



Faculty of Built Environment

Cost Reduction-Client Satisfaction Framework for Green Buildings

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Cost Reduction-Client Satisfaction Framework for Green Buildings

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



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ABSTRACT

The benefits of implementing green building construction encompass not only the environmental dimension, but equally, if not more importantly, the economic advantages this endeavour brings to the construction stakeholders. There are few concerns raised related to the green building construction which may be causing hindrance towards its development and implementation. Green building construction is notorious for its cost premium and high upfront cost as compared to conventional building. There is a need in addressing the issues related to the green construction to alleviate the cost risk. In spite of the surging concern regarding the issue, there is limited knowledge related to the economics of green building construction. The purpose of this research was to formulate a Cost Reduction-Client Satisfaction Framework green building construction. This research utilised a literature review to identify the cause of the significant cost of green building construction, strategies for cost minimisation, and the relationship between cost reduction strategies and stakeholders' cost satisfaction. The variables were validated through preliminary interview. Furthermore, questionnaire was adopted to unfold the research questions. The study revealed that roof and structural elements contribute significantly to the cost premium. The proposed cost reduction strategies improve the stakeholders' cost satisfaction. Therefore, a Cost Reduction-Client Satisfaction Framework of green building construction for a more satisfactory green building construction deliverance was developed.

Keywords: Economic, green building element, cost reduction strategies, stakeholders' satisfaction

Rangka Kerja Pengurangan Kos-Kepuasan Pelanggan untuk Bangunan Hijau

ABSTRAK

Faedah pelaksanaan pembinaan bangunan hijau merangkumi bukan sahaja dimensi alam sekitar, tetapi sama, jika tidak lebih penting, kelebihan ekonomi yang dibawa oleh usaha ini kepada pihak berkepentingan pembinaan. Terdapat sedikit kebimbangan yang dibangkitkan berkaitan pembinaan bangunan hijau yang mungkin menyebabkan halangan ke arah pelaksanaannya. Pembinaan bangunan hijau terkenal dengan kos premium dan kos pendahuluan yang tinggi berbanding bangunan konvensional. Terdapat keperluan dalam menangani isu berkaitan pembinaan hijau untuk mengurangkan risiko kos. Terdapat pengetahuan yang terhad berkaitan dengan ekonomi pembinaan bangunan hijau. Tujuan penyelidikan ini adalah untuk merumuskan Rangka Kerja Pengurangan Kos-Kepuasan Pelanggan pembinaan bangunan hijau. Penyelidikan ini menggunakan kajian literatur untuk mengenal pasti punca kos besar pembinaan bangunan hijau, strategi untuk meminimumkan kos, dan hubungan antara strategi pengurangan kos dan kepuasan kos pihak berkepentingan. Pembolehubah telah disahkan melalui temu bual awal. Tambahan pula, soal selidik telah digunakan untuk merungkai persoalan kajian. Kajian itu mendedahkan bahawa bumbung dan elemen struktur menyumbang dengan ketara kepada kos premium. Strategi pengurangan kos yang dicadangkan akan meningkatkan kepuasan kos pihak berkepentingan. Oleh itu, Rangka Kerja Pengurangan Kos-Kepuasan Pelanggan untuk pembinaan bangunan hijau yang lebih memuaskan telah dibangunkan.

Kata kunci: *Ekonomi, elemen bangunan hijau, strategi pengurangan kos, kepuasan pihak berkepentingan*

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LIST OF ABBREVIATIONS

BOQ	Bills of Quantities
Cont.	Continued
GBC	Green Building Council
GBI	Green Building Index
GreenPASS	Green Performance Assessment System
GreenRE	Green Real Estate
IoT	Internet of Things
JKR	Jabatan Kerja Raya
PHJKR	Penarafan Hijau JKR
PWD	Public Work Department
UNIMAS	Universiti Malaysia Sarawak
WBLFF	Work Below Lowest Floor Finish

