he has enthusiastically and devotedly provided persistent support towards completing this thesis. I would also like to thank my co-supervisor Dr. Syarmila Hany Haron for her insightful comments and assistance during this undertaking.

I am thankful to my best friend and partner in life Elena for walking along my side in this journey, supporting me unconditionally, and believing in me and our dreams. I certainly could not have carried out this research without her love, support, motivation, caring sacrifices, and toleration of my stressful days and nights.

Maman, Baba, Maryam, Alireza, Mamochka, and Sergey, thank you for being there for me whenever I needed you, and thank you for supporting me in whichever way you could, throughout these years. I am so blessed for having all of you in my life.

## TABLE OF CONTENTS

<b>ACKNOWLEDGEMENT</b> .....	<b>ii</b>
<b>TABLE OF CONTENTS</b> .....	<b>iii</b>
<b>LIST OF TABLES</b> .....	<b>vi</b>
<b>LIST OF FIGURES</b> .....	<b>vii</b>
<b>LIST OF ABBREVIATIONS</b> .....	<b>viii</b>
<b>LIST OF APPENDICES</b> .....	<b>x</b>
<b>ABSTRAK</b> .....	<b>xi</b>
<b>ABSTRACT</b> .....	<b>xiii</b>
<b>CHAPTER 1 INTRODUCTION</b> .....	<b>1</b>
1.1 Introduction.....	1
1.2 Background of the Problem .....	3
1.3 Problem Statement .....	5
1.4 Research Questions .....	6
1.5 Aims and Objectives .....	6
1.6 Scope of the Research .....	7
1.7 Significance of Research.....	8
1.8 Thesis Outline .....	8
<b>CHAPTER 2 LITERATURE REVIEW</b> .....	<b>10</b>
2.1 Introduction.....	10
2.2 Interior Design Profession .....	11
2.3 Interior Design Education .....	16
2.4 Sustainability in Interior Design .....	22
2.5 Malaysian Construction Industry .....	28
2.6 Sustainability Assessment Tools in Malaysia.....	30

2.6.1	Energy Efficiency (EE).....	33
2.6.2	Indoor Environmental Quality (EQ) .....	34
2.6.3	Sustainable Site Planning and Management (SM).....	34
2.6.4	Materials and Resources (MR) .....	35
2.6.5	Water Efficiency (WE) .....	35
2.6.6	Innovation (IN) .....	35
2.7	Review of Barriers to Sustainable Interior Design .....	36
2.7.1	Economic Barriers .....	38
2.7.2	Attitude and Market Barriers .....	42
2.7.3	Information, Knowledge and Awareness Barriers.....	45
2.7.4	Governmental Barriers.....	49
2.7.5	Technology and Training Barriers .....	53
2.8	Summary.....	55
<b>CHAPTER 3 METHODOLOGY.....</b>		<b>59</b>
3.1	Introduction.....	59
3.2	Overview of the Research Approach .....	59
3.3	Research Design.....	60
3.4	Enhanced Fuzzy Delphi Method.....	64
3.4.1	Sampling and Expert Selection Criteria.....	67
3.4.2	Number of Experts .....	70
3.4.3	Number of Rounds .....	71
3.4.4	Analysis and Reliability .....	73
3.5	Parsimonious Cybernetic Fuzzy AHP .....	75
3.5.1	Sampling and Expert Selection.....	78
3.5.2	Application Steps .....	78
3.6	Semi-structured Interview.....	84
3.7	Summary.....	85

<b>CHAPTER 4 RESULTS AND DISCUSSION.....</b>	<b>88</b>
4.1 Introduction.....	88
4.2 Refining Potential Barriers with Respect to the Context of Malaysia .....	88
4.2.1 First Round.....	90
4.2.2 Second round .....	90
4.3 Assessing the Significance of Barriers .....	94
4.3.1 PC-FAHP – Categorial and Individual Barrier Prioritization.....	96
4.4 Potential Solutions Towards the Adoption of SID .....	103
4.5 Summary.....	108
<b>CHAPTER 5 CONCLUSIONS AND RECOMMENDATIONS.....</b>	<b>110</b>
5.1 Conclusions of the Research.....	110
5.2 Contributions of the Research.....	111
5.3 Limitations and Directions for Future Research.....	113
<b>REFERENCES.....</b>	<b>115</b>
<b>APPENDICES</b>	
<b>LIST OF PUBLICATIONS</b>	

## LIST OF TABLES

	<b>Page</b>
Table 2.1 Environmental Assessment Tools in Malaysia.....	31
Table 2.2 Comprehensive list of barriers identified in the literature .....	57
Table 3.1 Guidelines for Delphi Method in construction field.....	69
Table 3.2 Point system for expert qualification in a Delphi study.....	70
Table 3.3 (1-9) Likert scale of importance .....	72
Table 3.4 The fuzzy AHP scale of importance .....	81
Table 4.1 EFDM experts' background.....	89
Table 4.2 Cronbach's Alpha reliability test results for EFDM round two.....	91
Table 4.3 EFDM round two analysis .....	92
Table 4.4 P-CFAHP experts' background .....	96
Table 4.5 Results of P-CFAHP analysis .....	97
Table 4.6 Comprehensive ranking of barriers to the practice of SID .....	99
Table 4.7 Interview phase experts' background .....	103

## LIST OF FIGURES

	<b>Page</b>
Figure 2.1 Sustainable Interior Design (SID) .....	24
Figure 2.2 GBI Interior Tool evaluation criteria.....	33
Figure 2.3 Classification of barriers identified in the literature.....	38
Figure 2.4 Economic barriers identified in the literature .....	39
Figure 2.5 Attitude and market barriers identified in the literature .....	42
Figure 2.6 Information, knowledge and awareness barriers identified in the literature .....	46
Figure 2.7 Governmental barriers identified in the literature .....	50
Figure 2.8 Technology and training barriers identified in the literature.....	53
Figure 3.1 Overall research flow diagram .....	61
Figure 3.2 Research Framework .....	63
Figure 3.3 Delphi Method procedure.....	64
Figure 3.4 EFDM flowchart.....	66
Figure 3.5 Triangular Fuzzy Number .....	73
Figure 3.6 The hierarchical structure of AHP.....	79
Figure 4.1 EFDM round two results – selection and rejection of barriers.....	93
Figure 4.2 The hierarchical structure of the problem .....	95
Figure 4.3 Prioritization of the main categories of barriers to SID .....	98
Figure 4.4 Summary of experts’ recommendations.....	104



