

**EVALUATING THE ADOPTION THE USE OF GREEN
TECHNOLOGY AND SUSTAINABILITY DESIGN FOR
BUILDINGS IN PENANG**

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**EVALUATING THE ADOPTION THE USE OF GREEN TECHNOLOGY
AND SUSTAINABILITY DESIGN FOR BUILDINGS IN PENANG**

by

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TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENT	ii
TABLE OF CONTENTS	iii
LIST OF TABLES	vii
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xvi
ABSTRAK	xvii
ABSTRACT	xviii
CHAPTER 1: INTRODUCTION	1
1.1 Introduction.....	1
1.2 Background.....	2
1.3 Problem Statement.....	4
1.4 Aim and Objective of Study.....	8
1.5 Scope of Study.....	9
1.6 Significance of Study.....	9
1.7 Research Methodology.....	10
1.8 Research Outline.....	12
1.8.1 Introduction.....	12
1.8.2 Literature Review.....	12
1.8.3 Research Methodology and Case.....	13
1.8.4 Research Analysis and Findings.....	13
1.8.5 Conclusions and Recommendations.....	14
1.9 Summary.....	16
CHAPTER 2: LITERATURE REVIEW	17
2.1 Introduction.....	17
2.2 Background of Green Building and Sustainable Technology.....	22
2.3 Green Building Technology and Sustainable Design Preferences.....	24
2.4 Green Building around the world.....	26
2.4.1 United Kingdom.....	27
2.4.2 United States.....	31

2.4.3	Australia.....	35
2.4.4	Africa.....	38
2.4.5	United Arab Emirates (UAE).....	40
2.5	Green Building in South East Asia.....	44
2.5.1	Singapore.....	45
2.5.2	Thailand.....	49
2.5.3	Philippines.....	52
2.5.4	Indonesia.....	56
2.6	Green Building in Malaysia.....	58
2.6.1	Kuala Lumpur	61
2.6.2	Putrajaya, Selangor.....	66
2.6.3	Johor Bahru, Johor.....	68
2.6.4	Ipoh, Perak.....	71
2.6.5	Malacca City, Melaka.....	74
2.6.6	Shah Alam, Selangor.....	76
2.7	Green Building in Penang.....	78
2.7.1	Culture and Heritage in Penang.....	80
2.7.2	Tourism in Penang.....	83
2.7.3	Architecture in Penang.....	85
2.7.4	Green Building and Sustainable Technology in Penang.....	92
CHAPTER 3: RESEARCH METHODOLOGY.....		94
3.1	Introduction.....	94
3.2	Design of Research.....	95
3.2.1	Research Approach.....	98
3.2.2	Instruments of Research.....	101
3.2.3	Research Setting.....	103
3.2.4	Research Framework.....	104
3.2.5	Research Hypothesis.....	104
3.3	Data Sample.....	106
3.3.1	Sampling Criteria.....	107
3.4	Data Collection.....	111
3.4.1	Primary Data.....	111
3.4.2	Secondary Data.....	112

3.4.3	Data collection method.....	112
3.4.3(a)	Literature Review.....	113
3.4.3(b)	Survey Design.....	113
3.5	Problems and Limitations.....	130
3.6	Summary.....	131
CHAPTER 4: DATA ANALYSIS AND FINDINGS.....		132
4.1	Introduction.....	132
4.2	Survey Results.....	133
4.2.1	Section A – Demographic Data.....	134
4.2.2	Section B – Survey Questions.....	143
4.2.2(a)	Part I – Green Building Trend.....	144
4.2.2(b)	Part II – Public Awareness.....	153
4.2.2(c)	Part III – Priority and Preferences.....	162
4.2.2(d)	Part IV – Sustainable Design.....	170
4.2.2(e)	Part V – Building Incentives.....	178
4.2.2(f)	Part VI – Green Building Features.....	187
4.2.2(g)	Part VII – Green Building Products.....	197
4.2.2(h)	Part VIII – Market Trends in.....	203
	Construction Approval	
4.3	Normality Test.....	211
4.4	Correlation Test.....	213
4.5	One-way Anova Test.....	216
4.5.1	Awareness of Green Building Concept.....	217
4.5.2	Green building is the most popular trend.....	219
4.5.3	Level of interest in adopting green building concept.....	221
4.6	Summary.....	223
CHAPTER 5: CONCLUSION.....		225
5.1	Introduction.....	225
5.2	Summary of Data.....	226
5.3	Result of Hypothesis.....	227
5.4	Fulfilment of Research Proposal.....	228
5.4.1	Aim.....	229

5.4.2	Research Objectives.....	229
5.4.2(a)	To determine the popular types of building..... design in Malaysia	230
5.4.2(b)	To identify the priority and preference of building.. design according to the public in Malaysia	231
5.4.2(c)	To propose the concern of architectural and..... construction departments about the effectiveness of green building technology which are more preferable and highly demanded	232
5.4.3	Summary of Conclusion.....	233
5.5	Recommendation.....	234
5.5.1	Increasing public awareness on the benefits and advantages..... of green building technology	234
5.5.2	Encouraging clients and developers to research and..... consider green products	235
5.5.3	Law implementation and enforcement by the local authority.....	236
5.5	Limitation of Research.....	237
REFERENCES.....		239
APPENDICES		

LIST OF TABLES

		Page
Table 3.1	Shows the summarization of the questions included in the survey form	118
Table 3.2	Shows the summarization of each question in part 1	126
Table 3.3	Shows the summarization of each question in part 2	126
Table 3.4	Shows the summarization of each question in part 3	127
Table 3.5	Shows the summarization of each question in part 4	127
Table 3.6	Shows the summarization of each question in part 5	127
Table 3.7	Shows the summarization of each question in part 6	128
Table 3.8	Shows the summarization of each question in part 7	128
Table 3.9	Shows the summarization of each question in part 8	129
Table 4.1	Percentage of respondents	135
Table 4.2	Age group of respondents	136
Table 4.3	Age*Gender Cross-tabulation table	136
Table 4.4	Profession group of respondents	138
Table 4.5	Working Experience of respondents	139
Table 4.6	Green Building Experience of respondents	140
Table 4.7	Working Experience*Green Building experience Cross-tabulation table	142
Table 4.8	Age*Experience Cross-tabulation table	142
Table 4.9	Emerging green building trends table	144
Table 4.10	Green building is the most popular trend Table	145
Table 4.11	Green technology used as building design table	146
Table 4.12	Green building is a good concept table	147
Table 4.13	Currently living/working in a green building table	148
Table 4.14	Green building has potential for future development table	149
Table 4.15	Statistics table for part I	150
Table 4.16	Reliability Statistics table for part I	151
Table 4.17	Item-Total Statistics table for part I	152
Table 4.18	Awareness about green building table	153
Table 4.19	U.S. Green Building Council (USGBC) or LEED certification table	154