CHAPTER 1

INTRODUCTION

1.1 Background of Study

United Nation Environment Programme (2020) recognized construction as one of the industries that has shown a steady increase in energy consumption and government is urged to make a strategy to reduce the energy consumption a priority. In Malaysia, Green Technology Master Plan Malaysia has been introduced in 2016 which includes building sector to incorporate design, construction and materials which are sustainable to the environment. Green building construction will not only bring benefits to the building constructed but also benefitted the global market (WorldGBC, 2019). Some of the advantages of green building construction are cost effectiveness, availability of construction material, efficiency of energy, cost and waste reduction improving community's economy, promoting cultural heritage, adaptability to the environment, eco-friendly, enhancing social wellbeing and reduced carbon emission (Adeniyi et al., 2021). The cost and complex nature of green construction adoption has caused hesitancy among stakeholders to implement green construction (Issa et al., 2010). There are few policies and programmes of green building implementation that has been introduced to achieved greener environments. Some of these policies are National Green Technology Policy (2009), National Energy Efficiency Master Plan Study (2010) and Low Carbon Cities Framework and Assessment System (2011) (Suhaida et al., 2013). To assist in implementation of green building construction, different rating tools are developed which are Green Building Index (GBI), PWD Green Rating Scheme or PHJKR Malaysia, Green Performance Assessment System (Green PASS) and Green Real Estate (GreenRE). It can be observed that available policies and rating system

focuses on the implementation but not the economical aspect of green building construction.

Problem Statement

The construction of green building has since been sought for and is being recognised worldwide (Mohd Pauzi et al., 2021). The extensively used term of green building and sustainability are founded to be vaguely defined which in return, various green rating systems have been developed to quantify the performance target of green building (Dwaikat & Ali, 2018a). Green building rating system tools incorporated indicator system, scoring system and rating system to assess building sustainability (Wen et al., 2020). These rating tools aided in assessing the building life cycle processes from the beginning to the operation of a building (Mohamed Ghazali et al., 2017). World Green Building Council listed fifty-eight green building rating tools administered by the Green Building Council which includes Green Building Index rating tool which are being widely used in Malaysia construction industry. Zhang et al. (2020) also listed two other green building rating tools used in Malaysia construction industry which are Green Real Estate (GreenRE) and Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCrest).

From building life cycle perspective, advocates of green buildings contend that a green building outperforms its conventional (non-green) counterpart; they identified numerous benefits associated with a green building which includes energy savings and reduction of water consumption (Dwaikat & Ali, 2018). By incorporating green construction, problem such as scarcity of space and environmental problems can be tackled (Ismail et al., 2018). The implementation of green building required the use of green material which does not only will reduce construction wastage and pollution but also increasing the quality of material used for building construction (Tambichik et al., 2018).

The cost saving from green building construction is not only limited to the environment but also economic benefits to the industry stakeholders (Mohd Pauzi et al., 2021). On the long run, the reduced energy consumption of green building will result in overall building cost reduction (Dwaikat & Ali, 2018). Cost savings for maintenance and operation of green building can be achieved up to 21% compared to conventional building (Weerasinghe & Ramachandra, 2018). Firms equipped with green building construction certificate are founded to be having a high return of asset (ROA) and positive financial performance (Samad et al., 2020).

Although there are arrays benefits of green building implementation, green building construction has several drawbacks that raised some concerns regarding the implementation. Green building construction is notorious for the high deemed cost of implementation as well as high upfront cost (Mohd Pauzi et al., 2021; Onuoha et al., 2018; Wei et al., 2020). The construction of green building required additional cost of construction as compared to conventional building construction (Weerasinghe & Ramachandra, 2018). The additional cost imposed is known as ‘cost premium’ which is influenced by the hard cost and soft cost of green building construction (Abidin & Azizi, 2021). Other major factor for the cost increase is due to the building material cost escalated due to dependability to imported materials and scarcity in the local market (Syed Jamaludin et al., 2018). Despite numbers of green building rating system has been developed, the rating system failed to incorporate economic aspect into the system (Latief et al., 2017). Advocacy to green building construction worldwide and by local government did not prevent the lack of knowledge and innovation in green construction industry (Olanrewaju et al., 2020). Due to the lack of knowledge in green building construction, green building experts’ and consultants’ skills are

imperative in determining the success of green building construction and their service comes with a cost (Abidin & Azizi, 2021).