## LIST OF ABBREVIATIONS

SID	Sustainable Interior Design
WCED	World Commission on Environment and Development
CIDA	Council for Interior Design Accreditation
LAM	Lembaga Arkitek Malaysia/ Board of Architects Malaysia
PAM	Pertubuhan Akitek Malaysia/ Malaysian Institute of Architects
ACEM	Association of Consulting Engineers Malaysia
GBI	Green Building Index
MGBC	Malaysia Green Building Confederation
MIID	Malaysian Institute of Interior Designers
ASID	American Society of Interior Designers
EFDM	Enhanced Fuzzy Delphi Method
P-CFAHP	Parsimonious Cybernetic Fuzzy Analytic Hierarchy Process
UNEP	United Nations Environment Programme
CIDQ	Council for Interior Design Qualification
IIDA	International Interior Design Association
IFI	International Federation of Interior Architects/ Interior Designers
IDEC	Interior Design Educators Council
IDr	Professional Interior Designer (Title)
FIDER	Foundation for Interior Design Education Research
HVAC	Heating, Ventilation, and Air Conditioning
LEED	Leadership in Energy and Environmental Design
SDG	Sustainable Development Goals
USGBC	U.S Green Building Council
CIDB	Construction Industry Development Board

CITP	Construction Industry Transformation Programme
Green PASS	Green Performance Assessment System
PH JKR	Skim Penilaian Penarafan Hijau JKR
MyCREST	Malaysian Carbon Reduction and Environmental Sustainability Tool
GreenRE	Green Real Estate
BREEAM	Building Research Establishment Environmental Assessment Methodology
IEA	International Energy Agency
GBT	Green Building Technology
AHP	Analytic Hierarchy Process
VOC	Volatile Organic Compound
DHP	Delphi Hierarchy Process
FDM	Fuzzy Delphi Method
PCM	Pairwise Comparison Matrix
TFN	Triangular Fuzzy Numbers
GM	Geometric Mean
PAHP	Parsimonious Analytic Hierarchy Process
FAHP	Fuzzy Analytic Hierarchy Process
RB	Reference Barrier
REHDA	Real Estate and Housing Developer's Association
UBBL	Uniform Building By-Laws

## **LIST OF APPENDICES**

- APPENDIX A Sample of ‘Invitation to Participate’ letter sent to potential experts.
- APPENDIX B Detailed background of participating experts
- APPENDIX C Sample of EFDM round two questionnaire
- APPENDIX D Expert’s input for EFDM round two questionnaire
- APPENDIX E Computation process of EFDM round two questionnaire responses
- APPENDIX F Sample of P-CFAHP direct ranking questionnaire
- APPENDIX G Computation process of P-CFAHP

**MODEL PENTAKSIRAN HIBRID TERHADAP PENGHALANG  
PENERAPAN AMALAN KELESTARIAN REKA BENTUK DALAMAN DI  
MALAYSIA**

**ABSTRAK**

Walaupun pengertian kemampunan telah lama menjadi perhatian utama dalam persekitaran binaan, amalan ‘Reka Bentuk Dalaman Mampan/ Sustainable Interior Design’ (SID) masih gagal. Penyelidikan ini bertujuan untuk mengkaji kekurangan amalan Reka Bentuk Dalaman Mampan di Malaysia. Untuk tujuan ini, setelah mengenal pasti 30 halangan yang berpotensi melalui tinjauan literatur, kaedah dua pusingan Enhanced Fuzzy Delphi Method (EFDM) yang melibatkan 13 pakar Malaysia yang berkecualan digunakan sehingga menyebabkan pengecualian 10 halangan dan penambahan satu halangan baru. Untuk mengutamakan halangan, sebuah novel Parsimonious Cybernetic Fuzzy Analytic Hierarchy Process (P-CFAHP) diperkenalkan, dengan ketara mengurangkan jumlah perbandingan berpasangan, dan menghilangkan keperluan untuk soal selidik AHP yang rumit. Hasil menunjukkan halangan utama yang tertinggi adalah: (1) kurangnya modul kemampunan yang memadai dalam pendidikan reka bentuk dalaman, (2) kurangnya pengalaman dan pemahaman pereka dalaman secara teknikal, (3) kekurangan kod, peraturan dan kerangka hukum tertentu yang dirancang untuk berbagai jenis projek, (4) kurangnya minat dari klien, dan (5) kekurangan latihan kepada pereka dalaman. Satu wawancara separa berstruktur telah dilaksanakan bersama dengan para pakar dan memberikan penyelesaian yang berpotensi mengenai pendidikan, peraturan, standard dan polisi bagi mengatasi halangan ini. Penemuan kajian ini memberikan pandangan berharga bagi pereka dalaman profesional, pendidik, pihak berkuasa berkanun, kerajaan, dan pembuat dasar. Dengan mempertimbangkan kekurangan literatur, kajian ini mengisi jurang

dengan memberikan senarai rintangan yang komprehensif terhadap SID, menetapkan asas dengan mengenal pasti masalah yang dihadapi oleh pereka dalaman di negara-negara membangun, dan memperkenalkan novel P-CFAHP yang belum pernah digunakan sebelumnya.