Table 4.20	Green Building Initiative (GBI) or Green Globes assessment program table	155
Table 4.21	NAHB Model Green Building Guidelines	156
Table 4.22	Level of interest shown by community	157
Table 4.23	Green building concept has been constructed in community table	158
Table 4.24	Statistics table for part II	159
Table 4.25	Reliability Statistics table for part II	160
Table 4.26	Item-Total Statistics table for part II	161
Table 4.27	Your company has adopted green concept table	162
Table 4.28	Level of interest in adopting the green technology table	163
Table 4.29	More company should adopt green building into their project table	164
Table 4.30	Interested in owning, leasing, or manage a green property table	165
Table 4.31	Green technology have potential to become the market trend in the future	166
Table 4.32	Statistics table for part III	167
Table 4.33	Reliability Statistics table for part III	168
Table 4.34	Item-Total Statistics table for part III	169
Table 4.35	Green technology used in building construction table	170
Table 4.36	Energy efficiency and sustainability is an important factor table	171
Table 4.37	Green building is better for the environment table	172
Table 4.38	Green building promotes to a healthier lifestyle table	173
Table 4.39	Green building able to save cost on maintenance table	174
Table 4.40	Statistics table for part IV	175
Table 4.41	Reliability Statistics table for part IV	176
Table 4.42	Item-Total Statistics table for part IV	177
Table 4.43	Whole-life cycle cost saving table	178
Table 4.44	Low utility bills table	179
Table 4.45	Taxes rebated table	180
Table 4.46	Emissions reduction table	181

Table 4.47	Increased property values table	182
Table 4.48	Improved health and productivity table	183
Table 4.49	Statistics table for part V	184
Table 4.50	Reliability Statistics table for part V	185
Table 4.51	Item-Total Statistics table for part V	186
Table 4.52	Energy efficiency and renewable energy table	187
Table 4.53	Water conservation table	188
Table 4.54	Environmental preferable building materials and other resources table	189
Table 4.55	Waste reduction table	190
Table 4.56	Efficient use of landscape and minimum possible damage to earth table	191
Table 4.57	Use of recycled material in construction and operations table	192
Table 4.58	Design buildings which will reduce greenhouse effect and global warming	193
Table 4.59	Statistics table for part VI	194
Table 4.60	Reliability Statistics table for part VI	195
Table 4.61	Item-Total Statistics table for part VI	196
Table 4.62	Energy efficient appliances/HVAC table	197
Table 4.63	Lighting schemes harvesting daylight instead of artificial light table	197
Table 4.64	Wind power table	197
Table 4.65	Solar-thermal or photovoltaic electricity table	198
Table 4.66	Solar hot water systems table	198
Table 4.67	Grey water or rain water catchments to save water table	198
Table 4.68	Alternative sewage disposal table	199
Table 4.69	Alternative building materials table	199
Table 4.70	Other green building certification table	199
Table 4.71	Statistics table for part VII	200
Table 4.72	Reliability Statistics table for part VII	201
Table 4.73	Item-Total Statistics table for part VII	202

Table 4.74	Expansion of role in code enforcement to include compliance assessment or verification of green building features	203
Table 4.75	The development of an expedited permitting process for projects that incorporate innovative green building strategies	204
Table 4.76	The role of building codes being used as one component of a broader policy initiative to reduce the impacts buildings have on human health and the environment	205
Table 4.77	The local state government and community leaders show an interest in green building programs	206
Table 4.78	Your scope of work currently have a green building program	207
Table 4.79	Statistics Table for part VIII	208
Table 4.80	Reliability Statistics table for part VIII	209
Table 4.81	Item-Total Statistics table for part VIII	210
Table 4.82	Descriptive table for Normality test	212
Table 4.83	Correlation table for Correlation test	214
Table 4.84	ANOVA table for Awareness of Green Building Concept	217
Table 4.85	ANOVA table for Green building is the most popular trend	219
Table 4.86	ANOVA table for Level of interest in adopting green building concept	221
Table 5.1	Result of Hypothesis table	228
Table 5.2	Summary of Conclusion table	233

LIST OF FIGURES

		Page
Figure 1.1	Flowchart of the Research Process	15
Figure 2.1	Shows The 3,770-square-foot bio-tapestry cloaks the southern end of the Rubens Hotel at the Palace (Chung, 2014)	30
Figure 2.2	Shows the concept used by Australian architects to blur the lines between interior and exterior environments of the residential housing (McFayden, Top 5 trends in Aussie Architecture for 2014, 2014)	36
Figure 2.3	The Makoko Floating School in Lagos, Nigeria floating above the water surface by using air barrels (Bustler, 2016)	39
Figure 2.4	The Dynamic Tower of Dubai, UAE is a sustainable and environmental friendly building structure (Hung, 2007)	43
Figure 2.5	The Parkroyal Hotel uses green building design in Pickering, Singapore (Luxury Dream Hotels, 2015)	48
Figure 2.6	The Chaeng Watthana Building is the third building of the Bank's Main Offices in Thailand is categorized as a green building (Creative Move, 2014)	51
Figure 2.7	The Net Lima Tower, Eco Tower Building in Taguig, Philippines – design by Chad Oppenheim, architect (EcoFriend, 2014)	55
Figure 2.8	The Syed Kechik Building, Jalan Kapas, Bangsar, 59100 Kuala Lumpur, Malaysia (Propwall.my, 2017)	65
Figure 2.9	The boulevard and landscaping in the streets of Putrajaya City (Ng, 2017)	67
Figure 2.10	The newly developed residential green building Green Haven situated in Johor Bahru (Property Guru, 2015)	70
Figure 2.11	The Railway Station in Ipoh is a heritage building that also utilizes green designs and sustainability (Balakrishnan, 2015)	73