The challenges faced has caused hesitancy on green building construction among industry stakeholders which has since limits its implementation (Mohd Nordin et al., 2018; Yee Sin et al., 2021). Green ‘cost premium’ has caused less interest in green building construction among construction project stakeholders. Due to this reason, green building experts or consultants are being hired to mitigate ‘cost premium’ imposed on the green building construction. The additional cost of employing green building experts and client can only be afforded by big companies thus causing less participation in green construction market from small to medium companies (Wei et al., 2020). Implementation of green building construction will also require extensive planning and cooperation from all the stakeholders (Sin et al., 2021).

It is found that cost has tremendous effect on the development of green building construction this includes cost saving motivation and monetary incentives for green construction (Onuoha et al., 2018). Therefore, to promote the implementation of green construction in the industry, there is a need in addressing the issues related to the cost of green building construction to alleviate cost risk that has previously being mentioned (Russ et al., 2018). This includes inclusion of economic aspect into the green building rating systems which are widely being used to quantify the performance of green building construction (Doan et al., 2017; Wen et al., 2020; Zhang et al., 2020).

From the issues highlighted above, it can be concluded that there is a need to address issues related to cost of implementation of green building construction. Therefore, this

research identifies the cause of the significant cost of building elements and green components, strategies for cost reduction, and relates it to stakeholders' satisfaction.

1.2 Research Overview

1.2.1 Aim of Research

This research aims at formulating a Cost Reduction-Client Satisfaction Framework of green building construction that is expected to encourage and motivate the industry stakeholders to invest in green building construction. As the national economy is now facing a great challenge in terms of economics and sustainability and has currently become the main government agenda, therefore this research, more significant and idealistic will attempts to fill in this gap.

1.2.2 Research Questions

- a) What are the elements and element with significant cost of green building construction?
- b) What are the strategies to minimise the significant cost of green building construction to reach industry stakeholders' satisfaction?
- c) What are the relationship between green cost strategies and stakeholders' green cost satisfaction?
- d) What is the Cost Reduction-Client Satisfaction Framework of green building construction?

1.2.3 Research Objectives

- a) To identify the most expensive elements in green building construction.

- b) To recommend the strategies in minimising the overall cost of green building construction.
- c) To study the relationship between cost minimisation towards stakeholders' cost satisfaction.
- d) To formulate Cost Reduction-Client Satisfaction Framework of green building construction.

1.2.4 Scope of Study

The main focus of this research is from middle to top management levels of those involved in certified green building construction in Malaysia. Purposive sampling was utilised, in which respondents were chosen from those involved in the planning and construction of GBI-certified green buildings in Malaysia. Limitation for this research is found to be as the followings: -

- a. Focus is only on middle to top management.

Construction industry is a fragmented industry and participation from various parties is imperative to determine project success (Boadu et al., 2020). For this research, only middle to top management stakeholders' participated in the research. Other parties such as suppliers and skill workers opinion also need to be taken into consideration for their insight might be differ from the managements. Different culture and working environment may impact the opinion on green building construction as different environment will impact green behaviour (Al-Swidi et al., 2021). By taking this concern in consideration the findings can further be elaborated.

- b. Research did not cover building occupant and end users.