**A HYBRID ASSESSMENT MODEL FOR BARRIERS HINDERING THE  
ADOPTION OF SUSTAINABLE INTERIOR DESIGN PRACTICE IN  
MALAYSIA**

**ABSTRACT**

While the notion of sustainability has long been a major concern in the built environment, the practice of sustainable interior design (SID) still falls short. This research aimed to investigate the deficiency in the practice of SID in Malaysia. To this end, after identifying 30 potential barriers through a review of literature, a two-round Enhanced Fuzzy Delphi Method (EFDM) involving 13 qualified Malaysian experts was employed resulting in the exclusion of 10 barriers and the addition of one new barrier. To prioritize the barriers, a novel hybrid method, the Parsimonious Cybernetic Fuzzy Analytic Hierarchy Process (P-CFAHP) was introduced, significantly reducing the number of pairwise comparisons, and eliminating the need for a complicated AHP questionnaire. Results showed the highest prioritized barriers are: (1) lack of sufficient sustainability modules in the education of interior designers, (2) designers' lack of experience and technical understanding, (3) lack of codes, regulations, and specific legal frameworks designed for different types of projects, (4) lack of interest from the client, and (5) designers' lack of training. Semi-structured interviews were conducted with experts and potential solutions concerning education, regulations, standards, and policies are provided on how to overcome these barriers. The findings of this research provide valuable insights for professional interior designers, educators, statutory authorities, governments, and policymakers. Considering the dearth of literature, this research fills the existing gap and establishes the groundwork by identifying the issues faced by interior designers in developing countries, and introduces a novel P-CFAHP that has not been employed before.

# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

The interior design profession as we know it today only appeared after the 20<sup>th</sup> century (Massey, 2020) and it has traditionally been about a one-dimensional practice that is to improve the aesthetics of interior space for a client (Cargo, 2013). In fact, the practice of interior design heavily depended on the surface application of artifacts and aesthetic elements to portray “distinction between social strata” and it was considered as means of communicating “wealth and class affiliation” (Kleinman et al., 2012). During the 1970s and 1980s, there was increasing public awareness and concern about environmental damages caused by rapid developments (Pile & Gura, 2014). This was followed by the famous 1987 Brundtland Report entitled “Our Common Future” by the World Commission on Environment and Development (WCED) which is considered to be the origin of sustainable development, and ever since, the idea of sustainability embedded itself with almost every facet of human life, particularly the built environment (Winchip, 2011).

The term Sustainable Interior Design (SID) has been around for decades and it is defined by Celadyn (2018) as an approach that deals with three main issues, (1) “an object’s ecological effectiveness” for reducing and/or eliminating its harmful effect on the environment; (2) the economic implications and consequences that may arise from the interior spaces’ energy performance; and (3) anticipating “social system’s considerations” with regards to the characteristics of the interior space and the impact on users’ psychological and physical comfort. An interior designer is no longer merely a decorator selecting textile finishes and arranging furniture, but rather someone who

takes all aspects of a project into consideration and makes environmentally responsible decisions that not only reduce – if not eliminate – the negative impact on the environment but also form functional spaces that prioritize safety, health, and comfort for its users in the most efficient way while advocating for their psychological and physical wellbeing (Bonda et al., 2014; Pile & Gura, 2014). Sustainable practice has also procured a need for interior designers to have good knowledge about other design and engineering disciplines within the built environment in order to be an active, effective, contributing, and valued member of the sustainable design team (Stieg, 2006). The aforesaid emphasizes on the fact that sustainability has become a critical component of interior design practice. This is not limited to the environmental impact of it which has received much attention before, but also the social and economical aspects as designers become aware of the influence of their work (Massey, 2020). Moreover, Elliot (2004) identified the knowledge of SID as a “professional necessity” and Stieg (2006) suggested that practicing SID is an ethical duty for professionals.

The importance of sustainability in interior design has been amplified within the academic standards and body of knowledge as well. It can be seen as early as 2002, when sustainability, environmental concerns, human-centered design, and human wellbeing became part of the compulsory knowledge for interior designers as set by the Council for Interior Design Accreditation (CIDA) (Stark & Park, 2016). In Malaysia, sustainability and environmental concerns have also found their way into interior design education. Details are provided in the Interior Design Accreditation report by LAM (2019) (Lembaga Arkitek Malaysia/ Board of Architects Malaysia) the body responsible for the enforcement of the Architects Act 1967. According to the report “Interior Design education should ensure that all graduates have knowledge and ability in interior design, including technology, technical systems, and its requirements as well



as considerations for environmental, health, and safety factors”. It also mentions that graduates must comprehend “cultural, intellectual, historical, social, economic, management and environmental context for interior design” (LAM, 2019).

## **1.2 Background of the Problem**

Prior research has generally confirmed that interior designers are demonstrating more support and interest for sustainable design than in the past, and many young designers are taught about sustainability and are equipped with additional knowledge about it (Bacon, 2011; Kang & Guerin, 2009b; Lee, 2012; Máté, 2009). In a study conducted by Stark & Park (2016) it was determined that senior interior design students expressed more intention towards “prioritizing social and environmental responsibility” than the freshmen (2016, p. 374). The study has also proven that knowledge and awareness concerning sustainable design are realized by senior students considerably more than freshmen students. One could argue that if there are interest and knowledge about a subject in theory, then it should be translated into practice as well. In fact, Sherwood (2018) suggested that learning sustainable practices can lead to reframing the design thinking that ultimately results in the application of sustainable design in practice. However, Stieg (2006) was among the first researchers and practitioners to express concern about a gap that exists between the theoretical knowledge and the practice of sustainable design that is taking place in real life, and she named this phenomenon “the sustainability gap” (2006, p. ix). Many years later numerous studies have confirmed that although the notion of SID has long been a key concern in the built environment, interior designers do not tend to make sustainable choices as often, and the practice of SID still falls short (Hayles, 2015; Lee et al., 2013; Pilatowicz, 2015; Sherwood, 2018).

While several studies have investigated the imbalance between theory and practice of SID, the overall number of such studies is not significant. Each of the said studies has taken different approaches including: from an attitude and behavioral standpoint (Bacon, 2011), supply and demand of such practice (Hayles, 2015), the characteristics of designers who practice SID (Kang & Guerin, 2009b), perceptions and motivations aspects (Templeton, 2011), as well as sustainability in the education of interior designers (Sherwood, 2018). These studies have identified several barriers to the practice of SID including a lack of interest from the client, higher cost and longer duration of sustainable projects, interior designers' resistance to adopt and embrace sustainable practice, and subsequently their lack of enthusiasm to encourage clients to use sustainable solutions. Designers' lack of technical knowledge and awareness as well as a lack of experience in sustainable practice have also been mentioned as barriers to the practice of SID. In the Malaysian context, however, the studies have largely focused on the overall sustainable practice in the built environment, rather than specific sectors such as interior design.