Figure 2.12	Masjid Sultan Salahuddin Abdul Aziz Shah, commonly referred to as the ‘Blue Mosque’ (Emily2U, 2017)	77
Figure 2.13	The Suffolk House near Georgetown serving as the residence of served as the residence of Francis Light (Trip Advisor, 2010)	87
Figure 2.14	The Campbell House, one of the modern shop houses located in Jalan Campbell is a 10-room hotel owned by Malaysia-born Nadya Wray and her Italian husband, Roberto Dreon (Wong, 2012)	89
Figure 2.15	Many green walls and roofs can be seen in Penang such as the Lone Pine Hotel (Trip Advisor, 2013)	92
Figure 3.1	Shows the flowchart for the framework process of the research	96
Figure 3.2	Shows the types of research approach typically used in a research (NTNU, 1998)	98
Figure 3.3	Shows the quantitative analysis approach workflow (Heyl, 2012)	100
Figure 3.4	Shows a portion of the total population used as data sample	106
Figure 3.5	Shows a simple map of Malaysia (Ismail & Manaf, 2013)	109
Figure 3.6	Shows a detailed map of Penang (Ren, 2009)	109
Figure 3.7	Shows a map of districts in Penang (data.gov.my, 2018)	110
Figure 3.8	Shows the steps to questionnaire design process (McLaughlin, 2008)	115
Figure 3.9	Shows the general construct for questions in Part 1	119
Figure 3.10	Shows the general construct for questions in Part 2	120
Figure 3.11	Shows the general construct for questions in Part 3	121
Figure 3.12	Shows the general construct for questions in Part 4	122
Figure 3.13	Shows the general construct for questions in Part 5	122
Figure 3.14	Shows the general construct for questions in Part 6	123
Figure 3.15	Shows the general construct for questions in Part 7	124
Figure 3.16	Shows the general construct for questions in Part 8	125
Figure 4.1	Number of respondents	135
Figure 4.2	Age group*Number of Respondents graph	137

Figure 4.3	Pie chart of Profession group of respondents	138
Figure 4.4	Bar chart of Working Experience of respondents	139
Figure 4.5	Pie chart of percentage of Green Building Experience of respondents	141
Figure 4.6	Histogram of Emerging green building trends	144
Figure 4.7	Histogram of Green building is the most popular trend	145
Figure 4.8	Histogram of Green building used as building design	146
Figure 4.9	Histogram of Green building is a good concept	147
Figure 4.10	Histogram of Currently living/working in a green building	148
Figure 4.11	Histogram of Green building has the potential for future development	149
Figure 4.12	Histogram of Awareness about the green building concept	153
Figure 4.13	Histogram of U.S. Green Building Council (USGBC) or LEED certification	154
Figure 4.14	Histogram of Green Building Initiative (GBI) or Green Globes assessment program	155
Figure 4.15	Histogram of NAHB Model Green Building Guidelines	156
Figure 4.16	Histogram of Level of interest shown by community	157
Figure 4.17	Histogram of Green building concept has been constructed in community	158
Figure 4.18	Histogram of Your company has adopted green concept	162
Figure 4.19	Histogram of Level of interest in adopting the green technology	163
Figure 4.20	Histogram of More company should adopt green building into their project	164
Figure 4.21	Histogram of Interested in owning, leasing, or manage a green property	165
Figure 4.22	Histogram of Green technology has potential to become the market trend in the future	166
Figure 4.23	Histogram of Green technology used in building construction	170
Figure 4.24	Histogram of Energy efficiency and sustainability is an important factor	171

Figure 4.25	Histogram of Green building is better for the environment	172
Figure 4.26	Histogram of Green building promotes to a healthier lifestyle	173
Figure 4.27	Histogram of Green building able to save cost on maintenance	174
Figure 4.28	Histogram of Whole-life cycle cost saving	178
Figure 4.29	Histogram of Low utility bills	179
Figure 4.30	Histogram of Taxes rebated	180
Figure 4.31	Histogram of Emissions reduction	181
Figure 4.32	Histogram of Increased property values	182
Figure 4.33	Histogram of Improved health and productivity	183
Figure 4.34	Histogram of Energy efficiency and renewable energy	187
Figure 4.35	Histogram of Water conservation	188
Figure 4.36	Histogram of Environmental preferable building materials and other resources	189
Figure 4.37	Histogram of Waste reduction	190
Figure 4.38	Histogram of Efficient use of landscape and minimum possible damage to earth	191
Figure 4.39	Histogram of Use of recycled material in construction and operations	192
Figure 4.40	Histogram of Design buildings which will reduce greenhouse effect and global warming	193
Figure 4.41	Histogram of Expansion of role in code reinforcement to include compliances assessment or verification of green building features	203
Figure 4.42	Histogram of The development of an expedited permitting process for projects that incorporate innovative green building strategies	204
Figure 4.43	Histogram of The role of building codes being used as one component of a broader policy initiative to reduce the impacts buildings have on human health and the environment	205

Figure 4.44	Histogram of The local state government and community leaders show an interest in green building programs	206
Figure 4.45	Histogram of Your scope of work currently have a green building program	207
Figure 4.46	Awareness about green building concept*Mean of Working Experience graph	218
Figure 4.47	Green building is the most popular trend*Mean of Experience in Green building graph	220
Figure 4.48	Level of interest in adopting green technology*Mean of Experience in Green Building graph	222

LIST OF ABBREVIATIONS

ASEAN	Association of South East Asian Nations
ANOVA	Analysis of Variance Test
CFL	Compact Fluorescent Lamp
CIDB	Construction Industry Development Board
ETP	Economic Transformation Programme
GBI	Green Building Index
GDP	Gross Domestic Product
GHG	Greenhouse Gases
HVAC	Heating Ventilation and Air Conditioning
IRDA	Iskandar Regional Development Authority
LEED	Leadership in Energy and Environmental Design
LED	Light Emitting Diode
NAHB	National Association of Home Builders
NCC	National Construction Codes
PAM	Pertubuhan Arkitek Malaysia
PR1MA	Perumahan Rakyat 1Malaysia
PBRs	Pearl Building Rating System
SEA	South East Asia
SPSS	Statistical Package for the Social Sciences
UAE	United Arab Emirates
UNESCO	United Nations Educational, Scientific and Cultural Organization
USGBC	U.S. Green Building Council
VOC	Volatile Organic Compound