Population for this research involved industry stakeholders' but doesn't take in consideration the building occupant and end user. Building occupant and end users' perspective might differ from those in the construction industry. Their behaviour in green building implementation might differ from those of stakeholders such as by their interaction with the building and building energy consumption (Chen et al., 2021). By acquiring their insights related to the green building performance, deeper understanding on the research topic can be achieved (Graham et al., 2021). Strategies that is relevant to increase interest in green building construction by the end user will increase the implementation and effectiveness of green building construction (Kabirifar et al., 2020).

- c. Primary data collection obtained is mostly quantitatively.

By collecting the data quantitatively, research objectives were being obtained by sets of structured questions obtained from literature review. Despite there is preliminary interview being conducted, the purpose is to validate the list of variables obtained in the literature review. Through quantitative method, reasoning behind respondents' opinion cannot be obtained and being further analysed that will pose as a building block of information that is not available in the literature (O'Connor & Joffe, 2020). Different construction project has different budget, risks, issues and conditions (Taofeeq & Adeleke, 2019). This includes providing a robust well informed and thoroughly documented information that is relevant to the research (Nassaji, 2020). Therefore, by taking qualitative data collection in consideration such as by conducting an interview and bills of quantities analysis, will increase the validity of the framework constructed.

d. Cost Reduction-Client Satisfaction Framework of green building construction need to be validated

Despite of the variables have already being validated through Preliminary Interview, the constructed framework needed validation from green construction experts including those from the industry and academia. This is to ensure the validity of the framework to be implemented in the industry. Insight from academia also much required to explore more ideas or current issues arises to further improve the framework.

1.2.5 Significance of Study

Green building construction has gained traction in the Malaysian construction economy due to its advantages to the project life cycle cost. The implementation, however, suggested otherwise due to the cost issues that have arisen. It is worth noting that with more extensive cost management, the ‘cost premium’ of green building construction can be addressed to make the green building construction more cost-effective. Therefore, it is important to identify what are the elements of green building construction that contribute to the cost of construction and which elements are the most prominent, how cost will impact stakeholder’s satisfaction and from the relationship, strategies can be analysed, and a framework then developed.

1.3 Thesis Outline

The thesis is being divided into five chapters. The content that each chapter covers are as follows: -

Chapter 1: Introduction

Content of this research content of this research is being introduced in this chapter under this chapter the background of the study problem statement aims of research objectives research questions scope of study and methodology are being covered.

Chapter 2: Literature Review

Literature review is being conducted under this chapter published and unpublished works which relates to the topic of interest are being reviewed. This includes bills of quantitates of green building,

Chapter 3: Research Methodology

Research methodology is being presented in this chapter discussion of the chosen pathways of method carried out for this study is being conducted under this chapter elaboration on the justification of the chosen method and selections are being included in this chapter.

Chapter 4: Preliminary Interview

Preliminary interview being conducted for the purpose of validating variables that have being obtained from the previous chapter. Methodology, analysis and findings for the interview will be discussed in this chapter.

Chapter 5: Analysis and Findings

Analysis and findings for this thesis objective proposed during the initial stage of the research are being used as a guideline to synthesis information from the collected findings.

Chapter 6: Conclusion and Recommendations

Conclusion and recommendation chapter for this thesis conclusion being drawn and recommendation then being proposed achieved aims and objectives validated processes of research and recommendation based on finding shall be included

CHAPTER 2

LITERATURE REVIEW

2.1 General

Comprehensive overviews of a general topic related to the research are described under this chapter. Reviews of theories and previous works from published literature regarding the definition of main terms related to green building elements, cost strategies for green building construction, and stakeholders' cost satisfaction are being discussed in this chapter.