In Malaysia, both the government and scholars have been promoting and encouraging sustainable construction for at least a decade (Olanrewaju et al., 2020). In 2008, Pertubuhan Akitek Malaysia/ Malaysian Institute of Architects (PAM) started to develop a local green building rating tool that is “designed specifically for the tropical climate and Malaysia’s social, infrastructure and economic development” to address the growing need in the construction industry. Working together with the Association of Consulting Engineers Malaysia (ACEM) the ‘Green Building Index’ (GBI) was officially launched in May 2009 (GBI, 2020a). Subsequently, GBI Interior Tool was also developed in a joint effort by the Malaysia Green Building Confederation (MGBC)

and Malaysian Institute of Interior Designers (MIID) as well as the GBI Technical Committee, and it was launched in September 2014.

### **1.3 Problem Statement**

While the number of GBI Certified projects have been increasing gradually over the past few years (from the year 2013 with 17 buildings certified in 7 sectors to December of 2020 with a total of 563 buildings) (GBI, 2021), the interior design sector does not seem to be putting enough efforts towards sustainable practice and it is evident by having a total of three projects certified over the same period. As Kang and Guerin (2009b) proposed, more knowledge about the influences that would result in sustainable practice or otherwise, could provide tools to encourage interior designers to practice SID. Literature has identified several barriers to SID such as lack of interest from the clients (Deng et al., 2018), higher cost (Hayles, 2015), and longer duration (Hankinson & Breytenbach, 2012), as well as interior designers' resistance to adopt and embrace sustainable practice (Bonda et al., 2014). However, there is a lack of studies with a specific focus on identifying and prioritizing all barriers to the practice of SID comprehensively. Furthermore, the abovementioned existing studies have limited scopes, are geographically restricted, and/or examined barriers that may not apply to the context of other countries.

On the other hand, several studies have been done to identify barriers to sustainable construction and green building in Malaysia from the perspective of different stakeholders in the construction industry (Bin Esa et al., 2011; Durdyev et al., 2018; Olanrewaju et al., 2020; Shari & Soebarto, 2014; Zainul Abidin, 2010). However, to date, there have been almost no studies on the barriers to sustainable practice in the interior design sector in Malaysia. Additionally, the lack of implementation of SID is

still relevant and illustrated by the number of GBI-certified ID projects. Consequently, in order to eliminate this deficiency, there is a need to comprehensively identify the barriers to the practice of SID together with further analyses of the said barriers which could offer much-needed insight on how to overcome them.

#### **1.4 Research Questions**

The latest available statistics of GBI certified projects verifies that the practice of SID in Malaysia is sparse and the existing literature does not offer ample information as to why this is the case. The factors that are influencing a certain matter must be identified first to find appropriate solutions, therefore, the questions concerning this research are:

- What are the barriers to the practice of SID in Malaysia?
- Which are the most significant barriers to the practice of SID?
- What possible solutions are there to overcome the major barriers?

#### **1.5 Aims and Objectives**

This research aims to investigate the deficiency in the practice of SID in Malaysia identify and analyze the barriers to the adoption of SID practice. In order to achieve this aim, the following objectives have been determined:

- To identify the barriers to the practice of SID;
- To assess the significance of barriers to the practice of SID;
- To recommend potential solutions towards the adoption of SID in Malaysia

## 1.6 Scope of the Research

The scope of this research focuses on barriers to the practice of SID faced in the residential interior renovation projects in Malaysia. Renovation is an important part of the campaign for sustainable development as it has the potential for plummeting energy consumption related to existing buildings as well as a tremendous reduction in cost (Edwards et al., 2019; Passoni et al., 2021). Additionally, the *Outlook and State of Interior Design* report (ASID, 2020), stated that renovation projects are on the rise and have been increasing over the past decade. It is also an area that suffers from a lack of research by the academic community in Malaysia (Kamaruzzaman et al., 2019). Furthermore, based on observations, and as pointed out by experts within the industry, interior design firms in Malaysia are generally associated with renovation works rather than involvement from the early stages of new building construction. To this end, the scope of this research focuses on the two major cities of Penang and Kuala Lumpur, which have similar markets in terms of renovation, and host many interior design firms.

The experts involved in this research must have architectural or interior design backgrounds and be active in either industry or academia. Since a preliminary review of literature revealed certain barriers that are related to interior designers' knowledge and education, it is important to include the perspective of academia in this research as well. Additionally, the qualification of the experts to be involved in this research is assessed using a set of predetermined criteria that will be discussed thoroughly in Chapter 3. Finally, although several barriers are identified within the literature, they should be further investigated to ensure their applicability to the Malaysian local context. This is also carried out based on the opinion of qualified Malaysian experts.

## **1.7 Significance of Research**

Considering that people spend most of their time indoors, implementing principles of SID for interior renovations is as important as the rest of the built environment, if not more. In Malaysia, the concept of SID is still in its infancy and interior designers are faced with many challenges. By identifying and examining the barriers to the practice of SID in the Malaysian context, this research exposes underlying issues and introduces solutions that could potentially lay the path for more sustainable-centric practices in this line of work to meet the ever-growing needs for sustainable development in Malaysia.

The findings of this research are valuable not only to the professional interior designers in the field, but also to educators, representative bodies, statutory authorities, governments, and legislators. The implementation of SID can lead to a growth in the economy, generate demand for local resources, reduce energy consumption, and ultimately, it is a step towards achieving the Sustainable Development Goals (SDGs) as set by the United Nations and committed by Malaysia. Additionally, the findings of this research offer a more comprehensive view of this issue from different perspectives. This may result in the introduction of better educational and training frameworks for future interior designers that place more focus on the issue of sustainability.