**MENILAI PENGAMBILAN PENGGUNAAN TEKNOLOGI HIJAU DAN
REKA BENTUK KEMAMPAHAN UNTUK BANGUNAN DI PULAU
PINANG**

ABSTRAK

Tujuan utama penyelidikan ini adalah untuk mengkaji dan menilai penggunaan teknologi bangunan hijau dan reka bentuk kemampahan dari segi keutamaan, keperluan dan keutamaan yang berkaitan dengan keperluan awam di Pulau Pinang. Objektif utama penyelidikan ini adalah untuk menilai penggunaan teknologi hijau dan reka bentuk kemampahan untuk bangunan di Pulau Pinang. Matlamatnya adalah untuk mengenal pasti keutamaan dan keutamaan reka bentuk bangunan mengikut orang awam di Malaysia supaya ia boleh digunakan untuk mencadangkan kepada arkitek tempatan, kontraktor dan pemaju mengenai keberkesanan teknologi hijau. Data yang dikumpul untuk penyelidikan ini dikumpulkan menggunakan pelbagai instrumen seperti kajian literatur dan soalan tinjauan. Kertas soal selidik diedarkan kepada populasi sampel, dikumpul semula dan dianalisis dengan menggunakan perisian SPSS untuk mendapatkan keputusan. Keputusan menunjukkan bahawa kebanyakan orang menyatakan tindak balas positif terhadap konsep teknologi hijau. Walau bagaimanapun, kebanyakan responden tidak sedar dan memahami sepenuhnya konsep itu sendiri. Oleh itu, penyelidikan telah dijalankan dan penemuan penyelidikan ini diharapkan dapat membantu pemilik bangunan masa depan dan pemaju untuk memahami konsep teknologi bangunan hijau dan keistimewaan reka bentuk. Mudah-mudahan, ini akan memenuhi keperluan dan keutamaan orang ramai.

EVALUATING THE ADOPTION THE USE OF GREEN TECHNOLOGY AND SUSTAINABILITY DESIGN FOR BUILDINGS IN PENANG

ABSTRACT

The main purpose of this research is to study and evaluate the adoption of the use of green building technology and sustainability design in terms of priority, requirements and preferences in relation to the public's requirements in Penang. The main objective of this research is to evaluate the adoption of the use of green technology and sustainability design for buildings in Penang. The goal is to identify the priority and preference of building design according to the public in Malaysia so the it can be used to propose to local architects, contractors and developers about the effectiveness of green technology. The data gathered for this research was collected using various instruments such as literature review and survey questions. The questionnaire papers are distributed to the sample population, recollected and analysed using the SPSS software to obtain the results. The results show that most people expressed a positive respond to the concept of green technology. However, most respondent are not well aware and fully understand the concept itself. Accordingly, the research was conducted and the discoveries of this research are expected to assist future building owners and developers to fully comprehend the concept of green building technology and design preferences. Hopefully, this will meet with the public's requirements and preferences.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Since the beginning of mankind, building design and architecture has always played a major role in the construction of buildings as it is the very nature of humans to seek refuge and shelter, the construction of buildings is a necessity for one's daily lives. The term building design can be referred to the application of designs to the construction of a building or structure based on several angles such as architectural, engineering and technical terms. In most cultures and countries, the architecture of a building is considered a work of art which created an aesthetical value that is pleasing to the public's eye but at the same time retains and even promotes to the building functionality. The biggest challenge faced by architects is to create a design for a building where the aesthetic qualities can assimilate with the function of the building and how the two aspects can integrate with each other without hindering one or another (Mehaffy, 2015). The recent green building trend however, allows this feat to be achieved far more easily.

The purpose of this research is to evaluate the adoption of the use of green building technology and sustainability design in terms of priority, requirements and preferences in accordance to the public's needs for the building design and development sector. This research also focuses on the subject of green technology for

the sole reason of green building is currently in trend in recent years and is expected to persevere in many years to come. In the last decade, many building owners and developers has committed themselves to establishing that sustainably designed commercial buildings can save energy, cost less to operate in long term, have smaller carbon footprints, and more satisfied occupants (Environmental Protection Agency, 2010). Therefore, the findings of this research are expected to aid architects and developers to understand the concept of green building technology and design preferences.

1.2 Background

The rise of demands in constructions in most advanced countries results in the increase of business opportunities for developers which are supported by the entry of foreign companies into emerging local markets. With the recent progression in our society's information and technology fields, this creates openings for further development of our local industry which also endorses the procurement of skills and knowledge in fields such as architecture, engineering and building construction services, and has led to the establishment of several job markets on a global scale. With numerous varieties of business involved, the type, design and functionality of the building development may differ according to the situation and public demands. This is the reason why this study is conducted, to determine how certain aesthetic quality and evaluation of buildings could be predicted. These predictions are important for architects as they can be used to find the users preferences and expectations of the design (Mehaffy, 2015).

Thus, begins our country's endeavors in advancing in the fields of architecture and construction to keep up with the recent demands of developers and trends. Since the rapid growth of Malaysia's economy from the year 1970 to 1990, the design requirements and priority of building construction changes drastically which are noticeable from the architectural styles of local buildings and the increasing number of high rise buildings. From Malay to Islamic and then to late-modernism and post-modern architecture, the evolution of building design in our country is slowly but surely advancing. Many buildings with modern designs and all-glass and steel structure exteriors are visible throughout most advanced states with the most prominent examples being Kuala Lumpur and Pulau Pinang. Even more commercial and government building owner and developers have adapted green building technology into their design. This occurrence is probably aided by the recent booming in Malaysian economy. Not to mention that our country's value of construction contracts awarded in 2015 was 250% larger in comparison to 2014. It is expected that Malaysia's building sector will continue to grow in the next few years (ITE Build & Interiors, 2015).

