SALVAGE VALUE OF GREEN BUILDINGS IN MALAYSIA

FIONA LOO

FACULTY OF BUILT ENVIRONMENT
UNIVERSITY OF MALAYA
KUALA LUMPUR

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SALVAGE VALUE OF GREEN BUILDINGS IN MALAYSIA

FIONA LOO

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ABSTRACT

As the market increasingly recognize the benefits of green projects and show willingness to pay a premium for them, developers are proactively presenting green sustainable construction projects as a competitive edge in the industry and to enhance their profit margins. However, most of the studies have focused on the overall value of green buildings rather than the salvage value of the green components which is one of the important components of building's life cycle cost. Therefore, this paper aim to develop a framework for salvage value of green components for the use by property and estate valuers and quantity surveyors. The objective of this study is to identify the green components ideal for Malaysia's tropical environment. And also determining factors contribute to the condition of salvage value of the green components and then analyzing the salvage value of green components. The study involves a literature review of academic and draws on data relating to green components in green building, International green rating tools and salvage value. Using a quantitative methodology, this study sent 213 sets of questionnaire questionnaires to quantity surveyors, estate agents, and property valuers. But just 166 sets, or 77.9%, got a response. To ascertain the optimal green components for Malaysia's tropical climate, factors influencing the condition of green components, and the floating of salvage value of green components, mean analysis and Relative Important Index analysis were performed. In Malaysia's humid and hot atmosphere, the popularity of passive daylighting and natural ventilation techniques highlights their benefits. The length of time a green component is used and its proximity to disposal restrictions stand out as the most critical factors affecting green component's condition. In the result, the findings of this research paper could be beneficial to the construction industry by recognizing the hidden cost or value of assets after their useful life and taking building life cycle costing into account.

Keywords: Green Building, Green Components, Salvage Value

[SALVAGE VALUE OF GREEN BUDINGS IN MALAYSIA]

ABSTRAK

Memandangkan pasaran semakin mengiktiraf faedah projek hijau dan menunjukkan kesediaan untuk membayar premium untuk mereka, pemaju secara proaktif mempersembahkan projek pembinaan mampan hijau sebagai kelebihan daya saing dalam industri dan untuk meningkatkan margin keuntungan mereka. Walau bagaimanapun, kebanyakan kajian tertumpu kepada nilai keseluruhan bangunan hijau dan bukannya nilai salvage komponen hijau yang merupakan salah satu komponen penting dalam kos kitaran hayat bangunan. Oleh itu, kertas kerja ini bertujuan untuk membangunkan rangka kerja bagi nilai simpanan komponen hijau untuk kegunaan penilai hartanah dan ladang serta juruukur bahan. Objektif kajian ini adalah untuk mengenal pasti komponen hijau yang sesuai untuk persekitaran tropika Malaysia. Dan juga faktor penentu menyumbang kepada keadaan nilai salvage komponen hijau dan kemudian menganalisis nilai salvage komponen hijau. Kajian ini melibatkan kajian literatur akademik dan menggunakan data yang berkaitan dengan komponen hijau dalam bangunan hijau, alat penarafan hijau antarabangsa dan nilai salvage. Menggunakan metodologi kuantitatif, kajian ini menghantar e-mel 288 set soal selidik soal selidik kepada juruukur bahan, ejen harta tanah dan penilai hartanah. Tetapi hanya 166 set, atau 50.0%, mendapat respons. Untuk memastikan komponen hijau optimum bagi iklim tropika Malaysia, faktor-faktor yang mempengaruhi keadaan komponen hijau, dan terapung nilai salvage komponen hijau, analisis min dan analisis Indeks Penting Relatif telah dilakukan. Dalam suasana Malaysia yang lembap dan panas, populariti pencahayaan siang hari pasif dan teknik pengudaraan semula jadi menonjolkan kelebihannya. Tempoh masa komponen hijau digunakan dan kedekatannya dengan sekatan pelupusan menonjol sebagai faktor paling kritikal yang mempengaruhi keadaan komponen hijau. Hasilnya, dapatan kertas penyelidikan ini boleh memberi manfaat kepada industri pembinaan dengan mengiktiraf kos tersembunyi atau nilai aset selepas hayat bergunanya dan mengambil kira kos kitaran hayat bangunan.

Kata kunci: Bangunan Hijau, Komponen Hijau, Nilai Salvage

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TABLE OF CONTENTS

[SALVAGE VALUE OF GREEN BUDINGS IN MALAYSIA] ABSTRACT iii

[SALVAGE VALUE OF GREEN BUDINGS IN MALAYSIA] ABStrak v

ACTKNOWLEDGEMENT vii

Table of Contents viii

List of Figures xiv

List of Tables xv

List of Symbols and Abbreviations xvii

List of Appendices xix

CHAPTER 1: INTRODUCTION 20

1.1 General Introduction 20

1.2 Research Background 20

1.3 Problem Statement 22

1.4 Research Questions 24

1.5 Research Aim 24

1.6 Research Objectives 25

1.7 Research Methodology 25

1.8 Scope of Research 26

1.9 Significance of Research 26

1.10 Thesis Chapters 26

1.11 Summary 28

CHAPTER 2: LITERATURE REVIEW 29

2.1 General Introduction 29

2.2 Definition of Green Building 29

2.3 International Green Rating Tools ... 29
2.3.1 Leadership in Energy and Environment Design ... 30
2.3.2 Building Research Establishment Environmental Assessment Method ... 31
2.3.3 Green Star ... 32
2.3.4 Green Mark ... 33
2.3.5 Green Building Index ... 34
2.4 Green Components ... 35
2.4.1 Energy Efficiency (EE) ... 35
2.4.1.1 Solar Photovoltaic ... 35
2.4.1.2 Solar Shading Devices ... 36
2.4.1.3 Wall Insulation Materials ... 36
2.4.1.4 High- performance glazing ... 36
2.4.1.5 Green Roof ... 37
2.4.2 Indoor Environment Quality ... 37
2.4.2.1 Natural Ventilation Design ... 37
2.4.2.2 Sufficient Daylighting ... 38
2.4.2.3 Sound Insulation Design ... 38
2.4.3 Water Efficiency ... 38
2.4.3.1 Water- Efficient Fittings ... 39
2.4.3.2 Rainwater Harvesting System ... 39
2.4.4 Innovations and others ... 40
2.4.4.1 Building Passive Cooling Design ... 40
2.5 Green Components in Green Building Malaysia ... 42
2.6 Definition of Salvage Value ... 44
2.6.1 Salvage Value for Asset and Building Component ... 44
2.6.1.1 How to Calculate an Asset's Salvage Value ... 44

2.6.1.2 Variables Factors to Consider for Salvage Value 45
2.6.2 Salvage Value of Green Buildings 46
2.6.3 Definition of Condition of Building Components 46
2.7 Research Conceptual Framework 47
2.8 Summary 49

CHAPTER 3: METHODOLOGY 50
3.1 Introduction 50
3.2 Research Process 51
3.3 Research Design 53
3.3.1 Descriptive Research 54
3.3.2 Quantitative Research 55
3.4 Research Area 56
3.5 Target Population 57
3.6 Research Target Sample 58
3.7 Data Collection Method 60
3.7.1 Primary Data from Questionnaire 60
3.7.2 Secondary Data from Literature Review and Desktop Study 62
3.8 Data Analysis Method 62
3.8.1 Quantitative Data 62
3.8.1.1 Likert Scale 63
3.8.1.2 Frequency 64
3.8.1.3 Cronbach's Alpha 64
3.8.1.4 Relative Importance Index (RII) Analysis 65
3.8.2 Qualitative Data 66
3.9 Summary 66

CHAPTER 4: RESULT ANALYSIS..68

4.1 Introduction 68

4.2 Pilot Test..68

4.3 Survey Response Rate 69

4.4 Section A: Demographic of Respondents...70

4.4.1 Respondents' Designation/ Job Title..70

4.4.2 Respondents' Years of Experience in Construction Industry 71

4.4.3 Respondents' Years of Experience in Green Building Construction 73

4.4.4 Respondents' Highest Academic Qualification.......................................74

4.5 Section B: Objective 1 & 2..75

4.5.1 Cronbach's Alpha Reliability Test..76

4.5.2 Descriptive Analysis...76

4.5.2.1 Mean Analysis of Frequency of Use of Green Components.....76

Table 4.5: Mean Ranking of Frequency of Use of Green Components..77

4.5.2.2 Mean Analysis of Important of Green Components for Improving Building Sustainability in Malaysia 78

Table 4.6: Mean Ranking of Important of Green Components for Improving Building Sustainability in Malaysia 78

4.5.2.3 Mean Analysis of Identification of Factors Contribute to the Condition of Green Components' Salvage Value 79

4.5.2.4 Mean Analysis of Indication of Condition of Green Components after different years of use..80

4.5.3 Relative Importance Index (RII) Analysis 82

4.5.3.1 Relative Importance Index (RII) of Frequency of Use of Green Components...82

4.5.3.2 Relative Importance Index (RII) Analysis of Important of Green Components for Improving Building Sustainability in Malaysia 83

4.5.3.3 Relative Importance Index (RII) Analysis of Factors Contribute to the Condition of Green Components' Salvage Value 84

4.5.3.4 Relative Importance Index (RII) Analysis of Condition of Green Components after different years of use. 85

4.6 Section C: Objective 3 86

4.6.1 Cronbach's Alpha Reliability Test 87

4.6.2 Descriptive Analysis.. 87

4.6.2.1 Mean Analysis of Estimation of Floating of Salvage Value of Green Components with the Impact of above-mentioned Factors. 87

4.6.3 Relative Importance Index (RII) Analysis 89

4.6.3.1 Relative Importance Index (RII) of Estimation of Floating of Salvage Value of Green Components with the Impact of above-mentioned Factors. 89

CHAPTER 5: DISCUSSION 91

5.1 Introduction 91

5.2 Section B: Objective 1 & 2 91

5.2.1 RO1: To identify the green components. 91

5.2.2 RO2: To evaluate the condition of green components. 94

5.3 Section C: Objective 3 95

5.3.1 RO3: To demonstrate the floating of salvage value of green components. 95

CHAPTER 6: CONCLUSION ... 98

6.1 Introduction ... 98

6.2 Objective 1: To identify the green components ... 98

6.3 Objective 2: To evaluate the condition of green components ... 98

6.4 Objective 3: To demonstrate the floating of salvage value of green components ... 99

6.5 Contribution of the Study ... 99

6.6 Limitation of the Study ... 100

6.7 Recommendations for Future Studies ... 100

6.8 Summary of Chapter ... 101

References ... 102

LIST OF FIGURES

Figure 1.1: List of registered and certified Green Buildings in Malaysia as of 31 December 2022 (GBI, 2022) 21

Figure 2.1: Research Conceptual Framework for Salvage Value of Green Components. 48

Figure 3.1: Research steps. 51

Figure 3.2: GBI Projects Register – By State/ Territories (Source: GBIG, 2022). 56

Figure 3.3: Registered Members (Source: BOVAEP, 2023) 58

Figure 4.1: Response Rate for Questionnaire Survey 70

Figure 4.2: Respondents' Designation/ Job Title 71

Figure 4.3: Respondents' Years of Experiences in Construction Industry 72

Figure 4.4: Respondents' Years of Experiences in Green Building Construction 73

Figure 4.5: Respondents' Highest Academic Qualification 75

LIST OF TABLES

Table 1.1: Research questions 24

Table 2.1: Summary of green components recognized by international rating tools...... 41

Table 3.1: Scale to represent degree of agreement in Likert Scale (Gail, 2013). 63

Table 3.2: Degree of Internal Consistency by Cronbach's Alpha (Stephanie, n.d.)64

Table 3.3: Scale of Weightage in Likert Scale (Stephanie, n.d.) 65

Table 3.4: Research technique for different research objectives 66

Table 4.1: Reliability Results of Section B. 69

Table 4.2: Reliability Results of Section C. 69

Table 4.3: Respondents' Highest Academic Qualification. 74

Table 4.4: Reliability Test on Identification of green components and evaluation of its condition. 76

Table 4.5: Mean Ranking of Frequency of Use of Green Components 77

Table 4.6: Mean Ranking of Important of Green Components for Improving Building Sustainability in Malaysia 78

Table 4.7: Mean Ranking of Factors Contribute to the Condition of Green Components' Salvage Value 79

Table 4.8: Mean Ranking of Condition of Green Components after different years of use. 81

Table 4.9: RII Ranking of Frequency of Use of Green Components 83

Table 4.10: RII Ranking of Important of Green Components for Improving Building Sustainability in Malaysia 84

Table 4.11: RII Ranking of Factors Contribute to the Condition of Green Components' Salvage Value 85

Table 4.12: RII Ranking of Condition of Green Components after different years of use. 86

Table 4.13: Reliability Test on Estimation of the floating of green components' salvage value. 87

Table 4.14: Mean Ranking of Estimation of Floating of Salvage Value of Green Components with the Impact of above-mentioned Factors.. 88

Table 4.15: RII Ranking of Estimation of Floating of Salvage Value of Green Components with the Impact of above-mentioned Factors.. 90

Table 6.1: Top 3 Green Components Ideal for Malaysia's Environment........................ 98

Table 6.2: Top 3 Factors Affecting the Condition of Green Component 99

LIST OF SYMBOLS AND ABBREVIATIONS

BBCC	:	Bukit Bintang City Center
BCA	:	Building and Construction Authority of Singapore
BOVAEP	:	Board of Valuers, Appraisers, Estate agents and Property manager
BQSM	:	Board of Quantity Surveyor Malaysia
BREEAM	:	Building Research Establishment Environmental Assessment Method
EA	:	Energy and Atmosphere
EE	:	Energy Efficiency
GBCA	:	Green Building Council of Australia
GBI	:	Green Building Index
GreenRE	:	Green Real Estate
GHG	:	Green House Gas
IEQ	:	Indoor Environmental Quality
IN	:	Innovation
IP	:	Integrative Process
LEED	:	Leadership in Energy and Environmental
LT	:	Location and Transportation
MR	:	Materials and Resources
RICS	:	Royal Institution of Chartered Surveyors
RII	:	Relative Importance Index
ROR	:	Rental Obsolescence Rate
RP	:	Regional Priority
SM	:	Site Planning and Management
SPSS	:	Statistical Package for the Social Sciences
SS	:	Sustainable Sites

TRX	:	Tun Razak Exchange
UK	:	United Kingdom
USA	:	United States
WE	:	Water Efficiency

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

1.1 General Introduction

The study on salvage value of green building components is presented to solve the research void in the industry. It described the discovery of green components as well as methods for calculating their salvage value, which influences the building's salvage value in the end. This chapter discusses the research context, problem statement, research problem, aim and objectives, and research technique. Finally, towards the conclusion of the chapter, the structure of the thesis is outlined.

1.2 Research Background

Every country's economy depends heavily on the construction industry due to its potential to improve a country's economic performance, particularly in developing nations (Dakhil, 2013). According to Shafii and Othman (2007), despite providing the public with social and economic benefits, the building and construction industry has a negative effect on the environment. According to Ding et al. (2018), the development of green buildings has evolved into a key idea in construction operations works in recent years due to the rise of public awareness of the need to protect the environment. In UK, from the year of 1990, a total of 24,607 buildings have been registered for the building research establishment environmental assessment method (BREEAM, 2014); in China, green building numbers have increased from 10 to 1,092 units between 2008 and 2014 (Zhang et al., 2017); and in USA, just within thirteen years, the number of Green Certified projects has greatly expanded from 2 to 5,557 (Sue-Dong et al., 2014).