2.2 Green Building

2.2.1 Green Building Rating System

The World Green Building Council has identified 58 green building rating systems overseen by various Green Building Councils worldwide, including the Green Building Index (GBI), which is extensively adopted within Malaysia's construction sector. In addition, Zhang et al. (2020) highlighted two other rating tools utilized in Malaysia: Green Real Estate (GreenRE) and the Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST). Penarafan Hijau JKR (PHJKR) is also being widely used in the government sector for public sector building. PHJKR focuses on improving energy and water efficiency, material use and quality of indoor environments in government or public construction project (Rahman et al., 2023). Putrajaya Corporation has also launches its own green rating system which is known as Green Performance Assessment System (GreenPASS). GreenPASS primarily focusing on the operational aspect of the building.

Aspects that is being measured are energy and water consumption, waste generation and indoor environmental quality (Wahab et al., 2023; Chee & Fuad, 2018).

Table 2.1: Rating Tool, Scope and its Key Criteria

Rating Tool	Scope	Key Criteria
GBI	Buildings	Energy, water, indoor environmental quality, site, materials innovation
GreenRE	Buildings	Energy, water, waste, operations, indoor environmental quality
MyCREST	Buildings	Carbon footprint, resources, indoor environmental quality, water, site
PHJKR	Public buildings	Energy, water, indoor environmental quality, site
GreenPASS	Operational buildings	Energy, water, waste, indoor air quality

For this research, GBI is being chosen to be analysed and used as the database can be easily accessible through their website. This will increase understanding and helps to significantly improve this research, Furthermore, the rating tools and point system can easily be understood in layman's term.

2.2.2 Green Building Components

Green or sustainable building utilised energy, water and materials which are key resources efficiently (Kats, 2003). Building construction shall adhere to few principles of environmental sustainability to be recognised as green building. These principles are fulfilling the needs of the society, preservation of diversity, capacity to regenerate, reuse and recycle, and reducing the production of waste and using eco-friendly building materials (Morelli, 2011). Selection of materials for green building construction must implement strategies with steps such as efficient use of materials, use renewable energy and recycled resources and use materials with low environment impact (Broome, 2007). Green Building Index rating system, which is widely used in Malaysia, scored building points in Energy Efficiency (EE), Materials & Resources (MR), Water Efficiency (WE), Indoor Environment Quality (IEQ), Sustainable Site Planning & Management (SM) and Innovation (IN). Conventional and green building shared the same building elements, but green building shall fulfil requirements of green building construction to be part of green building construction.

2.2.3 Green Construction Cost Premium

Project budgeting is important to construction project owner (Taemthong & Chaisaard, 2019). Green building construction often will need 30% higher upfront cost compared to a conventional building (WorldGBC, 2013). Additional of 5% to 10% of the total construction budget applied to green building construction (Hwang et al., 2017). Large investment cost is needed for the implementation of green building construction and at often cost for other building elements were being reduced to fulfil requirement of green building construction. This observable fact will not be an issue if client is willing to fork out extra money on green building to benefit the industry in terms of its long-term cost saving.

Ade and Rehm (2019) argued that capital increase in construction in commercial buildings and larger residential sector is not caused by green building rating tools. Green building construction implementation has more benefits in the long run despite of high initial cost (Long et al., 2021). Green building construction will not only benefit the environment but also saving the operating cost by reducing the energy consumption (Mohd Pauzi et al., 2021).

Other cause of cost increase of green building construction include changing of requirement from conventional to green construction and scarcity of materials due to the industry and green market that are still budding (Ahmad Zaini, 2018).

2.2.4 Building Construction Cost Minimisation

Asides than the classification of either platinum, gold, silver, bronze, and certified, other external factors will affect the overall cost of green construction. The external factors are site location, design specifications, construction condition, material and equipment selection and construction expertise (Taemthong & Chaisaard, 2019). Overall cost reduction may be achieved by applying variables of high adaptability to any external and internal stress situations, revealing professional risks in timely manner and processes optimisation in green building construction (Borkovskaya et al., 2018).

Few strategies can also be implemented to reduce green construction cost. Hwang et al. (2017) laid out few strategies that can be taken to make green building construction more cost economical thus reducing cost premiums. Solutions laid out by Hwang et al. (2017a) are government to provide incentive, low interest loans, lending schemes, tax relief, skilled project team, educational course and subsidies for green building professional courses.