Ultimately, it is essential for building developers and architecture firms to pursue for the answer to the basic question about building preferences and its contribution to the public realm, and to the aesthetic qualities that are most demanded by consumers. When it comes down to it, architects and developers are encouraged to have a clear understanding of the functional and physical requirements of a project. Preference is a factor to involve conceptual assessment about whether the design is going to be liked or disliked, and also is the design is going to hinder the functionality of the building. This is to reduce overall project cost and wastage by specific project application and planning which can also avoid any delays in the project period. The

findings for this research can also be used to identify the essential conceptual properties that are related to aesthetic evaluation of façade designs using qualitative methodology. This can also enlighten some developers and architects' perception on some conceptual properties as they may not be similar and deviates from the views of non-architects (Mehaffy, 2015).

1.3 Problem Statement

In recent years, green building technology has made their way into the building industry and is considered to be the core for building design outlines for developers and architects. With the recent advancement of our countries economy, new businesses are appearing everywhere which parallels to the needs for new building construction and development (Bernstein, 2013). The increasing number of competition due to the entrance of foreign market into local sectors also stimulates the number of demands. As such, there is a requirement for designs of a building which differs according to the type of business involved, location and market customers. This also creates a challenge for architects and developers on ways to approach the construction of these buildings and to prioritize the designs whether in terms of functionality, practicality, sustainability, aesthetical, environmental and cost.

While most building developers and owners have adapted green building technology into their design, the majority of public may still not be aware of its existence and its beneficial properties. Some even may not consider implemented it at all because of cost and maintenance factor. Several developers and firms also avoided the topic at hand probably due to their practices involved solely on traditional construction method and they intend to continue that way. Other may lack the

knowledge and expertise to take on the newly discovered trend. Albeit historically speaking, the evasion and lack of green technology implementation seems to occur in Malaysia and other countries similar to it. In other thriving countries such as the United Kingdom, United States and Germany most of their municipalities had even instigated regulations to make green technology and sustainable designs mandatory in new urban development plans (Ansel, 2015). This is why there is a need for Malaysian municipalities to embrace the trend so that green technology can become an accepted standard in the building industry.

Moreover, as mentioned in the previous paragraph, the lack of green building implementation in our country may be resulted by the public having very little if not nonexistence knowledge and awareness regarding the concept discussed. Since most building properties are built to cater to the needs of publics, it is natural that their opinion and views have a stand in the issue at hand. Should there are more public awareness about sustainable designs in buildings, there might be more demands for green buildings and hence, more green projects for architects and developers and in turn may leads to a greener future. Nonetheless, the attitude and exposure of architects and building developers also plays a role in this outcome. There was a white paper study conducted by the Reed Research Group about workers in a firm's knowledge and experience in sustainable design. The results is a sizable percentage of respondents about 42% were at firms that had at least some experience in sustainable design, with many more 39% of workers expressing interest in it. Although others of approximately 19% having little or no interest in sustainable design at all or otherwise are not experience in the field (Cassidy, 2003).

However, there are still other obstacles to be faced when taking on green building technology and sustainable design. Several issues can obstruct the adaptation process such as in most countries, environmental regulations in the building sector are not well accepted. This can be opposed by both the developers and public for various reasons. There is also the problem with architectural integration. The design of a building must address several criteria with several issues regarding the implicitly and explicitly to prioritize the sequence of significance of these factors and the linkage between them. Although the best way to approach this is by fully exploiting each criterion for the building design, it is nothing but the best case scenario for a development project which is usually hindered due to the limited time, budget, resources, skills and any regulations or code restrictions (Bernstein, 2013). Which is why the prioritization and/or compromise of the building design is inevitable, and thus, surfacing the problem for building developers on whether to use green technology that requires specific knowledge to build and have prolonged construction period with relatively higher cost or to go with traditional construction method and are able to save budget and avoid other complication at the cost of not having greener building structure.

While most thriving and advanced countries such as the US and UK have no problem adopting the concept of green technology in their construction development project, other less flourished countries in other regions such as in the Middle East and South East Asia region may face with some difficulties when trying to take on the same achievement. Many factors can come to mind and these aspects may also differ from each region and country. A more obvious reason is the relatively high cost to construct a green building with sustainable design. It is common knowledge that countries in America and Europe are better off than countries in most regions in terms

of economy and resources. Shortages of materials at affordable prices and skilled construction teams lead to unreasonable prices from developers; consequently, most small building owners do not have the financial ability and justification to have green technology in their buildings. This factor is further supported by the very high cost required to maintain a green building (Vanessa, 2008). In contempt of green technology will be beneficial and tends to save cost in long term operation does not seem to change the fact that most building developers and owners are turned off by the idea of having to increase their expenditure on something that is still new and uncertain whether it will be profitable or not.

Therefore, this research was conducted to evaluate the adoption of the use of green technology and sustainability design according to the public's needs and preference for the building construction and development sector. The findings of this research also hopes to be able to assist architects and building developers to identify and prioritize the factors and perquisites when designing and constructing a building to further increasing its market value and profitability and simultaneously will be able to fit the descriptions of public demands in both design, functionality and sustainability. This study also aims to provide a methodical analysis of the economic value of both green technology and certified sustainable building design construction at the national and state levels (Environmental Protection Agency, 2010).

This research also strives to fill the knowledge gap left by the previous research concerning the nature of building construction and the development industry. This is particularly true for most research that revolves around the concept of green technology as the concept is relatively new or even nonexistent back then. The research papers and articles addressing the issue at hand which circulates around the World

Wide Web are mostly still lacking in both data quantity and validity. Even in our country, the practice of green technology and sustainable building design is rather scarce compared to other countries. This fact is most probably caused by the myth that green technology always cost more than what they put out of. While some cases it may be true, most of them have been demonstrated that many green technologies essentially cost the same and some even cost less than typical 'Non-green' constructions. This is also another reason why developers should make the public aware of its existence and benefits to promote the uses of green technology by integrating them into building construction.

1.4 Aim and Objective of Study

The main dissertation is aimed to evaluate the adoption of the use of green building technology and sustainable design in building construction and development for architectural firms and building developers in accordance to priority and preference.

The objectives for this research are listed below:

1. to determine the popular types of green technology and sustainability design for buildings in Malaysia
2. to identify the priority and preference of building design according to the public in Malaysia, and
3. to propose the concern of architectural and construction developers about the effectiveness of green building technology which are more preferable and highly demanded.