The development of green building construction is only kicking off recently in Malaysia. Prada Johor Premiun Outlet, IKEA Terbau in Johor Bahru, Olive Tree Hotel in Penang, and the Bukit Bintang City Centre in Kuala Lumpur are a few examples of green properties. These and many other green developments have shown that the green concept is expanding and being well received by the public. According to data published by the green building index (GBI) council as of 31 December 2022, there is total of 1115 registered Green Building and 638 buildings being certified as Green Building (GBI, 2022).

Executive Summary as of 31 DECEMBER 2022

GBI PROJECTS REGISTER – BY CATEGORIES

STAGE	TOTAL AS OF 31 DECEMBER 2022	NRNC NON RESIDENTIAL NEW CONSTRUCTION	RNC RESIDENTIAL NEW CONSTRUCTION	NREB NON RESIDENTIAL EXISTING BUILDING	INC INDUSTRIAL NEW CONSTRUCTION	IEB INDUSTRIAL EXISTING BUILDING	ID INTERIOR	T TOWNSHIP
Applied	1,191	643	383	57	65	9	10	24
Registered	1,115	602	362	54	56	8	10	23
Total Certified	638	330 (52%)	224 (36%)	32 (5%)	25 (3%)	4 (1%)	8 (1%)	15 (2%)
Provisional Certification DA/PA	404	220	139	13	16	1	3	12
Final Planning Certification FPA	3	N/A	N/A	N/A	N/A	N/A	N/A	3
Final Certification CVA	189	79	85	13	5	2	5	-
Renewal Certification RVA	42	31	-	6	4	1	-	-

Figure 1.1: List of registered and certified Green Buildings in Malaysia as of 31 December 2022 (GBI, 2022)

As people begin to evaluate the advantages of green projects and are likely to pay a higher cost for it (Hu et al., 2014), developers are actively offering green sustainable construction projects as a competitive advantage in the industry and to boost their earnings margins (Padgett and Moura-Leite, 2012). Professional valuers, as per RICS (2011), should continue to update their expertise to recognize whatever new influence that may impact the property's market value. Previous research has stressed the need for valuation experts including sustainability into the process of evaluation (Michl et al., 2016; Warren-Myers, 2012). Valuers should incorporate green components in the valuation process as the market share of green residential property grows (RICS, 2011).

Salvage value of a building is such a foreseen of its estimated market worth during the end of its useful life after depreciation is completed. (Renata, 2017). It is one of the main Life Cycle Cost components for building and materials selection – Initial Cost, Running Cost and Salvage Value (Alshamrani, 2014). The higher the salvage value or so-called residual value, the lower the asset's whole life cost.

Since various earlier researchers focused working on a study to quantify the effect of depreciation on estate property, the studies on this topic have received major emphasis between 1986 and 1999. A 1986 empirical study by Jones Lang Wootton examined the significant effects of market conditions and ageing on the Rental Obsolescence Rate (ROR) of residential and commercial structures in the UK between 1980 and 1985. While other researchers concentrated on examining the effects of depreciation rather than the variables affecting renting. Baum (1991) used cross-sectional and longitudinal surveys of commercial and residential applications in the UK to demonstrate that building qualities (the architecture, internal features, and exterior look) instead of age were the most important variables in explaining building depreciation.

1.3 Problem Statement

Numerous research has indeed been done over the years to explore the connection between green buildings and its component value. However, it was discovered that the bulk of the studies were prone to concentrate on the overall value of green buildings rather than the value of the green components that allowed the structure to be classified as "green" and hardly can find a discussion on its salvage value. The following researchers undertook some of the studies mentioned: Deng and Wu (2014), Bloom et al. (2011), Nevin and Watson (1998), and Yang (2013).

Some scholarly studies have discovered the single value of green components in order to define the influence of each green component on building values, regardless the consequences of the evolving environment of the knowledge base on the relation between greenery and building salvage values.

Additionally, compared to conventional projects, the effect of pre-project planning on cost performance is more crucial for buildings with green components. More planning is typically required for green buildings with enhanced cost performance, including planning for business model, project requirements, building programming, and building design criteria (Youngcheol, 2018).

The study on salvage value of green components is important because it will be the carrying value of the components of the green buildings after depreciation has been fully expensed. It is based on the value a property expert expects to receive from the sale of the green components at the end of its useful life.

Therefore, a study is necessary to investigate the salvage or residual value of the green components will be positive or negative with all the green components in it because green buildings known to be demanded more capital and resources than conventional buildings.

1.4 Research Questions

The research questions and the associated research objectives are shown in Table 1.1.

Table 1.1: Research questions

Research Questions	Research Objectives
• How many general green components are available in the market? • Which green components are ideal for Malaysia's tropical environment?	• RO1: To identify the green components.
• What is the common condition of green components after 5, 10 and 20 years? • What are the criteria or index to define the conditions of green building?	• RO2: To evaluate the condition of green components.
• What is the formula to calculate salvage value? • What affects the salvage value of green components? • How the condition of green component affects its salvage value?	• RO3: To demonstrate the floating of salvage value of green components.

1.5 Research Aim

The aim of this study is to develop a framework for salvage value of green components in Malaysia.

1.6 Research Objectives

This aim is achievable by the following objectives:

i. To identify the green component of green building.

ii. To evaluate the condition of green components.

iii. To demonstrate the floating of salvage value of green components.

1.7 Research Methodology

This research is designed to be an exploratory with the aim to evaluate the salvage value of green building in Malaysia with a quantitative research methodology. The research is kicked off with a comprehensive literature evaluation to investigate the research gap from earlier studies about the depreciation of green components and assets. The research is then be designed with three key processes including determining the green component of green building, evaluating the condition of green components and analyzing the salvage value of green components in Malaysia construction industry.

This study implements the technique of questionnaire survey to collect data. Questions for questionnaire survey will be designed based on the available green building issues in Malaysia from literature reviews in the format of structured closed-format questions. Prior to the distribution of questionnaire, pilot study will be carried out to validate the questions.

In order to determine the pace at which green components depreciate and to further assess their salvage value, the data acquired were analyzed using frequency and descriptive metrics. Furthermore, the correlation and regression approaches were used to evaluate the relevance of green building classes and components in determining the depreciation of green structures.

1.8 Scope of Research

Due to the abundance of existing green buildings certified by the Green Building Index (GBI), Green Real Estate (GreenRE), or the Leadership in Energy and Environmental Design (LEED) in Kuala Lumpur and Selangor. The focus of green buildings type are primarily office and commercial. This research will focus on licensed valuers who are registered members of Malaysia's board of valuers, appraisers, estate agents, and property managers (BOVAEP), estate agents and quantity surveyors in Klang Valley area. All construction professionals are open in this research study as well.

1.9 Significance of Research

It is widely known that salvage value and depreciation of a building has made an impact on the market and rental values of building properties. This paper will become helpful to the researchers, policy makers or practitioners in real estate industry and market who are exploring more on the future salvage value or depreciation which may affect the demand for green building in Malaysia.

This is significant because it gives valuation practitioners (both government and private assessors) fresh information about the worth of green buildings and the impact of green components on property prices, so enabling the Malaysian green building market to advance to a new level. As a result, it is hoped that this study will help valuation professionals in the future when they undertake valuations of green buildings.

1.10 Thesis Chapters

Chapter 1: Introduction

This chapter brief the research in general view, find out research gap and introduce research background. In this chapter, research aim and objectives had been decided and thus list down the limitation of study.

Chapter 2: Literature Review

This chapter goes through numbers of relevant papers, documents, conference, journals etc and summarize all the important points. This chapter also provides the key definitions of the research topic and determines the published green components for green building in the market and information required to determine the conditions of green components after the useful life and its salvage value.

Chapter 3: Methodology

This chapter has figured out the research design, process of the research, target research area and sample. This chapter also covered the data collection method, ways to do data analysis and ethical consideration. Then the questionnaire is developed to achieve objectives set in Chapter 1.

Chapter 4: Result Analysis

The data analysis and study findings are presented in Chapter 4. The data collected by means of survey questionnaires distributed, secondary data sources, and application of a quantitative methodology are analysed. The differences between the primary and secondary data will be arranged once the data analysis is finished.

Chapter 5: Discussion

In Chapter 5, the investigations are reviewed in light of the study goal outlined in Chapter 1. The questionnaire data are assessed by comparing them to previous researchers' findings, as described in Chapter 2.

Chapter: Conclusion

Chapter 6, which concludes this research report, provides a summary of the study's findings. This chapter concludes the rationale behind the research as well as identifies the green components and shows how the salvage value of the green components can fluctuate.

1.11 Summary

As stated in Chapter 1, the purpose of this research is to investigate the salvage value of green building in Malaysia. To offer a fuller picture of this study, the introduction, background of research and issue statement, target and objectives, and a short explanation for methodology used in this study are detailed and clarified.

CHAPTER 2: LITERATURE REVIEW

2.1 General Introduction

This chapter evaluated several papers and periodicals pertaining to Malaysia's green construction sector. The definitions of green building and salvage value are discussed in the following subsections. This chapter will state an overview of the rating tools for greenery and the green components which are recognized in all over the world and Malaysia. The label should be placed above the table itself and has the following format:

2.2 Definition of Green Building

Muldavin (2010) defines "green building" as the result of a building's performance being enhanced by green components, approaches, and green certification. In one of the 2005 researches, the Royal Institution of Chartered Surveyors (RICS) made it abundantly evident that there was a growing correlation between a building's market price and its green components and associated performance. Furthermore, Meins et al. (2010) highlighted that it is predicted that green features will increase property value. Green building features have a favorable effect on both a building's worth and market value, according to Lorenz and Lützkendorf (2008).

According to studies, green buildings are more value than conventional (non-green) ones (Salvi et al., 2008). The value of green residential buildings is reportedly up to 10% more than that of non-green residential properties, according to a number of empirical research on the subject (Popescu et al., 2012; Yang, 2013; Jayantha and Man, 2013; Deng and Wu, 2014;).

2.3 International Green Rating Tools

Considering countries were unable to agree on a green building performance objective, countries across the globe have devised their own criteria for green building evaluation (Dwaikat and Ali, 2018). Green building rating tools are defined as "certification that is being used to assess and recognize buildings that satisfy specified green requirements or standards" by the World Green Building Council. Green grading systems assess the performance of green buildings based on specific criteria and building categories such as residential and commercial. International and national green rating techniques were studied to find the green attributes that are frequently recognized in green property. Among these are leadership in energy and environmental design (LEED) in the United States, BREEAM in the United Kingdom, green star in Australia, green mark in Singapore, and green building index (GBI) in Malaysia.

2.3.1 Leadership in Energy and Environment Design

LEED is the most frequently used green building standard across the nation (Ding et al., 2018). LEED was designed by the United States Green Building Council in 1998. LEED, as a third-party certification, is widely regarded by the public as proof that a building is planned and constructed with materials and resources (MR) that have a slight influence on human health and the environment (Khashe et al., 2015). As per LEED (2019), over 94,000 projects in over 165 countries have implemented LEED as green building standards and assessment tools to analyze building performance. LEED for residential buildings consists of nine green building assessment criteria for residential property: integrative process (IP), location and transportation (LT), sustainable sites (SS), water efficiency (WE), energy and atmosphere (EA), material and resources (MR), indoor environmental quality (IEQ), innovation (IN), and regional priority (RP).

IP allows the project team to minimize development expenses by using relevant green solutions during the building construction phase. LT focuses on perks such as amenities for people and neighborhood development while selecting a site. The intention of SS is to prevent pollution and negative environmental consequences caused by building activity. Water is a critical resource in building operations; hence, WE is incorporated to monitor and minimize water consumption. In a green building, EA is used to enhance overall energy performance and minimize greenhouse gas (GHG) emissions. MR contains eco-friendly building materials that improve the building's longevity and function. IEQ can enhance occupant health by lowering indoor air pollutants, boosting thermal comfort, and improving ventilation performance. IN gives the design team the chance to support the new design idea in green architecture. The main objective of RP is to tackle a building's geographical and environmental concerns.

2.3.2 Building Research Establishment Environmental Assessment Method

Since its launch in 1990, BREEAM, another world's most widely used technique for evaluating green building performance (Ding et al., 2018), has worked to promote the notion of sustainability in both new and existing structures (BREEAM, 2014). This evaluation approach, developed in the United Kingdom and extensively used in European nations such as Spain, Germany, the Netherlands, and others, is recognized as one of the most complete ways for evaluating a property's green performance (Ding et al., 2018). According to Doan et al. (2017), there are 561,600 BREEAM-certified buildings in 77 countries.

The BREEAM evaluation of a green building must take into account 10 different factors, including management, healthcare, energy, transport, water, materials, waste, land space and environment, pollution, and lastly innovation. Management was set in place to maintain the sustainability concept from building construction through operation. The healthcare quality increased user satisfaction in terms of health and safety. In addition, adopting an energy-efficient design for housing developments may reduce harmful externalities like carbon emissions and reduce running costs during the building's lifespan. The transportation sector concentrated on improving accessibility and local amenities for inhabitants in order to reduce automobile usage. The water department strives to minimize water demand and consumption during the life of the building.

Furthermore, the materials and resources utilized in construction should be evaluated in terms of their influence on the building's lifetime and the environment. The purpose of waste in BREEAM is to encourage the reduction of waste from building operations as well as waste management for tenants. BREEAM land use and ecology are focused on long-term environmental challenges in the development site and nearby regions. Pollution in BREEAM was used to manage the environmental effect of the building and to avoid pollution. The innovation component encourages all necessary stakeholders to contribute to the new green concept to improve the performance of the building.

2.3.3 Green Star

A non-profit organization called the Green Building Council of Australia (GBCA) was established in 2002 to encourage the use of green ideas and design in building operations (Morris et al., 2018). In 2003, the Green Building Council of Australia (GBCA) created the green star as a unit of measurement for gauging the effectiveness of green buildings in Australia. Additionally, this grading system was developed to advance a common viewpoint, lessen the detrimental effects of buildings across their whole lives, and increase construction industry understanding of sustainability (Morris et al., 2018).

Green star is also used as a green building grading system in New Zealand and South Africa (Illankoon et al., 2017). Green star evaluates and grades a building in nine categories: management, IEQ, energy, transportation, water, materials, land use and ecological, emission, and IN. Building management effectiveness may be improved by the use of green ideas such as energy reduction, environmental management, and others. With proper designs, high indoor environment quality focuses on improving occupant productivity and health. Adoption of the energy category may monitor and minimize energy usage while minimizing GHG emissions to lower a building's energy consumption.

The green star transportation category urged inhabitants to utilize alternative transportation and decrease carbon emissions. The goal of water consumption monitoring is to minimize water demand and encourage the use of non-potable water sources such as rainfall or greywater. The use of sustainable construction materials should be addressed early on, and proper waste management systems should be implemented. Land use and ecology are concerned with minimizing the effects of development sites while also safeguarding the environment through legislation and management strategies. Emissions from building operations were also to be restricted. Finally, innovation was a step toward providing better ideas or concepts that may add to the building's sustainability.

2.3.4 Green Mark

The green mark program, a grading system for green buildings, was launched in January 2005 by Singapore's Building and Construction Authority (BCA). The tropical climate of Singapore served as inspiration for the development of the green mark program (Liu et al., 2017). It was put into place to promote ecologically friendly building practices and to reduce a building's energy consumption (Fesselmeyer, 2018). BCA (2019) claims that by increasing environmental awareness among developers, architects, and other key stakeholders as construction activities get underway, this would support the development of green buildings in Singapore.