## **1.8 Thesis Outline**

This research highlights the importance of SID practice and the lack thereof, and reviews the gap between theoretical knowledge and practice of SID both globally and in Malaysia. **Chapter 1** of this research provides a summary of the problem and formulates research questions and research objectives. **Chapter 2** presents an extensive review of literature which contains an overview of the interior design profession and

education as well as the concept of sustainability in interior design. The Malaysian construction industry, Green Building Index as well as its 'Interior Tool' will be discussed thoroughly. Furthermore, previous studies conducted with regards to barriers to sustainable construction and SID practice will be reviewed in detail in order to form a comprehensive understanding of the current situation.

**Chapter 3** describes the methodology, approach, and specific research methods employed in this research. A total of three main methods are employed in three different phases; (1) Enhanced Fuzzy Delphi Method (EFDM) for the purpose of refining the identified potential barriers to the practice of SID with respect to the local context of Malaysia, (2), Parsimonious Cybernetic Fuzzy AHP (P-CFAHP) to prioritize the refined barriers, and (3) semi-structured interview to recommend potential solutions to overcome significant barriers to the practice of SID. For each of the employed methods, Items such as sampling techniques, data collection techniques, as well as data analysis approaches will be reviewed and discussed.

In **Chapter 4**, the results of this research will be discussed based on individual phases. For phase one (EFDM), the addition and omission of barriers based on local context will be discussed. Phase two (P-CFAHP) reveals the weights obtained by each barrier and provides a categorical and individual ranking of barriers, and phase three (semi-structured interview) puts forward a set of recommendations.

In **Chapter 5**, the research objectives are revisited, limitations of the research are discussed, conclusions are drawn based on the findings, and recommendations for future research on this topic are provided.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

The construction industry consumes about 40% of the total global energy, is responsible for about 30% of greenhouse gas emissions, and produces nearly 40% of the total waste (UNEP, 2015). The rapid urbanization and the increase in construction activities have led to a growing concern about harms done to the environment, and consequently, amplified the attention given to implementing sustainability and sustainable developments around the globe. Authorities, scholars, and practitioners in the construction industry have been campaigning for sustainable development ever since the 1987 Brundtland Report (WCED, 1987). In light of the raised concerns and awareness towards this issue, many researchers have been focusing on various aspects and components of sustainability which has led to the establishment of an ever-expanding body of knowledge. However, there remain gaps that must be addressed in order to fully embrace and achieve sustainable development goals particularly in developing countries. While there has been much research on barriers to sustainable construction concentrating on different stakeholders in the industry, few researchers have investigated the barriers to sustainable interior design (SID) practice. Interior as the heart of a structure and space where people spend nearly 90% of their time (Al horr et al., 2016) is arguably as important as the envelope and the structure itself. Yet the frequency of such research in the vast ocean of studies concerning sustainability is comparatively low. Therefore, there is an urgent need to investigate, identify and analyze the gap between knowledge and practice of SID to propose solutions on how to overcome the matter. In an attempt to fully understand the background of the problem, this chapter looks into the history, current state, and scope of work of interior design as



a profession, sustainability components that are included in interior design education as well as the practice of SID. In addition, to understand the local context, this chapter also discusses the Malaysian construction industry and Green Building Index (GBI). Lastly, a thorough review of barriers to sustainable construction and interior design around the globe and in the region is carried out based on available and existing literature.

## **2.2 Interior Design Profession**

The lack of information in terms of specific dates and key figures with regards to the history of interior design makes it difficult to present a historical overview and a beginning point, however, the interest to create “functional and pleasant interior environments” has long existed in human nature even in the prehistoric era (Kilmer & Kilmer, 2014, p. 4). According to Rao (2008), before the establishment of interior design as a profession, carpenters, artists, painters, antique traders, and furniture shop salespersons were the ones advising homeowners on interiors arrangements. In the book *Designing Interiors*, Kilmer and Kilmer (2014) stated that during the 19<sup>th</sup> and 20<sup>th</sup> century, two distinct approaches toward interiors were established, one was primarily concerned with décor, surface ornamentation, accessories, colors, and furnishings, while the other approach took all aspects of interior design into considerations and gave noticeable attention to how things work, focusing on invention and innovation in terms of usage of space and construction systems. Rao (2008) stated in his book that the importance of the role of an ‘interior decorator’ became apparent due to the social and economic settings of the time as people wanted to display their wealth and social status and this was mostly done through showcasing antiques and crafts. Interior decoration has never been concerned with structural elements or alterations and its goal has always been about beautifying a space through selection of wall, ceiling, and floor finish as well as lighting and color schemes. During the Second World War (1939-1945), the

concept of modernism was born and the works of well-known modern architects like Mies Van der Rohe led to major technical revolutions in the planning and design of interiors such as open concept floor plan and storage unit designs (Rao, 2008). After the Second World War (1939-1945), as the economy started booming especially within the commercial sector, the need for mere decoration was replaced with the need for a complex and holistic approach towards the interior, one that focuses on the functionality of space and provides the means necessary for activities within a space to be carried out most comfortably. During these times, professional interior designers were gradually being accepted and recognized by all the stakeholders in the industry (Kilmer & Kilmer, 2014).

In comparison to other professions in the built environment, interior design is still in its infancy, in fact, only in 1996 the federal government of the USA officially recognized the interior design as a profession (Piotrowski, 2014). Yet in this short duration, the scope of work for interior designers has changed dramatically. While today both ‘interior design’ and ‘interior decoration’ coexist as separate professions, interior decoration is still solely concerned with aesthetics, whereas, interior design has matured to be involved in solving complex issues and handling the ever-changing requirements of existing and new spaces. There are several definitions for interior design, however, the most commonly quoted one originates from the Council for Interior Design Qualification (CIDQ) (2019) which described it as a profession that “encompasses the analysis, planning, design, documentation, and management of interior non-structural/non-seismic construction and alteration projects in compliance with applicable building design and construction, fire, life-safety, and energy codes, standards, regulations, and guidelines for the purpose of obtaining a building permit, as allowed by law.” CIDQ further defined an interior designer as “qualified by means of

education, experience, and examination” and who has a moral and ethical obligation to safeguard building users through “the design of code-compliant, accessible, and inclusive interior environments that address wellbeing, while considering the complex physical, mental, and emotional needs of people.” (CIDQ, 2019). Interior designers bear the skills and knowledge concerning elements such as space planning, materials, furniture, furnishings, and equipment that relate to lighting, wayfinding, acoustics, ergonomics as well as human-environmental behavior, all of which allow them to contribute to the improvement of the interior environment for occupants. While technological innovations are growing in both quality and quantity, interior designers must provide robust, sustainable, and adaptive design solutions that not only reflect technological evolution, but also considers cultural, demographic, and political influences as well.