From the previous strategies listed in Table 2.1, it can be seen building cost minimisation study is required to be done to further increase and promotes green construction. Therefore, this research will scrutinises the monetary aspect of green building construction to address issues related to its implementation. This includes the identification of the cause of the significant cost of green building construction strategies for cost minimisation, and the relationship between cost reduction strategies and stakeholders' cost satisfaction.

2.2.5 Industry Stakeholders' Satisfaction

Implementation of green building construction will not only affect the cost of construction but also the satisfaction of stakeholders. Employee satisfaction must be taken in consideration for an exemplary implementation of green building construction (Presley et al., 2007). Liu et al. (2018) found that building occupants of green certified building showed higher satisfaction rate as to compare with occupants of non-certified building. Thermal comforts and air quality in a green certified buildings performed better than those in a non-certified building thus resulting in increase of satisfaction among building occupants (Abbaszadeh et al., 2006). Cost is observed to be one of the internal driver barriers that demotivated stakeholders towards a successful implementation of green building. This can be combatted by attitudes and behavioural change through enhancing financial and economic value as well as introducing credible policies and regulation tools (Mustaffa et al., 2021). Therefore, there is a need to address the industry stakeholders' satisfaction to evaluate and reduce the cost of green building construction.

2.3 Existing Model Pertains to Green Building Construction

There are various of existing model related to green building construction. Below are some of the available models which pertains to the issue of green building construction.

a. **Model 1 - Performance Indicator Model.**

Green construction is a vital aspect of green building, and the implementation process is long and strenuous task (Shi & Xie, 2009). Management Performance Indicator involved 6 indicators which are involvement of management, training, investment, environmental management program, environmental training, and management program (Tam et al., 2004).

b. **Model 2 - Operational Performance Indicators (OPIs).**

Green Construction Assessment is part of the important aspect of Operational Performance Indicator (OPIs). Equipment maintenance as well as control for air, noise, water, and waste pollution control must be carried out. Ecological impact and energy consumption shall also be taken in consideration under this model (Tam et al., 2004).

Model 3 - Green Construction Framework. Theoretical framework of green building construction includes environmental regulations, managerial concerns, and project stakeholder pressure. (Qi et al., 2010).

c. **Model 4 - Implementation of Green Construction.**

Implementation of green building construction must take few general statements under this model. The statement suggest environmental requirements, guide and specification must be easily accessible internally, green factors must be considered for public projects, green factors must be considered for private constructions, company must prepare ample green construction information and database, mandatory requirements to be fulfilled

with green considerations, voluntary participation in green construction and lastly, mandatory green building implementation is to be urged by the government (Shi et al., 2013).

d. Model 5 - The Path of Achieving Sustainable Development.

For this model there are three aspects that must be considered towards the path to achieve sustainable development. The first one is environmental protection that preserve built and natural environment and prevent adverse effect towards the environment. The second aspect is social well-being that focuses on human satisfaction, safety, and comfort. Lastly, economic prosperity also needs to be examined to achieve sustainable development (Lombardi, 2001).

e. Model 6 - BEACON model.

This readiness assessment model development is to purposely measure the readiness of construction organizations before concurrent engineering application. This model is based on four major components known as a process component, people component, project component, and technology component. Process maturity level of construction organisation will be assessed by using process components. People components involves assessment of management team issues within the organisation. Client's requirements and issues related design is to be assessed with project components. Technology introduction and utilisation is to be achieved by using technology component (Khalfan et al., 2001).

f. Model 7 - Green Construction Model.

This model was developed to facilitate construction stakeholders to implement green construction (Ahmad Zaini, 2018). They must be fully aware and understand the concept and definition, benefits, innovation, and current practices of green building construction. On

the other hand, the moderators in this model will help the construction stakeholders be more attentive to the disadvantages and challenges that might occur before or during the implementation of green construction (Ahmad Zaini, 2016; Ahmad Zaini, 2018).