The green mark criteria have been divided into five categories: advanced green activities, resource stewardship, smart and healthy buildings, and climatically sensitive design. By using management techniques, climatic responsive design seeks to lessen the impacts of climate change on buildings while simultaneously protecting the environment.

In the domain of building energy performance, the green design concept was utilized to improve energy efficiency and reduce consumption.

Resource stewardship strives for resource efficiency throughout the building's lifespan. Smart and healthy buildings deliver a higher quality interior environment to improve human health and well-being. Advancing green efforts through a green mark may assist relevant parties such as architects and developers in implementing the new green design in the building to improve overall building performance.

2.3.5 Green Building Index

Due to climatic factors, environmental difficulties, and cultural and societal demands, the Association of Consulting Engineers Malaysia was formed in 2009. (Shafiei et al., 2017). The goal of GBI is to encourage sustainability in the built environment as well as raise environmental consciousness among stakeholders, therefore contributing to a more sustainable future for future generations.

GBI evaluates a residential building based on six criteria: energy efficiency (EE), indoor environmental quality (IEQ), MR, sustainable site planning and management (SM), WE, and IN. As a criterion, EE employs an appropriate design or approach to improve energy conservation performance throughout the building lifetime. By preserving building interior quality, IEQ creates a comfortable atmosphere for residents. MR advocates the use of environmentally friendly building materials and promotes a waste management system. Good design in the SM category may increase tenant convenience while reducing negative environmental consequences during building construction and operation. Because water is a resource used in building operations, the WE idea was included in GBI to reduce water usage and demand. In addition, IN will support the new idea that matches the GBI's aims for improving the building's performance.

2.4 Green Components

Green components which are incorporated into the building would be able to boost the total value of the property. This research compiled four categories of green components based on a survey of worldwide green grading methods and the GBI in Malaysia, including EE, IEQ, WE, innovation, and others (IO).

2.4.1 Energy Efficiency (EE)

Energy efficiency is defined as "consuming less energy with no compromising the performance of the building" by Wang et al. (2012). This implies that the structure will have the same degree of energy performance while while using less energy. EE is crucial to achieving the lowest possible building running costs. The fundamental goal of energy efficiency is to lower a building's energy use and thus its total GHG emissions. The following five green components were taken into consideration in this category:

I. Solar photovoltaic
II. Solar shading devices
III. Wall insulation materials
IV. High-performance glazing
V. Green roof

2.4.1.1 Solar Photovoltaic

LEED, BREEAM, green star, green mark, and GBI all acknowledged solar photovoltaic technology's ability to provide sustainable energy. Singh (2013) stated that solar energy is a renewable power source and uses photovoltaic technology to directly capture and transform sunlight into electrical energy. In Malaysia, a system that produces renewable power for residential structures is solar photovoltaic. Despite the low public attention of solar photovoltaic, it should eventually rank among the main methods of renewable energy production (Muhammad-Sukki et al., 2011). For increased competitiveness, several Malaysian home developers have included solar PV into their brand-new housing complexes.

2.4.1.2 Solar Shading Devices

The green features indicated by LEED, BREEAM, green star, green mark, and GBI include sun shading equipment. The purpose of solar shading equipment is to reduce the total thermal transfer capacity of properties by obstructing the hot direct sunshine from entering the glazing (GBI, 2014). In especially for structures in tropical countries like Malaysia, Singapore, and Thailand, with good solar shading equipment may decrease the solar heat gain and offer a cooling zone to increase the happiness and productivity of inhabitants. Additionally, it gives building users enhanced heat transfer and aesthetic comfort at the same time (Prowler, 2008).

2.4.1.3 Wall Insulation Materials

One of the eco-friendly building techniques acknowledged by LEED, BREEAM, green star, green mark, and GBI is wall insulation. In nations with tropical temperatures, wall insulation is often utilized to improve the internal thermal comfort of buildings. Wall insulation will aid in lowering energy usage since it will be less necessary to use indoor air centralization when interior temperatures drop, as per Meng et al. (2018). GBI (2014) claims that employing double brick walls, compound insulate walls, and other solutions will increase the insulation of the walls.

2.4.1.4 High- performance glazing

LEED, BREEAM, green star, green mark, and GBI all supporting and promoting glazing as a green feature. High-performance glass is often used to enhance building energy efficiency and indoor thermal (Ander, 2016). In residential buildings, tinted glass, low-emissivity windows, or other types of glazing are often utilized.

2.4.1.5 Green Roof

One of the environmentally friendly elements listed by LEED, BREEAM, green star, green mark, and GBI is the green roof. Because of passive solar inputs from the roof, the roof is a key part of the building shell and is significant when evaluating the cooling efficiency of structures (Ran and Tang, 2018). According to empirical data from study conducted by the Malaysian Institute of Architects in 2008, the average solar thermal absorb by the roof range from 27 to 86 percent, depending on the various dwelling styles and geographical areas. Thus, in hotter tropical climates like Malaysia, green roofs are crucial for lowering cooling requirements and raising interior comfort levels in buildings (Jaffal et al., 2012).

2.4.2 Indoor Environment Quality

Humans spend the majority of their time indoors, hence IEQ is important in a structure (IQI Global, 2017). The welfare and safety of the inhabitants are impacted by a bad interior environment. The quality of the interior environment is influenced by a number of aspects, including the quantity and quality of light, airflow, noise level, and others (Kamaruzzaman et al., 2017). As a result, the current research classifies IEQ as one of the green elements which contribute importantly to building worth together with low-toxic finishes and furnishings, natural ventilation design, enough daylighting, and sound insulation design.

2.4.2.1 Natural Ventilation Design

The LEED, BREEAM, green star, green mark, and GBI all perceive natural ventilation system as a green concept. The definition of natural ventilation design is "natural forces such as winds and thermal buoyancy force resulting from variations in the densities of internal and outdoor air that move outside air through intent, building envelope apertures" (Chartier and Pessoa-Silva, 2009). According to GBI (2014), air flow and stack ventilation are the two forms of natural ventilation design that are offered in more than 75% of all livable rooms. Natural ventilation technology has evolved into a viable alternative to mechanical ventilation systems in order to minimize energy consumption and improve the indoor environmental quality environment for occupants as a result of growing environmental consciousness (Walker, 2016).

2.4.2.2 Sufficient Daylighting

Among the green design principles cited by LEED, BREEAM, green star, green mark, and GBI is enough daylighting. Daylighting is crucial to the design of green buildings. It is the controlled entry of natural light, direct sunlight, and diffused light into a building that helps reduce the need for electric lighting and conserve energy (Ander, 2016). A building's daylighting systems may be designed using windows, façade shading elements, ceiling panels, and atrium areas.

2.4.2.3 Sound Insulation Design

To increase user experience, sound insulation design was highlighted in LEED, BREEAM, green star, green mark, and GBI. Due to the prevalence of sound from building and renovation, increased traffic, and entertainment equipment in homes, taking into account minimal noise has become increasingly crucial (Prato and Schiavi, 2015). In terms of maintaining excellent acoustic insulation, that is defined as a sound transmission classifier of more than 45, GBI (2014) states that the goal of sound insulation is to promote and recognize building designs with acceptable noise attenuation capabilities.

2.4.3 Water Efficiency

Global water demand has risen by 1% year, according to UNWWAP (2018), as a result of population growth, economic expansion, and changes in consumption habits. On the other hand, owing to fast worldwide development, the amount of water resources available on Earth has decreased (Zhao et al., 2013). In order to promote the idea of water recycling and wise water usage, WE has therefore become one of the requirements. Water-efficient fixtures and a rainwater collection system these were two green components that were incorporated in the current study's Malaysia property appraisal according to WE criteria.

2.4.3.1 Water- Efficient Fittings

LEED, BREEAM, green star, green mark, and GBI all recognize water-efficient fixtures as environmentally friendly features. In general, water-efficient fittings will induce a decrease in the use of potable water via the use of effective tools. In Taiwan, a certified green building may use less water than a baseline conventional construction by around 37.6%, according to Cheng et al. (2016). Building structure may use a number of water-saving fixtures, including hot water-cooling ducts and shower head systems.

2.4.3.2 Rainwater Harvesting System

LEED, BREEAM, green star, green mark, and GBI for residential projects all referenced rainwater collecting systems. Malaysia, according to the Department of Statistics (2017), is a tropical nation with high average rainfall varying from 1,397.8 mm to 5,423.0 mm. Such an instance supports the use of rainwater harvesting systems as an appropriate environmentally friendly component for residential buildings in Malaysia. Utilizing a rainwater collection system will result in less potable water being used (GBI, 2014). To maximize rainwater collecting from the rooftop, this system needs extra pressure-boosting equipment and separate water storage tanks. Utilizing rainwater collecting systems is crucial for sustainable development since it may promote water reusing and reduce the need for public water supplies (Li et al., 2010). Sunway Group, which has this technology implemented in building industry including Sunway Serene, Sunway Mont Residences, and other developments, is one of the instances in Malaysia (Ch'ng, 2017).

2.4.4 Innovations and others

Building innovation is a novel idea and technology that aims to improve a structure's efficiency in terms of lowering expenses, increasing green practices, and decreasing consumption (Toole, 1998). As a result, IO could promote the creation of novel ideas for green buildings. According to this research, innovative architectural passive cooling designs and other green elements are crucial for Malaysian residential structures.

2.4.4.1 Building Passive Cooling Design

LEED, BREEAM, and green mark all recognize passive building cooling as a green design. Passive cooling components are the first step for a structure to minimize building energy consumption and relieve the problem of the global temperature rise, according to Prieto et al. (2018). Evaporative coolers, natural ventilation designs with nighttime purge ventilation, inner solar heat management, and other aspects of buildings may all be taken into account when designing a structure to accomplish passive cooling (Panchabikesan et al., 2017; Prieto et al., 2018). By lowering the cooling energy demand, these architectural elements provide building inhabitants a comfortable thermal environment (Saffari et al., 2017).

Table 2.1: Summary of green components recognized by international rating tools

Recognized Green Components	International Green Rating Tools				
	LEED	BREEAM	Green Star	Green Mark	GBI
1. Energy Efficiency (EE)					
1.1 Solar photovoltaic	✓	✓	✓	✓	✓
1.2 Solar shading	✓	✓	✓	✓	✓
1.3 Wall insulation	✓	✓	✓	✓	✓
1.4 High performance glazing	✓	✓	✓	✓	✓
1.5 Green roof	✓	✓	✓	✓	✓
2. Indoor Environment Quality (IEQ)					
2.1 Natural ventilation	✓	✓	✓	✓	✓
2.2 Sufficient daylighting	✓	✓	✓	✓	✓
2.3 Sound insulation	✓	✓	✓	✓	✓
3. Water Efficiency					
3.1 Water efficient fitting	✓	✓		✓	✓
3.2 Rainwater harvesting	✓	✓	✓	✓	✓
4. Innovation & Others					
4.1 Building passive cooling Design	✓	✓		✓	

2.5 Green Components in Green Building Malaysia

In Malaysia's green building landscape, a range of sustainable components contribute to environmental responsibility and resource efficiency. From the structural realm, recycled concrete minimizes virgin material demand (GBI Manual, Lim & Raj, 2015), while FSC-certified timber ensures responsible forestry practices (GBI Manual, Ahmad & Abdullah, 2018).

Moving to the building envelope, high-performance glazing optimizes energy efficiency and thermal comfort (GBI Manual, Ahmad & Abdullah, 2018), while green roofs act as natural insulators, improve air quality, and manage rainwater runoff (GBI Manual, World Green Building Trends 2020). Durable exterior cladding with high recycled content minimizes maintenance and withstands weather (GBI Manual, Lim & Raj, 2015).

Interior materials also embody sustainability principles. Locally sourced and recycled materials (GBI Manual, World Green Building Trends 2020) alongside low-emitting paints and adhesives (GBI Manual, International Living Future Institute Standards) prioritize both environmental impact and indoor air quality. Similarly, recycled carpets and flooring offer sustainable alternatives with a reduced footprint (GBI Manual, Ahmad & Abdullah, 2018), while FSC or GreenGuard certified furniture and finishes ensure responsible sourcing and minimal chemical off-gasing (GBI Manual, International Living Future Institute Standards).

Beyond materials, water-efficient fixtures and appliances (GBI Manual, World Green Building Trends 2020) and rainwater harvesting systems (GBI Manual, Ahmad & Abdullah, 2018) prioritize water conservation. Meanwhile, renewable energy sources like solar panels, wind turbines, and geothermal systems empower buildings to generate clean energy (GBI Manual, World Green Building Trends 2020). Finally, high-efficiency

HVAC systems minimize energy consumption for heating, ventilation, and air conditioning (GBI Manual, International Living Future Institute Standards).

This comprehensive approach to component selection makes Malaysian green buildings true exemplars of sustainability, minimizing environmental impact, maximizing resource efficiency, and paving the way for a healthier built environment.

Table 2.2: Summary of green components in Green Building Malaysia

Green Building Component	Description	Resource
Recycled concrete	Reduces virgin material use and environmental impact.	GBI Technical Manual, Lim & Raj (2015)
Sustainable timber (FSC certified)	Promotes responsible forestry practices.	GBI Technical Manual, Ahmad & Abdullah (2018)
High-performance glazing	Optimizes energy efficiency and thermal comfort.	GBI Technical Manual, Ahmad & Abdullah (2018)
Green roofs	Insulate, improve air quality, manage rainwater runoff.	GBI Technical Manual, World Green Building Trends 2020
Locally sourced and recycled materials	Minimizes transportation emissions and supports local producers.	GBI Technical Manual, World Green Building Trends 2020
Water-efficient fixtures and appliances	Reduce water consumption without compromising functionality.	GBI Technical Manual, World Green Building Trends 2020
Rainwater harvesting systems	Capture and reuse rainwater for irrigation or greywater applications.	GBI Technical Manual, Ahmad & Abdullah (2018)
Renewable energy sources (solar panels, wind turbines, geothermal)	Provide clean energy generation.	GBI Technical Manual, World Green Building Trends 2020
High-efficiency HVAC systems	Minimize energy consumption for heating,	GBI Technical Manual, International

	ventilation, and air conditioning.	Living Future Institute Standards

2.6 Definition of Salvage Value

Salvage value, also known as residual value, is one of several elements of a lease procedure, which expresses the decent worth of property in terms of the amount by which its initial value has depreciated. According to Lucko and Vorster (2003), the literature uses a variety of terms to describe the idea of salvage value, such as trade in value, market value, residual value and resale value. The salvage value in accounting refers to the expected sum that a business can get when selling an asset at the end of its usage has passed (Pirottea and Vaessen, 2008). The projected costs of transferring the asset should be taken out of this when doing so. Therefore, the price that might be achieved by selling a used item in a fair transaction between an informed purchaser and seller in the market in a certain economic situation may be regarded as the equipment's salvage value (Lucko et al. 2007; Fan et al., 2008).

2.6.1 Salvage Value for Asset and Building Component

An asset's salvage value can change over time and may not always be known in advance. Standardized assets with an active secondary market and little technological change may have a salvage timeline that is quite steady and predictable. Rapid technological progress can result in uncertain salvage prices for some assets (Myers and Majd, 1983). An asset's residual value may rise to an amount equal to or more than its fair value (S Board, 2019).