The scope of work of an interior designer can be simply described as creating and/or modifying interior environments for catering to client’s needs, desired spaces, experiences, and functions through the application and/or alteration of structural elements, spatial arrangements, furniture, materials, lighting, color schemes, and equipment, taking into account the building codes, safety aspects, environmental concerns, ergonomics, human behavior, comfort, health and wellbeing of the occupants (Kilmer & Kilmer, 2014). The most comprehensive scope of services for interior designers that are endorsed and cited by many professional bodies, institutions, and accrediting agencies (see APDIQ, 2017; ASID, 2014; IIDA, 2020; Piotrowski, 2014) is originated from the Council for Interior Design Qualifications (CIDQ, 2019) The following tasks are all or parts of the responsibilities carried out by professional interior designers:

- To learn, research, and analyze the client's requirements and needs, and to produce drawings, documents, and diagrams that feature those requirements.
- To present initial schematic drawings inclusive of conceptual sketches, two and three-dimensional layout plans, and images based on the client's needs, principles of interior design, and theories of human behavior.
- To confirm that the proposed concept, design, plans, and details are safe, visually pleasing, practical, functional, and are complying with all safety and welfare requirements consisting of building codes, accessibility, environmental, and sustainability strategies.
- To select materials, finishes, and colors that communicate the design concept and serve the socio-psychological, environmental, maintenance, lifecycle performance, and safety requirements.
- To provide the specification of the selected fixture, furniture, millwork, equipment as well as product descriptions and contract documentation to enable smooth installment, procurement, and pricing of the above.
- To prepare and supervise project management services such as project schedule and budget.
- To prepare construction documents including plans, sections, elevations, and detail drawings, to illustrate non-structural and/or non-seismic layouts such as furniture layout, reflected ceiling plan, lighting and looping, power supplies, and communication plans as well as materials and finishes layout.
- To assure construction documents comply with all the local building and fire codes, and any other regulations and guidelines relevant to the interior space.

- To coordinate and collaborate with other design and specialty consultants including architects, engineers, acoustical and audio-visual, security, technology, and several other specialists.
- To assure that all the drawings, details, and contract documentation are correctly signed and filed by the interior designer and presented to local authorities.
- To administer contract documents, bid, and negotiate, on behalf of the client, with contractors, sub-contractors, authorities, and other parties involved.
- To supervise, observe and report on the project progress and upon completion to verify the correct implementation of the design, and to conduct post-occupancy evaluation report.

There are numerous professional societies/bodies and national associations representing interior designers around the world. The most prominent ones in the field are the International Interior Design Association (IIDA - Est. 1994), American Society of Interior Designers (ASID - Est. 1975, also known as the ASID Foundation), and International Federation of Interior Architects/ Interior Designers (IFI – Est. 1963). Several other bodies are concerned with other aspects of interior design such as education; Interior Design Educators Council, Inc. (IDEC - Est. 1963), accreditation; Council for Interior Design Accreditation (CIDA - Est. 1970) and qualifications; National Council for Interior Design Qualification (NCIDQ - Est. 1974). Malaysian Institute of Interior Designers (MIID - Est. 1992) is considered as the key representative body for interior designers in Malaysia and it aims to educate, promote, and encourage better relations between the public and the professional members. According to the Architects Act 1967, Board of Architects Malaysia/ Lembaga Arkitek Malaysia (LAM) is the statutory authority responsible for the enforcement of the said act. The responsibilities of LAM with regards to interior design include registration of practice,

regulations of conduct and ethics, conducting professional examination as well as accreditation. Only recently LAM introduced the professional examination for interior designers, successfully passing the exam allows the individual to carry the title of Interior Designer (IDr).

### **2.3 Interior Design Education**

The body of knowledge required for an individual to practice interior design in the 21<sup>st</sup> century has significantly expanded. According to Fitoz (2015), interior design comprises both artistic and scientific knowledge and skills. Due to this interdisciplinary nature, interior design requires professionals to have a broad knowledge of design, building structure, theories of human behavior, materials, ergonomics, and sustainability among other things. Piotrowski (2014) mentioned that clients who hire interior designers expect the professionals to possess the essential skills and knowledge required to provide more than just aesthetics. The author stated that the expansion of the body of knowledge is mainly due to the advancement in technology, regulations with regards to safety and wellbeing of occupants within the built environment, as well as the need to incorporate sustainable approaches, elements, and principles into the education of interior design. Like many other evolving professions, interior designers must embrace the concept of lifelong learning and form a “future oriented innovative design vision” to keep up with the pace as human relations with the environment advance every day and new challenges are faced (Fitoz, 2015, p. 4129). According to Huber (2018), who studied the research utilization gap that exists in the interior design field, there seems to be a lack of interest in reviewing scholarly research among interior designers when performing project research. The author posited that interior design practitioners seek information that is interactive, graphic-based, short-form, and easily searchable, and suggested that ‘how’ a message is delivered to them is as crucial as

‘what’ the message is. The author concluded that in undergraduate studio syllables, there must be more focus on the application of research to prepare design practitioners to find suitable information and subsequently, apply the solutions properly.