1.5 Scope of Study

The scope of this research will be focusing on the green technology and sustainable building design according to priority and preference including methods of criteria selection practiced throughout the states of Malaysia. To narrow down the result, most of the research will be done within the states of Malaysia and focused of specifically the state of Penang.

Since there may be many types of buildings where green technology can be adopted into, the types of developments and properties that will be focused on are most public buildings such as residential and commercial buildings where most regular citizens makes it their residence and workplace.

The types of respondents that will be involved are the people working in the fields of construction and development such as architects, engineers and surveyors. The respondents that are involved are from different background with different education, age, experience and race. Approximately more than 100 survey questions will be distributed to the respondents

1.6 Significance of Study

The importance of this research is to identify and determine the effectiveness of green technology and sustainability design according to the public's needs and preference for the building construction and development sector. The research findings can also be used to aid building developers and architecture firms in their decision making and market study on the trends and preferences of green building in Malaysia in comparison to other countries.

There is also presently a gap of knowledge in the public's views regarding green building. Since our society is the target consumers for most residential and commercial building, the knowledge to educate and increase their awareness on the subject of matter is crucial which leads to the starting of this research to determine the data and information to fill them in. By raising the public's awareness on green building technology, there may be more demands for it. Since this method and type of construction is more practical, environmental friendly and energy saving, it will hopefully lead to a better future.

1.7 Research Methodology

Throughout this research project, the use of research methodology is a necessity to determine and obtain an accurate result in respect of the study, the data collected should be collected, identified, analyzed and documented.

Once the finalizing of the objectives and research limitation has been done, the research will begin and conducted using one of the two (2) methods, which are qualitative and quantitative method. The workflow of data gathering and collecting is as follows:

- i. the method that was selected is the qualitative approach. It involves a method of data collection in the form of grounded theory and is descriptive. This research will use qualitative methods such as performing a field research using various methods such as questionnaires and surveys, live observation, analysis of documents and materials, and interviews with the public.

- ii. for example, when gathering data from questionnaire survey, numerous amount of questionnaire papers are constructed and distributed to the public of various race, ethnicity, gender, age, social status and educational background. The data collected from questionnaire surveys are very crucial as they provide a detailed insight from the perspective views of our society regarding this research. The data can later be interpreted and determine whether this research is viable and the findings are valid or not.
- iii. for questionnaire surveys, a group of data is required to proceed. Results from respondents which are related to the problem statement are necessary to determine the result of this research. For this study, respondents are selected from various educational and professional backgrounds as long as it is related to the construction industry and development in any way.
- iv. interviews are also a method of primary data collection. Interviews sessions are conducted with the help of developers and architects working in various firms of different projects undertakings involved in the subject related to the research which, in this case concerning green technology and sustainable design study, and
- v. after the data collection methods have been conducted, the next stage of this research is to compile all the data and findings obtained and begin analyzing the data using software such as SPSS to obtain result. The final stage is the presentation of the result obtained from the analyzed data and writing the report including the conclusions and recommendations for the proposed issue.

1.8 Research Outline

The working process of this study is presented in self-contained chapters. This dissertation consists of five (5) different main chapters. The chapters are listed as follows in accordance to the relevance sequence of each chapter:

1.8.1 – Introduction

This is the first main chapter in this report. This chapter basically functions as a general overall view of this research. Background of studies introduces the report by providing a general insight to the matters regarding the research and the processes involved in completing it. Continued by the problem statement which is where the research states the problem that is occurring and outlining the possible cause and effect that may be relevant to this research. This chapter also introduces research objectives, scope and limitation of study, significance of research, and research methodology. Lastly, this chapter also includes a summary of each chapter followed by a conclusion.

1.8.2 – Literature Review

The second chapter mostly deals with data and information gathered from other sources of similar researches that has been done previously and was taken into this study for further clarification on the subject. The past studies that were used are mostly adopted from sources that are outside of this country such as Europe, United States, Australia, etc. and from within the country itself.

However, this research will be focusing on studies from Malaysia for this research regarding issues that are related to green building technology and sustainability design. It will be describing all matters such as definition, application, importance, significance, principles, and other relevant topics.

1.8.3 – Research Methodology and Case Study

This chapter will be discussing about the research design and methodology used for this research to obtain data and information significant to the study. The chapter also states the type of data used which in this case, is qualitative data method. Survey questionnaire questions are also presented here and other research related data collection methods. The instruments of research and techniques of analysis are also described in this chapter. The case study that was selected for this study was further elaborated in this part of the research to see any similarities regarding the same issue to obtain information that can be helpful to this research. Chapter 3 deals with the subject with more in-depth and comprehensive. For example, the design or research is elaborated further and broken down with more detailed explanation to make it easier for others to comprehend.

1.8.4 – Research Analysis and Findings

Chapter 4 of research analysis main objective is to analyze the gathered information and data to prove of its validity and present the result obtained from this research within the related analysis. The primary data that were

obtained from interviews and questionnaire surveys are analyzed to obtain results for the findings in the next section. The findings are then broken down and elaborated further to create a solution to remedy the problem statement of this research. The data findings in this chapter may be presented in various forms and technique such as table, graph and chart. From the results an explanation can be derived to conclude the research.

1.8.5 – Conclusions and Recommendations

All the results obtained from the previous chapter will be summarized in this chapter in a few short paragraphs. Then, a recommendation will be written based on the results regarding ways to improve and fix the issue. In this chapter also the researcher will address several suggestion and recommendation regarding the subject for the consideration of certain groups of people and authority so that it can be used to rectify the problem.