2.6.1.1 How to Calculate an Asset's Salvage Value

The salvage value of an asset can be determined by taking its initial purchase price and deducting any accrued depreciation throughout its useful life. Calculating the purchase price of the asset, including any original taxes, shipping costs, or installation costs, is the first step in determining the salvage value (IRS,2021). Estimating the asset's estimated remaining useful life is the second step. To calculate this, one can conduct research on similar market assets. The next stage is to calculate how much depreciation has been incurred during the asset's useful life, or the number of years it has been in use. The asset's current salvage value can then be calculated by deducting the asset's basic cost from the total depreciation (Hannah, 2022). The summary of calculation is indicated in the following equation:

Salvage Value = Basis Cost – Accumulated Depreciation

$$S = P - (I \times Y)$$

Wherein:

S = Salvage Value

P = Original Price

I = Depreciation

Y = Number of Years

2.6.1.2 Variables Factors to Consider for Salvage Value

When considering the salvage value of an asset, there are a few key variables to take into account. According to Hannah (2022), the component's condition including its age, usage frequency, maintenance needs, and environmental factors. The amount required for building component repair and maintenance will have an impact on the salvage value (S Board, 2019). The market rate for similar types of assets right now and the cost of replacing the asset, assuming one is available, are the other factors. Use or maintenance choices will also have an impact on the salvage value (Clifford and Wakeman, 1985).

The salvage value may also be impacted by environmental factors including hazardous materials and disposal limits.

2.6.2 Salvage Value of Green Buildings

Salvage value of a construction project has been linked to depreciation in other studies (Heald, 2003). The value of green building projects, however, would be difficult to quantify when they were transferred to the public or private sector. As stated by Oxford Dictionary, an asset is a piece of value, particularly property, that an individual or company owns and can use or sell to pay off debts. A general definition of an asset includes equipment, property, funds, goods, holdings, resources components, money, possessions, property, savings, securities, and wealth. In this case, the salvage value of a green building should be focus on the salvage value of green project components.

After the green buildings have been transferred back to the public sector or other service providers, the green components must ensure that they can be operated with standard functionality, favourable capital privileges, and a comprehensive organizational structure to continue providing quality service. This means that the given conditions include not only financial conditions like equipment market price or historical leasing data for a building but also nonfinancial conditions like the ability to maintain the green building's environmental sustainability.

2.6.3 Definition of Condition of Building Components

As stated by American Society for Testing and Materials (2016), the physical state and usefulness of building components are referred to as their condition, and this is determined by a number of criteria including age, degradation, damage, performance, and maintenance. It's an essential sign of the general value, safety, and health of a building. The following factors are crucial for evaluating the condition of building components:

I. Visual inspection: Assessing parts for obvious damage, rust, corrosion, or water stains, among other indications of degradation.

II. Functional testing: Process of assessing how well components work.

III. Non-Destructive Testing: Finding hidden problems without causing damage to components by using specialised methods like ground-penetrating radar or infrared thermography.

IV. Component Age: Taking into account the anticipated lifetime of various components as well as their propensity to deteriorate with time.

V. Maintenance History: Analysing records of replacements, repairs, and preventative maintenance to determine how well-maintained certain parts have been maintained.

VI. Environmental Factors: Evaluating how the weather, moisture, and pollution affect the state of the component.

2.7 Research Conceptual Framework

A conceptual framework explains how a researcher perceives the elements and/or variables that are part of the study and how they relate to one another (Anfara and Mertz, 2014).

The purpose of the conceptual framework below is to clarify the presumed relationships among International Green Rating Tools, evaluation of green components, factors contribute to condition of salvage value and the fluctuation in salvage value of green components.

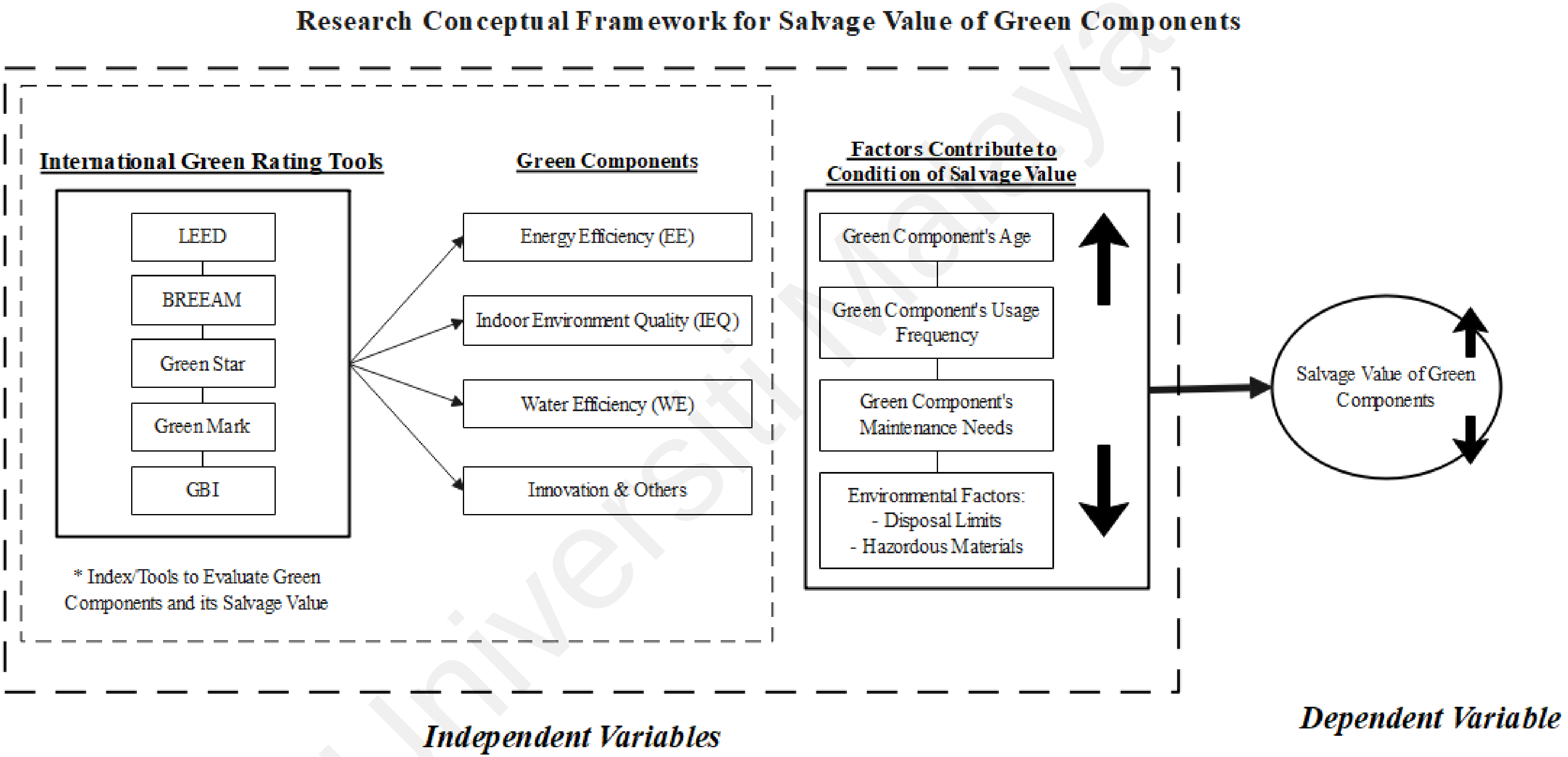


Figure 2.1: Research Conceptual Framework for Salvage Value of Green Components.

2.8 Summary

To recap, the literature study discussed ideas and provided definitions of green buildings, listed down the stated worldwide green ranking tools and accessible green components. Eventually, the salvage value formula and calculating procedure were described.

CHAPTER 3: METHODOLOGY

3.1 Introduction

Research methodology commonly link to the practical or how of any piece of study is being done. More exactly, it demonstrates how a researcher may methodically arrange a study to ensure logical and trustworthy results that meet the study's goals and objectives (Derek, 2020).

During the methodology part, several decisions must be made, including the segments of data to be gathered, the population from whom to collect data, the methods to collect data, and the techniques to analyze the data acquired. These concerns may be categorized as research designs, sample design, data collection methodology, and data analysis method, respectively. A strong chapter on research methodology should incorporate all of the aforementioned elements. Essentially, this chapter not only describes the methodological choices but also explains why they were made.

The first objective is to identify the green components which suitable for Malaysia's green buildings. Green components were chosen because, as demonstrated by several studies, they are effective in controlling indoor comfort in buildings, consume less energy, and have other positive environmental effects. According to the literature, there are several green construction components. However, the primary aim of this study is to investigate the salvage value of green buildings in Malaysia. Therefore, this study determines green components' condition based on their integration with building structure that have influence on property value, and then the salvage value.

This study will adopt quantitative approach mainly to assess how salvage value of green components and building is impacted by its condition of green components after their useful lives have ended. Literature study of national and international green rating tools provides the basics for determining significant green features in green properties. A questionnaire survey will be conducted among the valuers in Malaysia to solicit opinions about their consideration of condition of green components in property salvage values.

3.2 Research Process

Each phase in the research process is related to the one before it in the sequential order. To make sure that changes are duplicated in the progress, the researcher must revisit and examine all of the remaining phases if any modifications are made in one phase of the process. In short, here are the 5 major research process steps researcher used to carry out research work including identify research problem, design research project, collect data, analyse data and lastly report the research findings (Abdul, 2019).

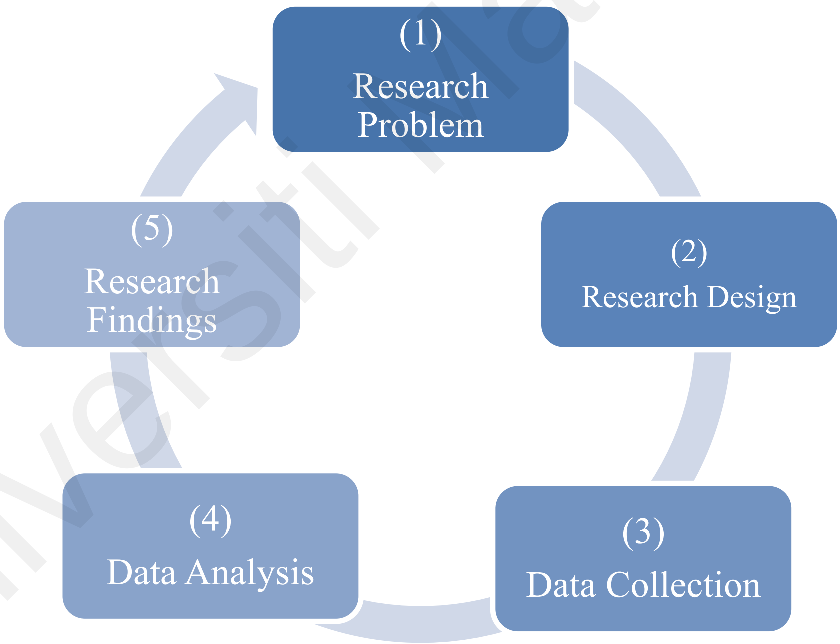


Figure 3.1: Research steps.

Finding the research problem is the first step in this cycle. It is a remark regarding the field of interest and concerns, queries on methods for improvement of the situation, removal of challenges, the scholarly doubt that founds in scholarly literature, theories or practice, which leads to consequential understanding and thoughtful needs. A research problem is a topic that provides an answer to a specific issue. As an example, which related to this study, how the conditions of green components in physical appearance, function etc. will affect the salvage value of the components. Both qualitative and quantitative research include the selection of a research issue or query. The issue with this study is that researcher had to study it in depth in order to understand more about it.

The research project layout is step two, and it focuses on developing a research plan or comprehensive approach to handle the given topic or problem. A research technique or strategy serves as a guide or framework for conducting marketing research projects. It outlined the processes required to get the appropriate data, and its goal was to construct a study that analyzed the relevant hypothesis, assessed possible responses to the research questions, and provided the data needed to make decisions. The research project layout including the following steps:

I. Carried out secondary analysis from existing literature, different studies or papers.
II. Made decision on quantitative and qualitative research.
III. Defined the needed information such as research area info.
IV. Identified measuring and scaling research processes.
V. Designed questionnaire form.
VI. Determined sample process and sample size.
VII. Planned for data analysis.

According to Pride and Ferel (2010), step 3 data collection was all about gathering data that a researcher will need to issues found. Data collection implies field force or personnel that works either in a field (in-home, shopping centre intercept, or computer-helped individual interviewing), over the phone such as telephone interviewing, or via email (conventional mail and mail panel surveys with selected families). In this research study, only quantitative method was implied to collect data. The questionnaire survey involved both close and open-ended questions to examine the target respondents' aspects related to green components and its salvage value. The survey questionnaire was divided into three sections to achieve the research's goal: Section A to learn about respondents' backgrounds; Section B to evaluate the green components known by market and its condition after usage, and Section C to analyse the salvage value of green components. Pilot test will be carried out to support the questionnaire survey.

After gathering enough data and information, the 4th step will be data analysis. During operational planning, the researcher determines how the data will be reviewed. In questionnaire sections B and C, this research utilizes some revealing statistical analysis approaches such as frequency determination, Relative Important Index analysis, and reliability tests. The researcher can assess the level of satisfaction of respondents using these analysis methods. To present the data, pie charts and tables will be useful tools. Not to forget, the Statistical Package for Social Science (SPSS) software will be used to analyze quantitative data and generate findings.

The step five is to summarize the research. All findings will be provided at the end in an easily accessible manner so that they are ready for the decision-making phase. The researcher will make a list of relevant limitations and recommendations for future study.

3.3 Research Design

The research design will concentrate on developing a research plan to achieve the targeted objectives. The researcher's research style influences the approaches and strategies he or she employs. The researcher focuses on analyzing procedures that are appropriate for the subject matter and planning productive experiments (QuestionPro, 2019).

3.3.1 Descriptive Research

In a descriptive design, the researcher's main goal is to describe the situation or case being studied. The process of designing it is theoretically based and involves acquiring, analyzing, and presenting data. This helps the research to discuss the goals and methods of the investigation. People may have better understand the significance of the findings via descriptive research.

Although qualitative research can be used to explain the outcome, descriptive research is more commonly classified as a sort of quantitative research. The study design was meticulously prepared to achieve accurate and dependable outcomes. One of the most prevalent descriptive research methodologies is survey research. Survey research allows researchers to collect large amounts of data, which can then be evaluated for trends, frequency, and averages. Survey research is used in this study to describe the demographics of the target respondents, gather input on the type of green components and their condition, and analyze respondents' perceptions of the impacts on salvage value of the green components (McCombes, 2020).

According to Loeb et al. (2017), low inference is essential for a good descriptive analysis. Measures of relative importance index (RII) value, measures of variance, and simple frequency analyses are useful statistical tools for descriptive analysis. Because of the diverse audience groups, multiple points of view would be obtained during the simplification process. For example, research on the same subject published in a student academic publication may differ from research published in a policymaker journal. As a result, the complementary end results contain only a piece of the researcher's evaluation. The 'raw materials' of the findings remain unaltered, but the "final" presentation is altered as a result of the data being updated to fit the subject. The translation from raw to published findings is done precisely to meet the audience's needs. In general, a quantitative description method aimed at providing answers to questions about real-life situations.

3.3.2 Quantitative Research

In this research study, the quantitative method will be implied to find out the green components for green buildings in Malaysia, what is the condition of green components after its useful lifespan and what is the salvage value of the green components. These three aspects will be examined, discussed, compared and constructed and generated. Normally the qualitative approach is used to enhance the quantitative method's results.

To explain and interpret the results, a quantitative analysis design is used to investigate the interactions between variables using figures and statistics. Large sample sizes are required for quantitative research, which is more concerned with the number of responses than with gaining more focused or psychological insight into an issue. By asking the same questions to each respondent, quantitative research design ensures that the entire data collection can be analyzed similarly. The questionnaires will be provided in numerical form and can be evaluated quantitatively using statistical methods (Leinhardt and Leinhardt, 1980).