The CIDA (formerly FIDER, the Foundation for Interior Design Education Research) was established and began setting interior design education standards in 1970. As early as 2002, the focus was primarily placed on sustainable materials and resources, and in the subsequent years 2006, 2011, and 2014 the focus continued to be revolving around the integration of knowledge of sustainability in interior design education (Stark & Park, 2016). Today, CIDA is the most recognized organization responsible for accrediting interior design programs in North America and has accredited many universities/colleges and programs around the globe. According to the latest Professional Standards report of (2020) by the CIDA, which is the document comprising of the criteria and standards for the accreditation of interior design programs, there are a total of sixteen standards under two sections namely the “Program Identity and Context” and “Knowledge Acquisition and Application” that must be met. The first considers the characteristics and curriculum of the program, the college/university’s faculty, and administration structure, learning environments, and necessary resources. The latter is concerned with areas such as global context, collaboration, business practice and professionalism, human-centered design, design process, communication, history, design elements and principles, light and color, products and materials, environmental systems and human wellbeing, construction, and lastly regulations and guidelines (CIDA, 2020, p. 7). For the purpose of this research, certain criteria under section two of the latest published professional standards (2020) that are related to the concept of sustainability will be discussed and elaborated in detail.

## **Global Context**

This standard is to ensure that designers are aware of the impact of the social, cultural, economic, and ecological matters on their work. It also calls for the development of a global view that lays the ground for designers to work in a diverse set of conditions and have a general understanding of the terms above. Graduates must realize that environmental conditions, cultural norms, current, and emerging issues in the society differ depending on geographic location and the local context which should guide their design and construction decisions. For instance, climatic settings influence the selection of materials, and human interactions and behaviors differ in rural versus urban contexts (CIDA, 2020, p. 16).

## **Human-Centered Design**

The Health and wellbeing of the occupant is of utmost importance in interior design and this standard calls for strategies to be implemented in the education of interior designers so that the graduates apply the knowledge of human behavior, performance, and experiences in the designing of the built environment. Designers must be able to integrate ergonomics, human factors such as human perception, and behavior patterns into their design solutions in order to successfully respond to and satisfy occupants' needs while promoting the health and wellbeing of the users (CIDA, 2020, p. 20).

## **Light and Color**

The science of light and color shapes the human experience within the built environment and designers must be aware of the environmental impact of lighting strategies while considering the influence of light and color on the safety, health, and



wellbeing of the users. This includes a thorough understanding of natural and artificial lighting as well as theories and principles of color which discusses the physiological and psychological effects of colors on humans. Finally, the graduates must comprehend the relation between materials, lighting, and color in order to efficiently communicate the design intent (CIDA, 2020, p. 26)

### **Products and Materials**

Other than aesthetic values of products and materials, designers must also understand the fabrication process, maintenance requirements, and installation methods to efficiently apply/select equipment, materials, furnishings, and finishes based on their performance, ergonomics, environmental attributes, and lifecycle cost. The report also highlights that the human and environmental wellbeing concerns such as responsible use of resources, safety, health, and comfort must be considered by graduates to appropriately select and apply the products and custom design elements (CIDA, 2020, p. 27)

### **Environmental Systems and Human Wellbeing**

As the title suggests, this standard is concerned with elements such as indoor air quality, acoustics, passive and active thermal comfort, water, and waste systems that not only directly impact human wellbeing but also cause concern about environmental wellbeing. The guideline suggests that the training expectations is for designers to decide on selecting and/or applying the systems and equipment related to the aforementioned elements such as noise control, floor, wall, and ceiling systems, passive and mechanical air flow systems as well as filtrations, mold prevention and materials based on principles of sustainability (CIDA, 2020, p. 28)

## **Construction**

According to the guideline, interior designers must attain awareness with regards to the environmental impact of construction through understanding renewable resources, recycling materials, sustainable waste management, locality of the materials as well as transportation. They are also required to understand base-building construction methods, interior systems, and constructions, as well as the integration of electrical and mechanical systems such as power, lighting, telecommunications, as well as HVAC, plumbing, and sprinklers respectively into the interior environment. Finally, the guideline suggests that graduates must be able to incorporate energy management systems both passive; such as light shelves and building orientation, and active; such as mechanical and digital controls into their design (CIDA, 2020, p. 29).

## **Regulations and Guidelines**

This section focuses on students' understanding of laws, regulations, codes, and standards that apply to interior environments. It specifically mentions guidelines related to sustainability such as Leadership in Energy and Environmental Design (LEED) and suggests that students must be able to demonstrate the ability to apply such guidelines among other codes and laws, to their design (CIDA, 2020, p. 31).

In Malaysia, Lembaga Arkitek Malaysia/ Board of Architects Malaysia (LAM) is the organization responsible for accrediting interior design courses. According to the Appendix A of policy and procedure for accreditation provided by LAM (2021), there are five key aspects of knowledge and skills that must be attained by students throughout their education in interior design/architecture program including; “design, creative work by research method”, “knowledge of material, visual research”, “people and the environment”, “communication” and “professional practice” (LAM, 2021).

Apart from the general history, technical skills, art, and design-related topics, LAM guidelines also require interior design graduates to demonstrate the knowledge concerning human wellbeing, the welfare of the natural world and generations to come, sustainable environment as well as an understanding of codes and regulations with regards to the safety of the occupants both during and after the construction. It also states that students must show the ability to consider space, aesthetics, technical solutions, and social qualities of design, not only related to the micro interior environment but also in the context of the macro environment. Another important aspect of interior design education that must be incorporated within the structure of the program is practical training. The recommended duration of such training varies among different accrediting agencies and subsequently universities/colleges, however, it is a mandatory part of interior design education. Additionally, Afacan (2014) suggested that responsive social environments through which students, instructors, and industry partners are engaged, could increase students' technical and functional knowledge of sustainability that is more applicable than theory.