The flowcharts that list down the process of work such as data collecting and analyzing are listed as below:

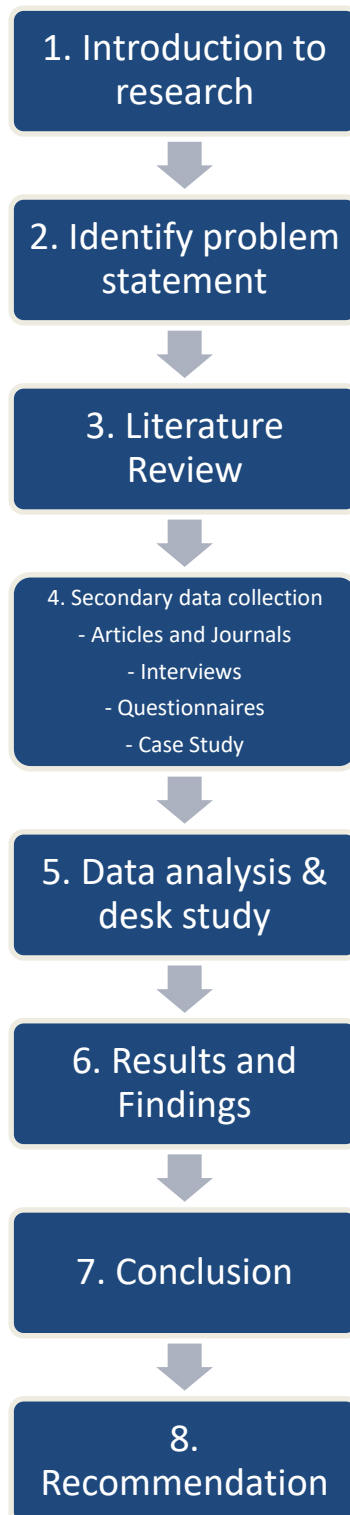


Figure 1.1 – Flowchart of the research process

1.9 Summary

The importance of this research is to determine and identify the recent market trends and demands on the requirement of types of building design according to the respected audience. This research also deals with problems involving the lack of green building structures and sustainable technologies in building construction of our country. In other words, to specify the shortage of green building designs from the perspective of the general public and their opinion on the matter. The overall goal of this research is to determine the best approach for the prioritization of building design in construction and study about green building technology and its advantages and benefits to allow developers to make better decision in their selection and planning towards a more systematic and effective way which accommodates the public's needs and requirements. This research also aims to encourage building developers and architects to create more sustainable and greener building that are energy efficient and environmental-friendly so that our society can build a better future for our country.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The creation of buildings and structures has evolved throughout the years and continues to do so to adapt and adjust according to the needs and preferences of its occupants. The construction of buildings and structures is a very complex method which involves a few strategically planned sequences of events which is commonly referred to as a building design process. The significant factor to any construction projects is to determine the needs and requirements for the building or whether the building is necessitated whatsoever (Smith, et al. , 2016). As such, by establishing the buildings requirement, other important elements of the project can be determined such as type and function of the building, cost and budgeting, location of site, and other essential data which, can otherwise be time consuming and could ultimately affect the design and construction process if not obtained in advance. Needless to say, the type and requirements of the proposed building plays an important role in the decision of the design team for the development project especially nowadays where there is a specific trend in building construction which is most in demand by the clients presently, the green building construction and technology (Smith, et al. , 2016).

The issue presently seeks to foreground the concept of ‘green building construction and technology’ to implement this method of building design which are in demand by the public based on the recent inclinations of design preferences. The market trends of global and local construction massively impact the outcome of a

development project. However, the styles and natures of the designs itself are dependent according to the location and region of the project mainly due to environment, custom, and availability of materials (Hensel & Cordua, 2015). Since the 18th century, mankind has progressively led to the apprehension that architecture should be solely based on climate, geography, local materials, and local traditions. It has been tacitly assumed that such a foundation is essential for the development of an authentic modern architecture. However, the idea of design trends according to a specific region depends on it being possible to correlate cultural codes with geographical regions. These determining factors are drastically fading from society and even cease to exist in some part of the globe (Hensel & Cordua, 2015).

In the last few decades, there have been various seismic shifts in the styles and preferences of architectural designs. Beginning from the first civilization of Egyptians around the Mediterranean basin until the appearance of Neoclassicism in Paris, architectural designs seems to revolve around a certain aspect which is established in order to suit the lifestyles of the society which are currently present in the moment of the location and time. Whether to focus on functionality or aesthetical properties, these characteristics seems to differ depending on the location, time period, local customs, and religion (Hensel & Cordua, 2015). These notions are apparent when referring to the dissimilarity in architectural preferences and needs of two different areas or time periods.

For instance, in 1890 the concept of Art Nouveau Architecture was introduced during the English Arts and Craft Movement in Britain. Art Nouveau was a pioneering worldwide form of modern art that came to be an influential factor starting from its arrival until the First World War. Its arising was due to the response of 19th-century designs lead by historicism in general and neoclassicism in particular, the idea was to

propagate arts and designs as a part of society and everyday life. As such, most building during that time heavily fixated on appearance and aesthetics of the building by applying different types of art forms, mainly fine arts, flat, and decorative patterns to building structures. However, during the 1970 is the advancement of high-tech architecture (Mako, et al. , 2014). Also known as Late Modernism or Structural Expressionism, it is a style that emerged which focused on incorporating fundamentals of high-tech technology and engineering into building design. It appears as refurbished modernism architecture. The buildings that are constructed during this era tend to consists of emphasized technical elements that focused on functionality rather than appearances. Although the structure of high-tech architecture seems to diverse somewhat, yet most of them possess a few resemblances in design mainly the idea of orderly arrangement, use of pre-fabricated materials, and the exaggerated use of glass walls and steel frames (Collins, 2015).

This can also be due to the effect of complete urbanization. The conception of urbanization can be inferred as the overall transformation of society, ultimately altering the living conditions of populations in urban and rural areas. It is obvious that that major conversion of the traditional practices of societies occurring in consequence to urbanization, not only the material structure, the built environment and the urban morphology were shifting, but also everyday life. This creates a diversity and dispersion of people, activities, wealth, goods, objects, instruments, means and thoughts among the population of different areas which, in this case, urban and rural areas (Lefebvre, 2003). With the segregation of two populations it is bound to result in different target consumers with different needs and preferences. Because of this, the style of architecture and functionality of the buildings differs accordingly. Urban settlements are distinctive by their more advanced public facilities and amenities,

educations, transportations, business and social interactions and generally better in terms of living standard. Subsequently, urban areas have more high-rise building which inclines towards post-modern design architecture styles (Lefebvre, 2003). Whereas rural settlements are grounded more on natural resources and procedures, although lacking when comparing to urban areas in terms of science and technology, rural population tends to have lower cost of living and needs. While urban inhabitants receive the benefits of man's advancement and development, rural dwellers are more nature-dependent for their day to day occupations (Lefebvre, 2003). As such, rural areas have less buildings which consists mostly of residential homes and even fewer or none public amenities or facilities such as hospitals, shopping malls, educational institutes and corporate buildings.