There are numerous advantages to utilise quantitative research design techniques. According to Rahman (2016), stated that statistical software can reduce the amount of time spent on data analysis. For example, the Statistical Package for the Social Sciences (SPSS) software is used to generate results from questionnaire responses. Furthermore, this research design allows the researcher to control and select the study groups (Daniel, 2016). For instance, the researcher could select the respondent and only send the survey questionnaire to collect data.

3.4 Research Area

This study will concentrate on Peninsular Malaysia, also known as West Malaysia, a region of Malaysia's 13-state federation. Peninsular Malaysia is comprised of the Malaysian states of Johor, Kedah, Kelantan, Malacca, Negeri Sembilan, Pahang, Penang, Perak, Perlis, Selangor, and Terengganu, and also the federal territories of Kuala Lumpur and Putrajaya.

Figure 3.2 provides a clear breakdown of registered projects under GBI distribution by state using data from the Green Building Index (GBI) database. There were 1,115 projects in total. As can be seen, the majority of the projects are located in Selangor and Kuala Lumpur, and they are mostly rated. As a result, the Klang Valley area will receive more attention in order to statistically reflect the real situation in Malaysia's Green Building industry.

GBI PROJECTS REGISTER- BY STATE/ TERRITORIES

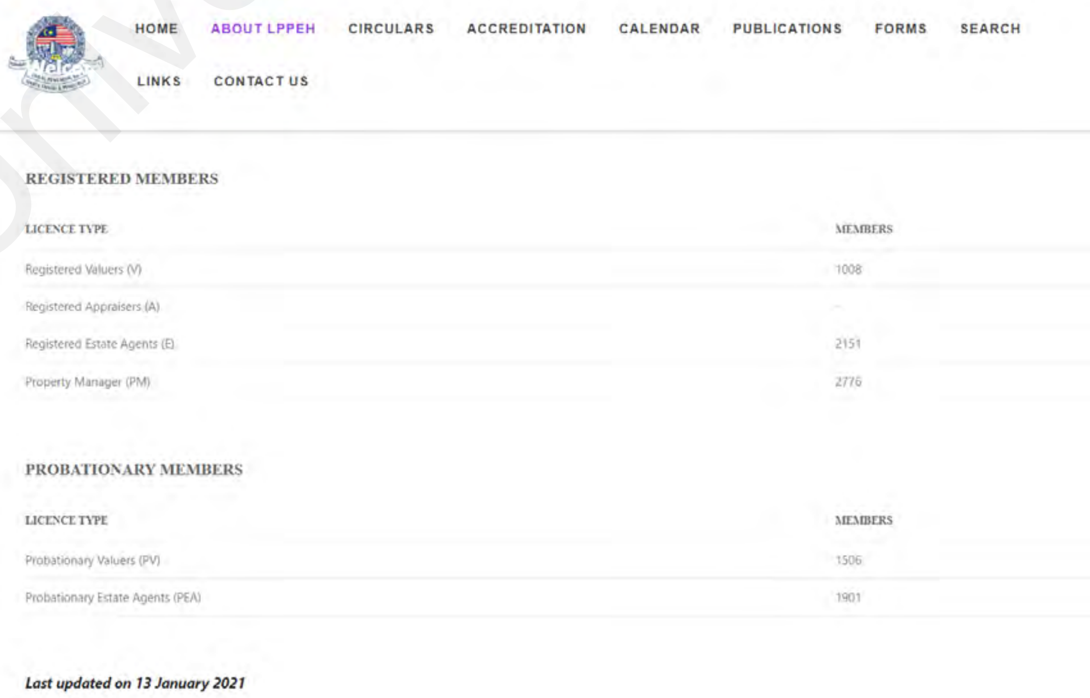
STATE/ TERRITORY	NOS. REGISTERED	NOS. RATED
Kuala Lumpur	311	222
Selangor	376	203
Penang	156	69
Putrajaya	41	31
Johor	113	56
Melaka	19	8
Sarawak	28	17
Sabah	14	4
Perak	14	8
Pahang	11	4
Negeri Sembilan	19	10
Kelantan	2	1
Kedah	9	4
Perlis	-	-
Terengganu	2	1
Labuan	-	-

Figure 3.2: GBI Projects Register – By State/ Territories (Source: GBIG, 2022).

3.5 Target Population

The targeted respondents in this study are licensed valuers who are registered members of Malaysia's board of valuers, appraisers, estate agents, and property managers (BOVAEP) and also quantity surveyors who play the role as cost consultant. According to the BOVAEP's registered valuer member listing, a total of 1008 valuers were registered in Malaysia as of 2021 as shown in Figure 3.3 below. According to the list of the Board of Quantity Surveyor (BQSM), there is total 147 quantity surveying consulting companies located within Klang Valley area, by assuming each quantity surveyor from each company, a total of 147 quantity surveyors is being targeted as the respondents.

This research will be focusing on Malaysian property valuation practitioners with green building valuation experience and quantity surveyors with experience project claim and cost evaluation. This group was purposefully chosen because of their experiences, knowledge, and exposure to green building valuation. This is important to ensure the credibility of the questionnaire respondents in order to obtain valid results.



REGISTERED MEMBERS

LICENCE TYPE	MEMBERS
Registered Valuers (V)	1008
Registered Appraisers (A)	–
Registered Estate Agents (E)	2151
Property Manager (PM)	2776

PROBATIONARY MEMBERS

LICENCE TYPE	MEMBERS
Probationary Valuers (PV)	1506
Probationary Estate Agents (PEA)	1901

Last updated on 13 January 2021

Figure 3.3: Registered Members (Source: BOVAEP, 2023)

3.6 Research Target Sample

The licensed valuers registered with BOVAEP and quantity surveyors are the study's target samples in this study. The targeted sample participants in this analysis must have a broad understanding of green buildings in Malaysia. Because they have adequate and professional experience in building valuation, their participation as respondents will make this study more reliable. The following formula was used to determine survey sample size (Chee Hung, 2015):

$$n = \frac{P[1-P]}{\frac{A^2}{Z^2} + \frac{P[1-P]}{N}}$$

Where:

n = Sample size required.

N = Number of people in the population

P = Estimated variance in population, as a decimal: (0.5 for 50-50, 0.3 for 70-30)

A = Precision desired, expressed as a decimal (i.e., 0.03, 0.05, 0.1 for 3%, 5%, 10%)

Z = Based on confidence level: 1.96 for 95% confidence, 1.6449 for 90% and 2.5758 for 99%.

R = Estimated Response rate, as a decimal.

Licensed valuer in Malaysia:

n = 288 (288.277)

N = 1008 + 147 = 1155

P = 0.5

A = 0.05

Z = 1.96

By using the formula used in determination of survey sample size as shown above, manual calculation was done to calculate the total respondents from registered valuers and quantity surveyors' population. Initially, the target population was set at 1155 Malaysian valuers. After calculation, a total of 288 respondents are targeted in this study with a 95% confidence level and a 5% margin of error.

In order to ensure the quality of the research, a filtering process was used to make sure the target 288 respondents have participated in Malaysia's green projects. Prior to distributing the questionnaire, the filter process was completed by consulting the Malaysian professional associations, the Quantity Surveyors' Association of Malaysia (QSAM) and the Board of Valuers, Appraisers and Estate Agents (BOVEA), for lists of members who are specialists in green building projects, have actively worked on such projects. Then by accessing to green building project databases, provided the resources list companies and individuals working in Malaysian green building projects, and they can be accessed via accessing databases such as the Construction Industry Development Board (CIDB) Green Building Index or the GreenTech Malaysia directory. These databases allow respondents to be filtered depending on area and expertise.

The final method is participating in online networks via social media platforms like Facebook and LinkedIn groups devoted to Malaysian green building experts. Before distributing the questionnaire to the intended respondent, the research purpose was explained and their previous experience with green buildings was confirmed.

Ultimately, only 213 responses are reliable enough for this study.

3.7 Data Collection Method

Data collection is the methodical gathering and assessment of information on relevant factors that enables researchers to answer research questions, test hypotheses, and assess results. In many academic disciplines, notably the social and behavioral sciences, the humanities, business, and others, data collecting is a crucial component of research. Despite the fact that techniques differ by discipline, the need of precise and trustworthy data collecting never changes (Most et. al, 2003). Both primary and secondary data are utilized in this research. While secondary data came from desk research and a literature review, the main data came from a questionnaire survey.

3.7.1 Primary Data from Questionnaire

Primary data is information gathered from firsthand sources such as creative efforts (paintings, film reels, and music), diaries, experiments conducted by themselves, letters, surveys, official records, and interviews. A primary source is one that comes straight from the source. It is not compromised by other people's opinions or decisions (Stephanie, n.d). The primary data collection methods to be implied in this study are pilot tests and questionnaires.

Respondents are required to answer a series of open-ended or closed-ended questions in a questionnaire. A questionnaire may be sent through phone, email, fax, living in a public area or at a university, electronic mail, or another means. Property valuers, who are typically very busy, are the respondents who were sought for this study. Survey questionnaires are thought to be a practical way for them because it requires a quick response time (Syed Muhammad, 2016).

The structure of the questions decided whether a quantitative or qualitative approach will be used to arrive at a solution. Quantitative approach, such as bar charts and tables are used to test answers to closed-ended questions with multiple choice answer choices. However, qualitative approaches are used to test the responses to open-ended questions which involved discussion reply.

A pilot test is usually carried out to assess the viability of methodologies, methods, questionnaires, and interviews as well as how they interact in a particular setting. It may also reveal any conceptual and practical issues that can impede the main research (Doody & Doody, 2015). Therefore, before beginning the bigger study, researchers may use pilot studies to spot design faults, improve data collecting and analysis strategies, familiarize themselves with the research team, evaluate recruiting procedures, and gather crucial data on participant burden (Beebe, 2007). If respondents have trouble completing sampling techniques, researchers may tweak item wording, reverse the sequence in which items are given, or change the instrument type (Conn et al., 2010).

The simplest approaches for calculating the sample size for the pilot trial are sample size rules of thumb. Julious (2005) cites using a minimum sample size of 12 participants per treatment arm, but Browne (1995) suggests using a general flat guideline of ‘use at least 30 respondents or larger to estimate a parameter.' All of these guidelines, however, have limitations because they apply regardless of the size of the primary trial. When the main trial is large or small, the ease of this flat technique comes at the cost of a greater overall sample size.

In this research study, the pilot test will take place over the first two weeks. Professional data on the populations of respondents will be reviewed. An invitation email will first provide background information on the study, introduce potential participants to the survey, welcome them to participate, and clarify that completing the survey would constitute informed consent. A reminder email will then issue three days following the initial invitation to individuals who had not yet responded. Finally, after the respondents submitted the survey forms, they would receive an email expressing gratitude for their participation.

3.7.2 Secondary Data from Literature Review and Desktop Study

Information acquired from the source that has previously been made available in a certain format is known as secondary data. Secondary data are the main subject of any study of the literature in research. Secondary data is required since it is challenging to conduct a fresh survey that can effectively capture historical change and/or trends. To accomplish the research objectives, abundant of internet article, database, research journals, books etc related to green buildings and salvage value had been reviewed to collect as many of background information. Secondary data has a predetermined degree of validity and reliability due to the thorough background analysis (Syed Muhammad, 2016).

3.8 Data Analysis Method

Basic techniques for analyzing results in descriptive research include correlating variables, contrasting core tendencies, and calculating percentages by frequency. The type of data to be evaluated determines the tool to be used. This study examines results using nominal, ordinal, and interval data (Loeb et. al., 2017).

3.8.1 Quantitative Data

The quantitative data will be created and examined using Excel and the Statistical Package for Social Science (SPSS). SPSS will be adopted to analyze the survey data that has been collected. The evaluation, supported by SPSS software, confirmed the accuracy and dependability of the data. The program compares and analyzes the outcomes of various study questionnaire variables. Excel is frequently employed to create the images and quantify some analytical findings (Open Learn, n.d.).

3.8.1.1 Likert Scale

Likert components is applied to measure the perceptions and attitudes of respondents towards a specific topic or statement. The data was generally coded as shown in Table 3.5 to analyse it. Likert-type data serve as ordinal data, which means that researcher can only tell if one score is higher than the next, but the distance between two points are not measurable (Gail, 2013). A Likert Scale is also an individualized scale in which respondents indicate their level of agreement with one of the response categories.

Table 3.1: Scale to represent degree of agreement in Likert Scale (Gail, 2013).

Value	Degree
1	Strongly disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly agree

As stated by Bujols (2012), the statistical terms of central tendency analysis are mean (average), medium (middle) and mode (most common). Mean will be seldom use in Likert Scale as one cannot calculate mean for both strongly agree and strongly disagree. When the results are above or below the middle point, median will be used. This is because when adding in new numbers into data, median will be affected the least. Mode will be applied to determine the most frequently number. The median and most measures are the most suitable for central tendency. Median and mode can be used even there is an outliner in the data.

3.8.1.2 Frequency

Jiafeng (2013) claims that the frequency analysis is a straightforward data analysis technique that enables everyone to see the overall picture. By examining the frequency distribution, one can learn how frequently different values are encountered as well as what proportions they represent for the same variable. For the variable "age," one can, for instance, use frequency distribution to determine how many respondents are between the ages of 15 and 30 and how many are between the ages of 31 and 36. The pie chart and table are helpful visual aids for understanding the findings.

3.8.1.3 Cronbach's Alpha

Surveys with multiple Likert scale questions are evaluated for reliability using Cronbach's alpha tests. Latent variables, or unobservable or unseen characteristics, such as the respondent's conscientiousness, sociopathy, or transparency, are assessed by these questions. These are extremely challenging to quantify in real life. Cronbach's alpha dials the degree of correlation between a set of survey questions (Stephanie, n.d.).

A high alpha value may indicate that the test items are strongly correlated, however it is affected by the number of items in a survey. A bigger number of items can lead to bigger alpha, whereas a lesser number of items can lead to smaller alpha.

For dichotomous questions (questions have two correct options) or Likert scale questions, a general guideline is:

Table 3.2: Degree of Internal Consistency by Cronbach's Alpha (Stephanie, n.d.)

Cronbach's alpha (α)	Internal Consistency

≤ 0.5	Poor
≤ 0.7	Acceptable
≤ 0.8	Good
> 0.8	Very Good
> 0.9	Excellent

3.8.1.4 Relative Importance Index (RII) Analysis

The Relative Importance Index is used to determine the relative importance of quality activities and criteria (RII). In this study, the relative importance of green component condition and its effects on salvage value will be estimated using the RII approach. According to Gündüz et al. (2013), the RII value is a number that ranges from 0 to 1. The RII value increases in direct proportion to the magnitude or frequency of the variables. The equation below shows how to calculate RIIs for each factor. The respondent's weighting of each component is equal to the value of W on the Likert scale. N represents the total number of respondents, and A denotes the. Table 3.3 below displays the level of agreement in the question and answer.

$$RII = W / (A*N)$$

Table 3.3: Scale of Weightage in Likert Scale (Stephanie, n.d.)

Level of Response	Weightage
Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

3.8.2 Qualitative Data

Qualitative analysis is concentrates on descriptions, ideas, observations, words and sometimes images. Since it is practically impossible to derive full meaning from such data, it is mainly used for exploratory study. In this case, content analysis and narrative analysis methods were implied.

One of the most often used methods for analyzing qualitative data is content analysis. This method usually used to interpret documented information which come in the form of words, media and physical sources and sources of communication. This approach is widely use to evaluate responses collected from interview (Kerryn, 2020).