In summary, the significance of environmental issues has procured a need for the integration of the principles of sustainability in the curriculum of interior design education programs. Investigating the standards and guidelines set by the accrediting organizations such as CIDA and LAM has revealed that it is compulsory for interior design students to attain in-depth knowledge about human behavior in relation to the environment, human and environmental wellbeing, environmentally responsible materials and equipment selections, ergonomics, human comfort, theories and principles of light and color as well as their impact on occupants, along with an understanding of building structure, and electrical and mechanical systems within the building. in a study conducted by Stark and Park (2016) that assessed interior design

students' perception towards sustainability, it was demonstrated that interior design students are graduating with much more awareness, information, and knowledge about sustainability than the freshmen. Therefore, it seems that as far as education is concerned, concrete steps have been taken to ensure the awareness regarding sustainability among entry-level interior designers is present. However, as mentioned by Piotrowski (2014), interior design is a profession that involves lifelong learning through practice, workshops, and seminars to keep up with the evolving context of the interior environment and human behavior.

Within the context of Malaysia however, there are very limited standards concerning sustainability in interior design, especially when it comes to residential renovations. There are no compulsory frameworks, laws, or regulations that must be followed for a residential interior renovation, whether regulations concerning the usage of certain materials, certain fixtures, or types of equipment. There are however certain regulations that must be abided by only if there are structural changes to be made and this requires the signature of a registered architect. This will be further discussed in-depth in the succeeding sections.

#### **2.4 Sustainability in Interior Design**

The term Sustainability is most commonly defined as “meeting the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations, 2020). The origin of the concept of sustainability and sustainable development dates to 1987 when the Brundtland Report by the World Commission on Environment and Development (WCED) entitled “Our Common Future” was published. Today, as it can be seen in the Sustainable Development Goals report by the United Nations, sustainability is intertwined with every aspect of life such as energy,

resources, equality, production, and consumption among other things. Sustainability in interior design is also known as environmentally responsible interior design, environmentally sustainable interior design, and environmentally conscious interior design. Often the term ‘green design’ is also used to describe sustainable design; however, Winchip (2011) stated that it only applies to the micro-scale of the interior, whereas SID considers economic, environmental, and social aspects of sustainability as well. Kang and Guerin (2009a) defined it as interior design that minimizes harmful, and maximizes positive impacts on the environmental, social, and economic systems during the life cycle of a building, through the integration of design, purposefully selected systems and materials as a whole. Pilatowicz (2015) pointed out that until recently, the approach towards sustainable interior was revolving solely around “performance of buildings’ systems” and “resource conservation” which was primarily developed and applied by architects and engineers and this has resulted in a struggle for interior designers to find their role in the sustainability scene (2015, p. 101). The author posited that the healthcare design industry is responsible for the transformation in the approach that resulted in a significant shift of focus from mere conservation to the vision of healing environments with increased operational performance and improved indoor environmental quality for occupants. She further stated that designing health care facilities is a complex and challenging procedure that requires knowledge of physical and psychological human needs, sensory experiences, air quality, and thermal comfort as well as theories of colors and lighting and their impact on the healing process. As illustrated in Figure 2.1, Celadyn (2018) described SID as an approach that deals with three main issues, (1) “an object’s ecological effectiveness” with respect to reducing and/or eliminating its harmful effect on the environment; (2) the economic implications and consequences that may arise from the interior spaces’ energy performance; and (3)

anticipating “social system’s considerations” with regards to the characteristics of the interior space and the impact on users’ psychological and physical comfort (2018, p. 1). For the purpose of this research, the definition provided by Celadyn (2018) is adopted due to its completeness.

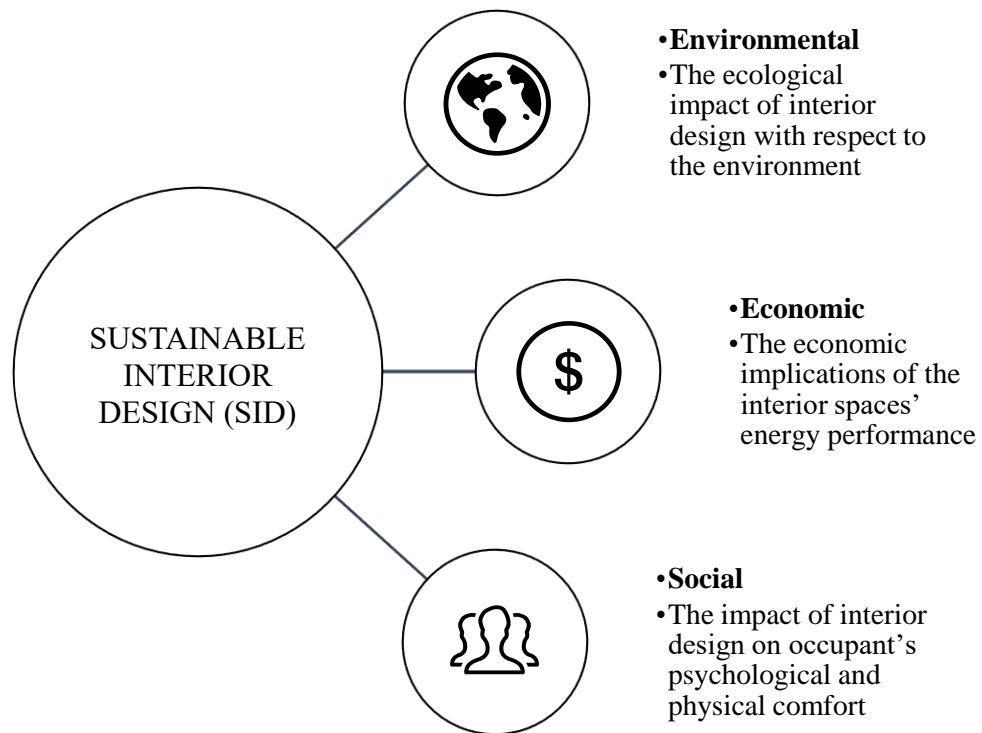


Figure 2.1 Sustainable Interior Design (SID) (Celadyn, 2018).

In the book written by Stelmack et al. (2014), the authors discussed the principles of SID that have been endorsed by the American Society of Interior Designers (ASID) (2014) which include a broad range of topics, in line with the triple bottom line theory that contains environment, social and economic aspects of sustainability. (1) “advocacy for safe products and services” discusses the roles of interior designers for encouraging clients, employers, and colleagues to adopt the development of spaces and products that are pro-environment, “produced in a socially just manner”, and that is safe