With the recent advancement of technologies and manpower, several contours and trends began emerging in the development industry market. The subject of matter here discourses the different facades of the discipline of architecture which includes the institutional framework, practices and numerous merging systems. This is also an attempt to address the opportunities in modern-day design approach and the materialization and construction process for local architectures (Mohammadian, 2014). The continuous presentation of commercial real estate industry in American and European countries is predicted to linger on in 2015, in both domestic and foreign grounds. The growing real estate markets forms adaptability to a sequence of mega trends influencing society and the global economy. These trends involve the quickening of urbanization, demographical transformations and the influence of distributive technological advancements (Roschelle & Carey, 2015).

Through the rising of the construction industry, it presents itself with a series of opportunities and threats. These trends which shifts the very foundation of the

industry, allegedly for the long term, opens new doors for the industry's market contributors and eventually controls the construction services business archetypal. With standard structures, comes more competitive bidding. This continues to provide more burdens on project owners to conduct construction procurement as a product, particularly with extremely competitive structures which are typically less complex and easier to construct, have generic designs and archetypes, and able to be achieved by large number of construction workers. Examples of these standard projects are housing projects such as residential and multi-family housing, warehouses and storage facilities, chain stores and retail shops, office buildings which do not include high-rise buildings and skyscrapers, lodgings, and schools and other educational institutes (Mehaffy, 2015).

For complex structures, there are lesser competitive bidding as they are more complicated which comes with more needs and requirement to construct. These are usually buildings that are less likely to be treated as commodities which comprises those that possesses one-of-a-kind and unique designs, involves the use of ground-breaking technologies, existing problematic building conditions, time and budget critical, or are generally larger in scope (Best & de Valence, 2007). These buildings consist of Industrial and chemical processing plants, stadiums, hospitals and other medical buildings, research facilities, power plant and other energy and resources facilities, bridges, oil platforms, museums and galleries and concert halls. For the more intricate building projects, owners have the tendency to pursuit for best value, so that he will be able to avoid the danger of poor quality and delay in schedules for these complex and large building projects (Chisholm K. , 2012). For instance, when a contractor fails to deliver on time on a major project such as a hospital or power plant facilities, the cost in lost event revenue or production for the delayed schedules or poor

workmanship can be catastrophic. The major risk in the low-bid squeeze play is that, although the owners are exploiting the greatly competitive market, those in the construction services business will participate in the competition and perform their best to rectify for winning the bid which results to negative profit margins projection by cutting corners with their workmanship, hence increasing the cost and number of order changes and billing for any extras possible (Chisholm K. , 2012).

2.2 Background of Green Building and Sustainable Technology

Green construction and sustainable building, or commonly referred to as green building, is a type of structure or building that utilizes the use of environmentally controlled processes within the building and has sustainable property or resources-efficiency throughout its entire lifespan beginning from the design phase, development and construction, operation, maintenance, renovation and finally demolition. The goal of a ‘green’ project is to mainly preserve and bring back the natural habitat that is important in order to sustain life. The epitome of a green building is the ones whose development and period of operation ensures the most environmental-friendly and healthiest processes and at the same time demonstrating itself as the most efficient and well-organized but also the least disruptive in terms of land, water, energy and resources allocation (EPA, 2010). The best case scenario for an optimum design approach is the one that able to successfully emulate all of the natural systems of the surrounding and conditions of the pre-developed site location after the construction has been completed.

In other words, a green building is a structure constructed to be able to find balance and synergizes well between the building and the natural sustainable

environment. The concept also happens to be a subset of sustainable technology which aims to create a better building with high performance facilities designed, constructed, renovated, and demolished of using environmental-related principles for the purpose of sustaining the health of building occupants and increase resource efficiency, plus reducing and minimizing the negative impacts of built environment on the natural environment (Kibert, 2004). The term ‘resources efficiency’ refers to satisfactory and proficient levels of energy allocation and water efficiency, suitable use of land areas and landscaping, the use of eco-friendly and environmentally safe building materials and minimizing life cycle adverse effects and threats of the building’s design and operation on the environment (Kibert, 2004).

Needless to say, the development process for green building in no easy task and very time, energy and resources consuming. It requires very close supervising and cooperation by the design team, architects, engineers and clients on all phases of the project. This creates an insinuation that green construction tends to cost more than regular construction with no assurance that it will be profitable and as a result, will create more loss for the clients and in turn causes developers to shy away from the whole concept. While it is true that most green materials tend to cost more than its regular pre-manufactured counterpart, it is statistically proven that most of the green technology approach actually cost the same or not even less than the so-called ‘traditional’ or ‘regular’ technology methods. By incorporating the perfect blend of sustainable technologies that cost similar or slightly higher, it has the potential to become a green building project that will ultimately cost the same or even lesser than a conventional one. As an example, using windows and frames with better performance increases the initial cost of the overall building envelope, but by doing so it will decrease the size and cost for the buildings heating and cooling system and then

compensates to the cost of the high-tech glazing system. As a result, the building will have a relatively lower initial cost, a better and more comfortable environment, efficient energy use, lower energy bills and overall operating cost for the buildings lifecycle (EPA, 2010).

2.3 Green Building Technology and Sustainable Design Preferences

The growing economy and technological advancements around the globe leads to the progression of lifestyles of our society. Hence, there will be an increase and changes of demands and needs from people for their building requirements (Yao, 2013). For example, back in the old days the number of population in a concentrated area is considered scarce comparing to the present. With the increasing number of demands for accommodation the available space for living is limited. Hence, more high-rise buildings are built to supply the needs of consumers. In a nutshell, building design and construction preferences and the prerequisites and standard of living of mankind are parallel with each other and continues to progress through the years (Feng, et al. , 2015). The recurring phase which commonly referred to as an emerging trend in the development industry, provides valuable information which is often sought by architecture and construction firms as a standard and guideline to determine the currently popular styles of building design for their target building owners.

Needless to say, for this very reason this research dissertation was conducted as a means to obtain data which will be used to determine the building design priority and preferences according to the architect's needs and the public's demands. In this case, the research will be focusing on the green building technology trend that has been going on recently in every part of the world. Although the concept itself is very popular