On the other hand, narrative analysis method is suitable to examine content from survey, interview with respondents or own observations. It reflects on using people's personal stories and experiences to solve research questions. The presumption is that stories have a realistic purpose. They literally help researcher to learn how they deal with problem and provide solutions (Kerryn, 2020).

3.9 Summary

The research approach illustrates the research's overall steps. The whole research methodologies are described for this study phase, from issue creation through problem validation, taking into account all aspects. The types of data and data processing processes, as well as data interpretation, are investigated. The research methodologies used may have an impact on the validity and dependability of a finding. As a result, a proper method is needed to conduct high-quality research. Table 3.4 summarizes the research techniques to be used for different research objectives.

Table 3.4: Research technique for different research objectives

Research Objectives (RO)	Research Technique
RO1: To identify the green components.	Literature Review and Questionnaire Survey
RO2: To evaluate the condition of green components.	Literature Review and Questionnaire Survey
RO3: To demonstrate the floating of salvage value of green components.	Questionnaire Survey

CHAPTER 4: RESULT ANALYSIS

4.1 Introduction

The data from the survey questionnaires, as well as the data interpretation, are presented in Chapter 4. Through a Google e-form, questionnaires are distributed to the target respondents in Klang Valley. Statistical Package for Social Science (SPSS) is used to analyse the results of the questionnaire survey. The primary data was collected via a survey questionnaire. The literature review, on the other hand, was treated as supporting secondary data. The purpose of the questionnaire is to identify the green component which suit Malaysia's tropical environment, as well as to evaluate the condition of green components and to estimate the floating of salvage value of green components.

The respondents' personal information is analysed using descriptive analysis in section A. While for section B and C, reliability test is used to test the data cohesiveness. Descriptive analysis in utilized to identify the green component of green building in Malaysia and condition of green components after certain years of usage in section B; while in section C it is used to demonstrate the floating of salvage value of green components. Relative Importance Index (RII) analysis is used in section B to find out the most frequent used green components listed for Malaysia's tropical weather; while in section C it is used to determine the most important impact to the salvage value of green building components.

4.2 Pilot Test

Pilot test was conducted to determine the feasibility of the questionnaire survey, with encouraging results. It's critical to evaluate a survey's reliability and consistency. 30 sets of responses were collected to use in this test. Cronbach's alpha was used to test the reliability of the internal consistency.

For section B, the Cronbach's Alpha reliability for the sum of the 30 questions in the pilot test was +.754. There is widespread agreement that an acceptable value of respondents denotes appropriate survey questions internal consistency.

Table 4.1: Reliability Results of Section B.

Reliability Statistic	
Cronbach's Alpha	Number of Items
0.754	30

For section C, the Cronbach's Alpha reliability for the sum of the 6 questions in the pilot test was +.765. There is widespread agreement that an acceptable value of respondents denotes appropriate survey questions internal consistency.

Table 4.2: Reliability Results of Section C.

Reliability Statistic	
Cronbach's Alpha	Number of Items
0.765	6

As stated by Cortina (1993), 0.7 of reliability is sufficient for pilot test and since both section B and C achieved more 0.7 of Cronbach's apha results, this indicates that the questionnaire survey is valid to be used for the following action.

4.3 Survey Response Rate

In this research, the questionnaire was delivered over email using Google Forms. As a result, an e-survey was used to conduct quantitative research. A total of 213 sets of questionnaires were sent out to property valuers, estate agents and quantity surveyors. However, the actual response rate of the questionnaire is only 166 respondents, 56 responses received from property agent, 30 responses from estate agents, 63 responses from quantity surveyors and 17 responses from others. The process of data collection took around four weeks to complete, from 20th November to 20th December 2023.

Table 4.1 shows that the response rate was around 78 percent, indicating that only 166 out of the targeted 213 respondents had completed the questionnaire survey.

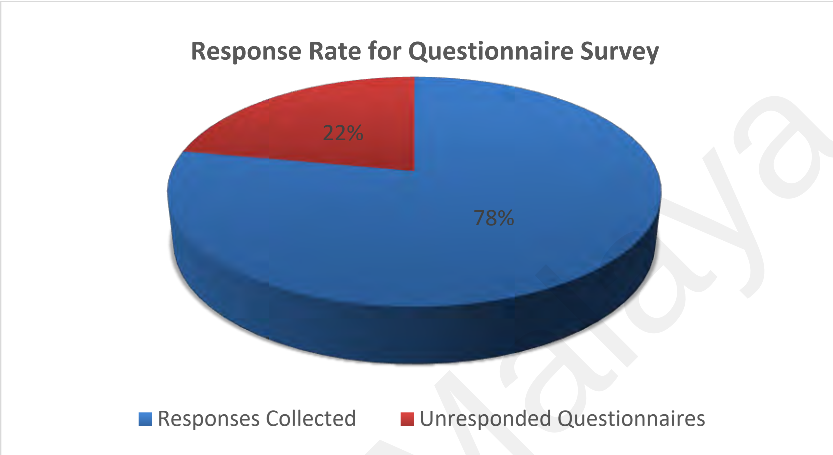


Figure 4.1: Response Rate for Questionnaire Survey

4.4 Section A: Demographic of Respondents

Section A is made up of four (4) questions on the respondent's personal information. The data % collected from respondents is shown in either pie chart or table, and the data analysis is presented after each chart.

4.4.1 Respondents' Designation/ Job Title

The first question necessitates the respondents to provide their occupation designation. Figure 4.2 illustrates the proportion and frequency of respondents based on their job title.

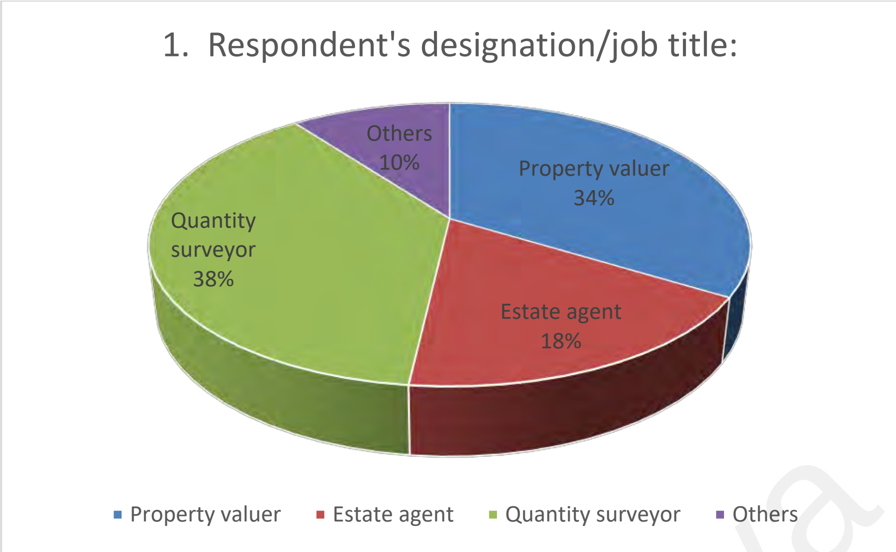


Figure 4.2: Respondents' Designation/ Job Title

Based on the responses from 166 participants, the distribution of respondent's designation/job title is represented in the pie chart in Figure 4.2. The majority of participants, constituting 34% of the total responses, identified themselves as property valuers. Following closely, estate agents accounted for 18% of the responses, while quantity surveyors made up the largest proportion at 38%. A smaller but notable segment, comprising 10% of the respondents, fell under the category of 'others' in terms of career. The pie chart provides a visual representation of the diverse professional backgrounds of the participants, shedding light on the composition of the sample in terms of job titles within the real estate and valuation domain.

4.4.2 Respondents' Years of Experience in Construction Industry

Figure 4.3 illustrates the respondents' years of experience in construction industry. Respondents with varying years of experiences will have different opinion on the usage of green components in Malaysia's green buildings and their conditions after several years.

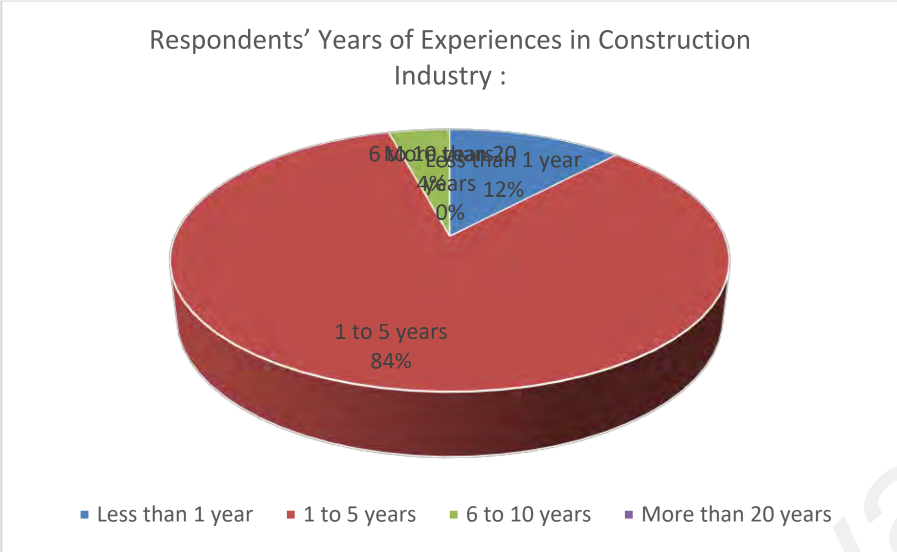


Figure 4.3: Respondents' Years of Experiences in Construction Industry

Continuing with the analysis of respondents' years of experience in the construction industry, the data reveals a diverse distribution. Among the participants, a noteworthy 12% reported having less than 1 year of experience, indicating a presence of individuals who are relatively new to the industry. The majority of respondents, constituting 84%, fall within the 1 to 5 years of experience category, with 139 individuals having accumulated experience in this range. This suggests a substantial proportion of participants are at a mid-point in their careers within the construction sector.

Furthermore, 4.2% of respondents reported having 6 to 10 years of experience, showcasing a segment with a more established professional background. Remarkably, there were no respondents indicating having more than 20 years of experience, highlighting the absence of highly seasoned professionals in the sample. The collective responses provide a comprehensive picture of the distribution of experience levels among the participants, offering valuable insights into the composition of expertise within the construction industry as per the survey data.

4.4.3 Respondents' Years of Experience in Green Building Construction

The percentage and frequency of respondents by working experience in the construction of green buildings are displayed in Figure 4.4.

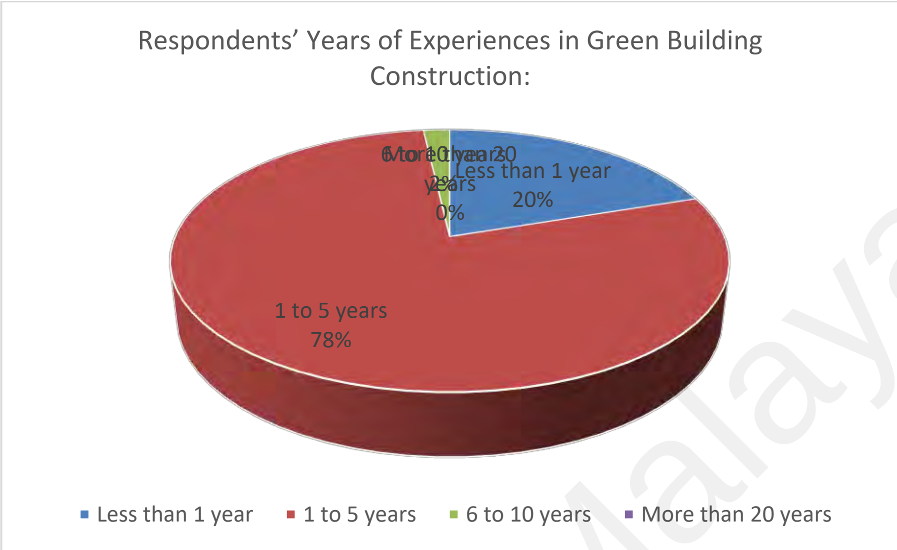


Figure 4.4: Respondents' Years of Experiences in Green Building Construction

Then, with the examination of respondents' years of experience, specifically within the realm of green building construction, the data provides interesting insights. Among the participants, a significant 20% reported having less than 1 year of experience in green building construction, indicating a notable presence of individuals who are relatively new to this specific domain. The majority of respondents, constituting 78%, fall within the 1 to 5 years of experience category, with 130 individuals having accumulated experience in implementing green building practices. This suggests that a substantial proportion of the participants have acquired expertise in green construction practices within the initial years of their careers.

Furthermore, a small yet noteworthy 2% of respondents reported having 6 to 10 years of experience in green building construction, showcasing a segment with a more established background in sustainable construction practices. Notably, similar to the previous categories, there were no respondents indicating having more than 20 years of experience in green building construction. This distribution underscores the prevalence of relatively early to mid-career professionals in the field of green building construction within the surveyed sample, shedding light on the collective expertise and focus on sustainability within the construction industry.

4.4.4 Respondents' Highest Academic Qualification

Figure 4.5 and table 4.3 assessing respondents' greatest academic qualifications which reveals their educational backgrounds. Remarkably, 6% of participants had secondary education or less. Most respondents (77%) have diplomas or degrees. This shows that a large percentage of participants have attended higher school to get building sector expertise.

Additionally, 16.9% of respondents had master's, doctoral, or post-doctoral degrees. The sample includes a large number of highly educated professionals, demonstrating the predominance of higher academic qualifications. The distribution of academic qualifications shows the educational diversity of the respondent pool, emphasising the relevance of continuing education and higher education in construction and associated industries.

Table 4.3: Respondents' Highest Academic Qualification.

Academic Qualification	Frequency	Percentage (%)
Secondary education and below	10	6
Tertiary education (diploma and degree)	128	77
Post-graduate (Masters, doctoral and post-doctoral degree)	28	17
Total	**166**	**100.00**

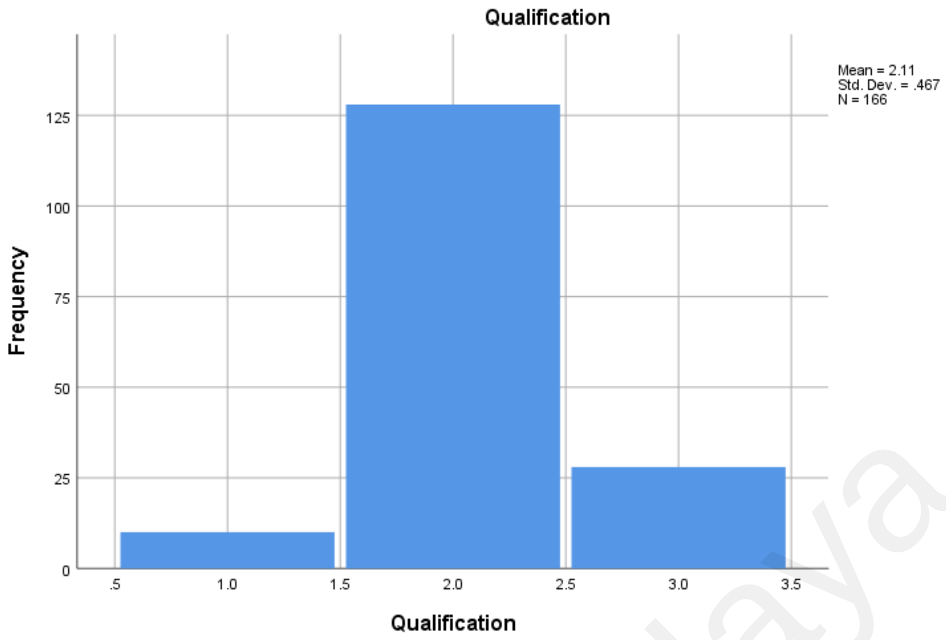


Figure 4.5: Respondents' Highest Academic Qualification

4.5 Section B: Objective 1 & 2

Section B is made up of four questions that are all related to the first and second objective. The first objective is to identify the green components while the second objective is to evaluate the condition of green components. The purpose of this section is to determine the green components ideal for Malaysia's tropical environment. The respondents are required to rate the usage frequency and importance of each green components, factors contribute to decline of condition of green components and the condition of green components after certain years of usage based on their perception and agreement.

All level of frequency of usage, level of importance and level of agreement to the statement are asked in Likert scale questions and analyzed by using SPSS software to generate the result. Cronbach's Alpha Reliability test is to test the data reliability, Descriptive Analysis is used to illustrates how often the green components have been applied, how is the condition of green components after certain years of usage and

Relative Importance Index (RII) use to analyze which green component and factors affecting green components is most emphasized by respondents.

4.5.1 Cronbach's Alpha Reliability Test

Cronbach's alpha is used to assess the data's reliability after it has been collected. Cronbach's alpha is used to determine the cohesiveness of a series of elements in a group's relationship by measuring the internal consistency and "quality" of data.

Table 4.4: Reliability Test on Identification of green components and evaluation of its condition.

Reliability Statistic	
Cronbach's Alpha	Number of Items
0.780	30

The reliability of respondents on the use green components in Malaysia's green buildings and evaluation of its condition is 0.780, which is regarded more than acceptable because it is higher than 0.7, as shown in Table 4.4. This section questionnaire's 4 questions with 30 components are reliable, indicating that the questionnaire is good and dependable for the study.

4.5.2 Descriptive Analysis

4.5.2.1 Mean Analysis of Frequency of Use of Green Components

Table 4.5 shows the mean ranking of the frequency of use of listed green components based on the project experience of the respondents in Malaysia. The higher the mean value, the higher the frequency of green components being adopted.

Table 4.5: Mean Ranking of Frequency of Use of Green Components

Code	Green Components	Mean (μ)	Ranking
E1	Solar photovoltaic in the building.	3.20	9
E2	Solar shading in the building.	3.41	6
E3	Wall insulation in the building.	3.43	5
E4	High performance glazing in the building.	3.32	7
E5	Green roof in the building.	3.51	3
I1	Natural ventilation in the building.	3.54	2
I2	Sufficient daylighting in the building.	3.84	1
I3	Sound insulation in the building.	3.02	11
W1	Water efficient fitting in the building.	3.20	10
W2	Rainwater harvesting in the building.	3.48	4
O1	Building passive cooling design in the building.	3.20	8

Table 4.5 presents the results of the mean ranking of frequency of use of green components in Malaysia's green buildings. In short, (I2) sufficient daylighting in the building was ranked first. It was followed by natural ventilation in the building, green roof in the building, rainwater harvesting in the building, wall insulation in the building, solar shading in the building, high performance glazing in the building, building passive cooling design in the building, solar photovoltaic in the building and water efficient fitting in the building. Sound insulation in the building was ranked the last at eleventh.

4.5.2.2 Mean Analysis of Important of Green Components for Improving Building Sustainability in Malaysia

The mean ranking of the most important green components for enhancing building sustainability in Malaysia is shown in Table 4.6. The respondents' importance level increased with the mean value.

Table 4.6: Mean Ranking of Important of Green Components for Improving Building Sustainability in Malaysia

Code	Green Components	Mean (μ)	Ranking
E1	Solar photovoltaic in the building.	3.51	9
E2	Solar shading in the building.	3.16	11
E3	Wall insulation in the building.	3.19	10
E4	High performance glazing in the building.	3.92	6
E5	Green roof in the building.	3.99	3
I1	Natural ventilation in the building.	4.18	1
I2	Sufficient daylighting in the building.	4.07	2
I3	Sound insulation in the building.	3.80	7
W1	Water efficient fitting in the building.	3.94	5
W2	Rainwater harvesting in the building.	3.76	8
O1	Building passive cooling design in the building.	3.98	4

From table 4.6, the top-ranked green components are those that have the most significant importance for the green building in Malaysia. These include natural ventilation, sufficient daylighting, and building passive cooling design. These components can help to reduce energy consumption, improve indoor air quality, and create a more comfortable living environment.

The lower-ranked components are those that are less important by respondents' perspective. These include solar photovoltaic panels, wall insulation, and solar shading. While these components can still be beneficial, they are not as essential for sustainable development as the top-ranked components.

4.5.2.3 Mean Analysis of Identification of Factors Contribute to the Condition of Green Components' Salvage Value

The average ranking of the factors that contribute to the condition of the salvage value of green components is shown in Table 4.7. The degree of agreement among respondents increases with an increased mean value.

Table 4.7: Mean Ranking of Factors Contribute to the Condition of Green Components' Salvage Value

Code	Factors	Mean (μ)	Ranking
1	The condition of the green component will decline as **its usage years increases**.	3.48	1
2	The condition of the green component will decline as its **use frequency increases**.	3.20	4
3	The condition of the green component will decline as its **need of maintenance increases**.	3.19	5
4	The condition of the green component will decline as its start to **generate hazardous material**.	3.33	3
5	The condition of the green component will decline as its **disposal limit increases**.	3.45	2

Based on Table 4.7, analyzing the the condition of green components' salvage value through mean ranking and respondent agreement, the study revealed a clear hierarchy of impacting factors. Topping the list, increasing usage years and increase of disposal limits pose the most significant threats, highlighting the importance of optimized operation and responsible end-of-life management. Generation of hazardous materials follows closely, impacting value due to disposal complexities. While use frequency and maintenance needs also play a role, their influence diminishes along the ranking sequence, suggesting focus should prioritize maximizing component lifespan and minimizing hazardous material presence for optimal economic recovery.

4.5.2.4 Mean Analysis of Indication of Condition of Green Components after different years of use.

Table 4.8 indicates the mean ranking of condition of green components after different years of use - five years, ten years and 20 years. The higher the mean value, the greater declination of green component's conditions.

Likert Scale of this section:

1 - Condition remains the same.

2 - Condition decline from 1% to less than 5%

3 - Condition decline from 5% to less than 10%

4 - Condition decline from 10% to less than 15%

5 - Condition decline from 15% to less than 20%

6 - Condition declines 20% and above

Table 4.8: Mean Ranking of Condition of Green Components after different years of use.

Code	Condition of Green Components	Mean (μ)	Ranking
C1	Condition of green components after 5 years of use.	2.67	3
C2	Condition of green components after 10 years of use.	3.62	2
C3	Condition of green components after 20 years of use.	4.25	1

Table 4.8 paints a clear picture of the inevitable: green components deteriorate with age. The higher mean ranking, representing greater decline in condition, reveals a concerning trend. Breaking down the data:

C1 - Condition of green components after 5 years of use: The mean of 2.67 suggests a moderate decline, ranging from 1% to less than 10%. While not alarming, it signifies the onset of wear and tear.

C2 - Condition of green components after 10 years of use: Doubling to 3.62, the mean indicates a more substantial drop in condition, ranging from 5% to less than 15%. This highlights the need for preventative maintenance and potential component replacements.

C3 - Condition of green components after 20 years of use: Reaching a high of 4.25, the mean reveals a significant decline exceeding 15% in many components. This suggests approaching end-of-life for many elements, demanding attention to responsible decommissioning and potential value recovery.

The ranking emphasizes the exponential nature of deterioration: the longer a component operates, the faster its condition declines.

4.5.3 Relative Importance Index (RII) Analysis

4.5.3.1 Relative Importance Index (RII) of Frequency of Use of Green Components

While mean analysis revealed general trends, Relative Importance Index (RII) offers a more nuanced understanding of green component frequency of use. By referring to Table 4.9's insight:

Top Tier:

I2 - Sufficient Daylighting (RII 0.768): Ranking first, efficient daylight utilization stands as a widely embraced practice, likely due to its cost-effectiveness, natural aesthetic appeal, and ability to enhance occupant well-being.

I1 - Natural Ventilation (RII 0.708): Following closely, natural ventilation underscores the industry's commitment to passive strategies for energy reduction and indoor air quality improvement.

E5 - Green Roofs (RII 0.702): Their ability to regulate temperature, manage stormwater, and create aesthetically pleasing spaces solidifies their popularity.

Promising Mid-Range:

W2 - Rainwater Harvesting (RII 0.696): Water conservation measures like rainwater harvesting are gaining momentum, demonstrating a growing awareness of water scarcity challenges.

E3 - Wall Insulation (RII 0.686): Its critical role in reducing energy demand for heating and cooling reinforces its adoption.

E2 - Solar Shading (RII 0.628): Preventing excessive solar heat gain, solar shading techniques are increasingly valued for their energy-saving potential.

Balance and Context:

The remaining components, with RII values between 0.664 and 0.604, highlight the importance of balanced decision-making. Factors like climate, building type, and project-specific goals influence their prioritization.

Table 4.9: RII Ranking of Frequency of Use of Green Components

Code	Green Components	Mean (μ)	RII
I2	Sufficient daylighting in the building.	3.84	0.768
I1	Natural ventilation in the building.	3.54	0.708
E5	Green roof in the building.	3.51	0.702
W2	Rainwater harvesting in the building.	3.48	0.696
E3	Wall insulation in the building.	3.43	0.686
E2	Solar shading in the building.	3.41	0.628
E4	High performance glazing in the building.	3.32	0.664
O1	Building passive cooling design in the building.	3.20	0.640
E1	Solar photovoltaic in the building.	3.20	0.640
W1	Water efficient fitting in the building.	3.20	0.640
I3	Sound insulation in the building.	3.02	0.604

4.5.3.2 Relative Importance Index (RII) Analysis of Important of Green Components for Improving Building Sustainability in Malaysia

Table 4.10 sheds light on the most priorities for green components within the context of Malaysian building sustainability, offering a more nuanced view than the general frequency data. I1 - Natural Ventilation (RII 0.836) topping the list, natural ventilation remains a crucial strategy in Malaysia's hot and humid climate. Then, is the I2 - Sufficient Daylighting (RII 0.814) which maximizing daylight utilization aligns with the goal of reducing energy consumption and creating visually appealing spaces, following closely by E5 - Green Roofs (RII 0.798. The remaining components display RII values ranging from 0.76 to 0.632, indicating their importance while allowing for context-specific prioritization. Factors like building type, budget, and specific environmental concerns will influence their implementation.

Table 4.10: RII Ranking of Important of Green Components for Improving Building Sustainability in Malaysia

Code	Green Components	Mean (μ)	RII
I1	Natural ventilation in the building.	4.18	0.836
I2	Sufficient daylighting in the building.	4.07	0.814
E5	Green roof in the building.	3.99	0.798
O1	Building passive cooling design in the building.	3.98	0.796
W1	Water efficient fitting in the building.	3.94	0.788
E4	High performance glazing in the building.	3.92	0.784
I3	Sound insulation in the building.	3.80	0.76
W2	Rainwater harvesting in the building.	3.76	0.752
E1	Solar photovoltaic in the building.	3.51	0.702
E3	Wall insulation in the building.	3.19	0.638
E2	Solar shading in the building.	3.16	0.632

4.5.3.3 Relative Importance Index (RII) Analysis of Factors Contribute to the Condition of Green Components' Salvage Value

Table 4.11 reveals the key influences on green component salvage value through Relative Importance Index (RII) analysis. F1 - Usage Years (RII 0.696), unsurprisingly, takes the top spot. Longer operation equates to greater wear and tear, diminishing value.

F5 - Disposal Limit (RII 0.690), approaching disposal restrictions lowers a component's desirability and marketability, impacting its potential worth. Then, F4 - Hazardous Material Generation (RII 0.666), the presence of hazardous materials poses significant handling and disposal challenges, deterring buyers and reducing value.

Table 4.11: RII Ranking of Factors Contribute to the Condition of Green Components' Salvage Value

Code	Green Components	Mean (μ)	RII
F1	The condition of the green component will decline as **its usage years increases**.	3.48	0.696
F5	The condition of the green component will decline as its **disposal limit increases**.	3.45	0.690
F4	The condition of the green component will decline as its start to **generate hazardous material**.	3.33	0.666
F2	The condition of the green component will decline as its **use frequency increases**.	3.20	0.640
F3	The condition of the green component will decline as its **need of maintenance increases**.	3.19	0.638

4.5.3.4 Relative Importance Index (RII) Analysis of Condition of Green Components after different years of use.

Table 4.12 focusing on the age-related decline in green components conditions. The ranking shows a significant decline with age:

C3 (Condition after 20 years) had the highest RII of 0.708, indicating the most degradation after 20 years.

C2 (Condition after 10 years) comes second with a RII of 0.603, suggesting modest decrease.

C1 (Condition after 5 years) had the lowest RII of 0.445, indicating a less effect on condition in the first five years.

Table 4.12: RII Ranking of Condition of Green Components after different years of use.

Code	Condition of Green Components	Mean (μ)	RII
C3	Condition of green components after 20 years of use.	4.25	0.708
C2	Condition of green components after 10 years of use.	3.62	0.603
C1	Condition of green components after 5 years of use.	2.67	0.445

4.6 Section C: Objective 3

Section C is made up of one question which is related to the third objective. The third objective is to demonstrate the floating of salvage value of green components. This section aims to estimate the floating of salvage value of green components with the impact of above-mentioned factors. The respondents are required to rate the level of impact to the decline of salvage value of green component by its condition.

All level of impact to the statement are asked in Likert scale questions and analyzed by using SPSS software to generate the result. Cronbach's Alpha Reliability test is to test the data reliability, Descriptive Analysis is used to illustrates the respondent's perspective on the impacts to the salvage value of green components and Relative Importance Index (RII) use to analyze the most critical impact to salvage value of green components with certain degree of decline in condition.

4.6.1 Cronbach's Alpha Reliability Test

Cronbach's alpha is used to assess the data's reliability after it has been collected. Cronbach's alpha is used to determine the cohesiveness of a series of elements in a group's relationship by measuring the internal consistency and "quality" of data.

Table 4.13: Reliability Test on Estimation of the floating of green components' salvage value.

Reliability Statistic	
Cronbach's Alpha	Number of Items
0.782	6

The reliability of respondents on the estimation of the floating of green components 'salvage value is 0.782, which is regarded more than acceptable because it is higher than 0.7, as shown in Table 4.13. This section questionnaire's 1 questions with 6 components are reliable, indicating that the questionnaire is good and dependable for the study.

4.6.2 Descriptive Analysis

4.6.2.1 Mean Analysis of Estimation of Floating of Salvage Value of Green Components with the Impact of above-mentioned Factors.

The mean ranking of the green component condition after varying years of use was the subject of Table 4.8 (described above), which provided an overall impression of degradation. Now, Table 4.14 goes a step further, utilising mean and ranking analysis to estimate the floating of salvage value.

Largest Decline: C5 (15–20% decline) has the highest mean of 3.66, suggesting the greatest possible loss of salvage value as a result of severe degradation.

Moderate Impact: The C6 (20%+ decline) shows a mean of 3.52, which is in close proximity and highlights the significant value loss that comes with a severe condition degradation.

Progressive Devaluation: With means of 2.70 and 3.37, respectively, C3 (5-10%) and C4 (10-15% fall) rank mid-range and point to a progressive decline in value as the condition deteriorates.

Minimal Change: With averages of 2.20 and 1.95, C2 (1-5% decrease) and C1 (no decline) are at the bottom of the list, suggesting that the salvage value of components with little to no deterioration will be minimally affected.

Table 4.14: Mean Ranking of Estimation of Floating of Salvage Value of Green Components with the Impact of above-mentioned Factors.

Code	Condition	Mean (μ)	Ranking
C1	Condition of green components remain the same.	1.95	6
C2	Condition of green components decline from 1% to less than 5%	2.20	5
C3	Condition of green components decline from 5% to less than 10%	2.70	4
C4	Condition of green components decline from 10% to less than 15%	3.37	3
C5	Condition of green components decline from 15% to less than 20%	3.66	1

C6	Condition of green components declines 20% and above.	3.52	2

4.6.3 Relative Importance Index (RII) Analysis

4.6.3.1 Relative Importance Index (RII) of Estimation of Floating of Salvage Value of Green Components with the Impact of above-mentioned Factors.

This section delves into the critical relationship between green component condition and their salvaged value. Using Relative Importance Index (RII) analysis, the percentage decline most detrimental to their financial potential has been pinpointed.

C5 - 15-20% Decline (RII 0.610): The highest RII exposes this range as the sweet spot for the most significant value loss. Every component experiencing a decline between 15% and 20% sees their potential resale price drastically impacted.

C6 - 20%+ Decline (RII 0.586): Close behind, exceeding a 20% decline presents another major threat. While slightly lower than C5's RII, it still signifies a substantial financial risk.

These two categories, encompassing deterioration beyond 15%, emerge as the primary culprits in depleting green component value. This underscores the critical importance of focusing efforts on preventing components from reaching these critical decline thresholds.

While all decline categories affect value to some degree, the RII values for C3 (5-10% decline) and C4 (10-15% decline) suggest a less pronounced impact. Here, strategies aimed at slowing down the rate of deterioration become crucial to minimize value loss over time.

Finally, C1 and C2, representing no decline and minimal decline (1-5%), highlight the importance of proper operation and maintenance. By diligently keeping components at their peak condition, we can maximize their potential resale value.

Table 4.15: RII Ranking of Estimation of Floating of Salvage Value of Green Components with the Impact of above-mentioned Factors.

Code	Condition	Mean (μ)	RII
C5	Condition of green components decline from 15% to less than 20%	3.66	0.610
C6	Condition of green components declines 20% and above.	3.52	0.586
C4	Condition of green components decline from 10% to less than 15%	3.37	0.561
C3	Condition of green components decline from 5% to less than 10%	2.70	0.450
C2	Condition of green components decline from 1% to less than 5%	2.20	0.366
C1	Condition of green components remain the same.	1.95	0.325

CHAPTER 5: DISCUSSION

5.1 Introduction

This section will discuss in-depth on the results obtained in Chapter 4. The outcomes of the reliability test conducted are also incorporated. Subsequently, a thorough exposition of the surveyed sample is provided.

5.2 Section B: Objective 1 & 2

This section examines the green components usage and importance in Malaysia's green buildings. It also covers the factors affecting the conditions of green components as well as the decline in its conditions after 5 years, 10 years and 20 years of usage.

5.2.1 RO1: To identify the green components.

Starting with frequency of use, the prevalence of passive daylighting and natural ventilation strategies underscores their value in Malaysia's hot, humid climate. By reducing air conditioning demands through free cooling and lighting methods, these techniques cut energy consumption and costs substantially. Daylighting's first place ranking indicates its widespread embrace for its energy efficiency, visually appealing spaces, and positive occupant wellbeing impacts. Natural ventilation follows closely, as its ability to passively cool and ventilate interior zones makes it foundational in passive buildings.

Beyond energy savings, these strategies also enhance air quality and thermal comfort when properly implemented, creating healthier indoor environments. Maximizing free daylight diminishes reliance on artificial lighting, which is linked to improved mood, cognitive function, and circadian health. Similarly, natural ventilation's air movement and fresh air circulation promotes alertness and productivity. For a nation facing rising electricity demand, harnessing free environmental resources through intelligent building design is paramount.

Likewise, green roofs and rainwater harvesting stand out for their third and fourth place frequency rankings, flagging a growing prioritization of ecological considerations. Green roofs mitigate the urban heat island effect, reducing cooling loads through evapotranspiration, shade, and insulation. Their stormwater retention capabilities also make them crucial for cities facing intensifying rainfall while combating flooding. Rainwater harvesting eases demand on municipal water supplies while recycling this free source. Against Malaysia's backdrop of development and climate change, the embrace of green roofs and rainwater capture highlights a positive trend towards solving pressing environmental challenges through buildings.

Beyond these leading strategies, wall insulation, high performance glazing, solar shading, and passive cooling also display prominent frequency rankings. Their prevalence indicates recognition of their multidimensional benefits. Insulation cuts conductive heat gain/loss, improving passive thermal regulation. Advanced glazing balances visibility, daylight passage and solar control to reduce loads. Solar shading limits excessive heat gain through strategic overhangs and screens. Passive cooling's holistic approach combines these elements for climatically responsive design. The interconnection and synergies between these technologies showcase how integrated solutions will become increasingly important.

Shifting focus to the sustainability importance rankings, natural ventilation and daylighting again emerge at the forefront. This reemphasizes their fundamental role in achieving energy efficiency and occupant wellbeing in Malaysia's context. Green roofs and passive cooling follow closely, reflecting their growing status as indispensible tools for ecological and thermal performance.

Natural ventilation's top ranking underscores its unmatched capacity for free cooling, ventilation and thermal comfort in hot-humid climates. Its first-cost, energy and maintenance advantages cement its necessity moving forward. Daylighting's second place ranking highlights its unparalleled benefits for energy savings, visual comfort and health. When paired with appropriate solar control, daylight can meet most lighting needs in well-designed buildings.

Green roofs' importance ranking brings their diverse advantages into focus. Their cooling load reduction, rainwater capture capabilities, aesthetic value for community spaces and ability to combat heat islands make them highly beneficial across numerous fronts. Passive cooling's high ranking emphasizes the need to transition towards climate-centric designs that harness site assets to maximize comfort with minimal energy.

The strong emphasis on water conservation measures like rainwater harvesting and efficient fittings aligns with Malaysia's rising water scarcity challenges. Similarly, the presence of solar PV in the upper rankings flags renewable energy integration as an emerging priority. Insulation and advanced glazing, while lower ranked, still offer major efficiency gains that should not be overlooked.

In essence, Section B findings reveal daylighting, natural ventilation, green roofs and passive cooling as top-tier building sustainability strategies for Malaysia's context. But the rankings also stress the importance of holistic thinking: no single solution will enable genuinely sustainable buildings. Instead, it is the synergistic implementation of complementary technologies that will lead the industry forward. In short, the result is concur with Chapter 2's findings of GBI Technical Manual, Ahmad & Abdullah (2018)and GBI Technical Manual, World Green Building Trends 2020.

5.2.2 RO2: To evaluate the condition of green components.

Transitioning to factors impacting green component salvage value, usage duration and proximity to disposal limits emerge as the most detrimental conditions. The number one ranking for usage years highlights durability as a pivotal determinant of reuse potential. Components that endure longer maintain utility and value. Thus, maximizing lifespan through resilient design and maintenance is critical.

Disposal limit's second place ranking emphasizes the risks as components near their regulated operation duration. Approaching disposal restrictions or bans diminishes marketability and value. Thus, optimizing usage years and considering value recapture before limits are reached is advised. Responsible end-of-life management through reuse, remanufacturing or recycling is essential to minimize value loss.

Generation of hazardous materials takes the third spot, flagging it as a major deterrent to salvage viability. Toxic components require complex handling and disposal, disincentivizing purchase. Eliminating hazardous constituents through careful materials selection is thus key to enabling safe reuse.

The primary factors for describing a building's condition are the age of the components, the need for maintenance, and any environmental hazards, according to the American Society for Testing and Materials (2016). This indicates that the results obtained from the questionnaire are consistent with the conclusions drawn from the literature review.

While use frequency and maintenance needs do impact condition, their lower influence indicates other factors take priority. Nonetheless, regular upkeep to slow wear and tear remains important.

The condition analysis over time provides sobering confirmation of component deterioration. Already by 10 years, the moderately high ranking suggests substantial degradation between 5-15% in many elements. After 20 years, the top ranking reveals critical decline, with many components approaching replacement necessity.

This starkly highlights the realities of building life cycles: material and component longevity rarely matches desired building lifespans. Consequently, plans must proactively address periodic renewal and value recapture. The onset of noticeable decline within 5-10 years for some components also signals the need for preventative maintenance before deterioration escalates.

In summary, result for objective 2 provides a snapshot of Malaysia's green building component landscape. Passive strategies and ecological design emerge as top sustainability solutions. Longevity and hazardous material avoidance also come into focus as salvage value determinants. Ultimately, an integrated outlook combining component durability, safe materials selection, and proactive renewal plans will be critical for viable sustainable buildings.

5.3 Section C: Objective 3

This section estimates the floating of salvage value of green components with the impact of above-mentioned factors.

5.3.1 RO3: To demonstrate the floating of salvage value of green components.

Building on objective 2 discussion foundation, the result discussion hones in on the complex relationship between green component condition and salvage value retention. The nuanced analysis of value diminishment at varying degradation levels provides actionable direction to curb revenue losses.

Underscoring the above conclusions, the 15-20% decline range surfaces as the most damaging condition threshold for salvage value viability. The steep RII drop from moderate decline to 15-20% degradation signals the onset of substantial value hemorrhaging. Clearly, keeping components from approaching this level of deterioration is essential to retain their income generating potential.

The high RII for 20% plus degradation further compounds the risks of major decline. Exceeding 20% wear and tear brings components near failure, entailing replacement costs that overwhelm value recovery revenue. Both 15-20% and above 20% deterioration represent cliffs where opportunity for gain rapidly evaporates.

These findings emphasis that the longevity and durability enable value. Allowing components to degrade to critical levels squanders their reuse income potential. While deterioration is inevitable, preventing decline beyond 15% for as long as possible is pivotal.

Reinforcing this observation, the lower RII figures for moderate decline in the 5-15% range point to a progression of incremental value loss prior to the 15% cliff. While minor condition reduction impacts financial potential, the effects intensify exponentially as overall degradation increases. Consequently, slowing early wear and tear via maintenance keeps components operating economically for longer.

Encouragingly, the near-zero RII values for no and minimal decline highlight that peak salvage value endures when components remain near pristine condition. This brings the value of preventative maintenance and early-stage renewal into sharp focus. Small repairs and upgrades to arrest minor issues support sustained viability.

In summary, this analyzed result provides succinct direction: curtailing deterioration is essential to retain income potential; allow significant degradation beyond 15% at future financial peril. Combined Objective 1 and Objective result analysis and life cycle perspective, this paints a full picture:

I. Prioritize durable, non-toxic components with longevity aligned to building lifespans.
II. Proactively maintain components to minimize decline, implementing minor repairs and targeted renewals.
III. Aggressively avoid permitting degradation beyond 15%, which marks the precipice of value hemorrhaging.
IV. Before regulatory disposal limits, consider value capture options through reuse, remanufacture or recycling.

Adhering to these principles, owners can maximize their income generation from green components. The data suggests operational adjustment is prudent around the 10 year mark, when decline becomes noticeable in many elements. Planning renewal cycles for 15-20 years emerges as ideal for sustaining financial viability. While variability between component types exists, these benchmarks provide sensible direction.

Ultimately, the results underscore that green building income potential and life cycle optimization are inextricably linked. Only a holistic approach attending to both sustainability and value retention will deliver genuinely feasible and profitable green buildings. The survey insights equip industry stakeholders with robust pointers to balance both goals.

CHAPTER 6: CONCLUSION

6.1 Introduction

The analytical results will be examined in respect to the 3 study objectives. In addition to contributing to future research, this study's limitations and recommendations are highlighted.

6.2 Objective 1: To identify the green components

By studying the mean of the 11 green components, which are optimal for Malaysia's environment, the first goal is accomplished. For green components, the Cronbach's Alpha value is 0.780, which is within an acceptable range. The top three green components that are best for Malaysia's environment are listed in Table 6.1. Table 4.5 and Table 4.6 contains the version that is more comprehensive.

Table 6.1: Top 3 Green Components Ideal for Malaysia's Environment

Green Components	Ranking
Natural ventilation in the building.	1
Sufficient daylighting in the building.	2
Green roof in the building.	3

6.3 Objective 2: To evaluate the condition of green components

By using RII analysis to analyse the factors affecting green component conditions, Objective 2 is also accomplished. The top 3 factors are listed in Table 6.2 below. Additionally, mean ranking revealed that after 20 years of use, the state of green components deteriorates the greatest, with the highest mean value of 4.85 and RII value of 0.708.

Table 6.2: Top 3 Factors Affecting the Condition of Green Component

Code	Factors	Mean (μ)	Ranking
F1	The condition of the green component will decline as **its usage years increases**.	3.48	0.696
F5	The condition of the green component will decline as its **disposal limit increases**.	3.45	0.690
F4	The condition of the green component will decline as its start to **generate hazardous material**.	3.33	0.666

6.4 Objective 3: To demonstrate the floating of salvage value of green components

By analysing the mean and RII of the impact level on a decline in the salvage value of green components based on their condition, objective 3 is achieved. The findings indicate that the most detrimental condition threshold for salvage value reduction is within the range of 15% to 20% decline.

6.5 Contribution of the Study

The research makes several notable contributions. Firstly, it pinpoints passive cooling strategies like natural ventilation and daylighting as top sustainability solutions for energy savings, air quality and occupant wellbeing. Secondly, it reveals green roofs, rainwater harvesting and passive cooling as key tools for minimizing environmental impact.

Additionally, the analysis quantifies condition decline rates, demonstrating the need for proactive maintenance and renewal planning. Most critically, the deterioration thresholds causing substantial value loss are identified, arming stakeholders with actionable targets for optimizing component lifespan.

In general, the research incorporates both technical and economical factors to facilitate comprehensive decision-making. Government officials, architects, and building owners will find the insights useful in adopting and running green buildings profitably.

6.6 Limitation of the Study

While producing meaningful results, some limitations exist. The sample size of 166 restricts generalization of the findings. Additionally, reliance on respondent perception for technical assessments like degradation rates carries inherent subjectivity.

More rigorous quantitative condition testing over time on specific components would provide greater accuracy. Moreover, real economic valuation data is needed to concrete the link between condition and salvage value.

In summary, this study delivers a robust foundation and signposting for amplification through more extensive data gathering, field experiments and longitudinal tracking.

6.7 Recommendations for Future Studies

Future research should concentrate on a number of important areas in order to advance the knowledge of the salvage value of green components and open the door to better resource management. First off, creating useful resources such as lifespan cost calculators or valuation standards can provide professionals with specific tactics to help them make well-informed choices about their investments in green buildings. Second, gathering actual decommissioning component resale values would yield priceless real-world data, strengthening the basis for precise valuation models.

Thirdly, broadening the scope of the study to include various regulatory environments and geographic areas will enable perceptive comparisons and shed light on contextual factors that affect value retention. Last but not least, monitoring a group of green buildings over an extended length of time provides the opportunity to set performance standards and maximise renewal schedules, guaranteeing that these constructions are resource- and sustainability-efficient for the duration of their lives. By following these suggestions, future research may have better understanding of this important area and create a constructed environment that is more sustainable and greener.

6.8

6.9 Summary of Chapter

In summary, the research objectives have been met by the collected results. The contribution of the research has been discussed. Additionally, this part explains the research limitations that were observed and provides recommendations for further research.

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