It can be observed that the existing models of green building construction are mainly focusing on awareness, readiness, design, and environment. Economic aspects are absent in the existing models. Hence, there is a need to examine the most expensive elements in green building construction and to propose recommendations to minimize the overall cost of green building construction. Based on the recommendations, a Cost Reduction-Client Satisfaction Framework based on developmental process will be formulated to encourage the clients and contractors to invest in green building construction.

2.4 Green Building Components

Green building construction without doubt imposed higher initial cost of building construction compared to construction of building through conventional method due to its known cost premium. According to Russ et al. (2018), there are 27 factors which can be divided into seven Components of green construction cost premium. The seven components are sustainable material, sustainable equipment, sustainable technology, sustainable design, tendering, contractors' experience and insurance. Throughout the life cycle of a building, construction cycle imposed the highest cost throughout the whole construction project.

For a building to be considered green, few characteristics and principle are required to be achieved. According to Solanki and Nayyar (2019), green building can be achieved by considering three main categories which are technical, managerial and behavioural. These

three characteristics took in the consideration from technological aspect of what making a building green to human behaviour concerning managerial and cultural aspect. The incorporation of social resources is required to achieve green of a building through the manipulation of basic form and space of a building. This can also be achieved through manipulation of passive green building elements being designed to fulfil climatical needs and changes. Green building is an effort in blending the existence of artificial structure to fit the organic existence of the nature (Zhang et al., 2021). Green building objectives and goals can also be reached through the utilisation of technology such as the implementation of smart building (Pramanik et al., 2019). Smart building utilises smart materials that will result in great command in energy consumption of a building. This characteristic corresponds with the need of green building to have a control of energy consumption (Patil et al., 2022).

Therefore there is an importance in identifying green building components that is going to be addressed in this research.

2.4.1 Green Building Index (GBI) Criteria and Points System

GBI divided main criteria of green building into Energy Efficiency (EE), Indoor Environmental Quality (EQ), Sustainable Site Planning & Management (SM), Material and Resources (MR) and Water Efficiency (WE) and Innovation (IN). Each of the main criteria were being assigned points to be fulfilled to reach a green building certification. The followings are the main criteria, criteria, points and technologies and strategies for Non-Residential New Construction green building as being stated in GBI Assessment Criteria Score Summary: -

Table 2.2: Main Criteria, Criteria and Points According to GBI Assessment Criteria Score Summary (Source: Green Building Index Guideline., 2009)

Criteria	Points	
Energy Efficiency (EE)		
EE1 (Minimum EE Performance)	1	
EE2 (Lighting Zoning)	3	
EE3 (Electrical Sub-Metering & Tenants Sub-Metering)	1	
EE4 (Renewable Energy)	5	
EE5 (Advanced EE Performance)	15	
EE6 (Enhanced Commissioning of Building Energy Systems)	3	
EE7 (Post Occupancy Commissioning)	2	
EE8 (EE Verification)	2	
EE9 (Sustainable Maintenance)	3	35
Indoor Environmental Quality (EQ)		
EQ1 (Minimum IAQ Performance)	1	
EQ2 (Environmental Tobacco Smoke (ETS) Control)	1	
EQ3 (Carbon Dioxide Monitoring and Control)	1	
EQ4 (Indoor Air Pollutants)	2	
EQ5 (Mould Prevention)	1	
EQ6 (Thermal Comfort: Design & Controllability of Systems)	2	
EQ7 (Air-change Effectiveness)	1	
EQ8 (Daylighting)	2	
EQ9 (Daylight Glare Control)	1	
EQ10 (Electric Lighting Levels)	1	
EQ11 (High Frequency Ballast)	1	

Table 2.2 continued

EQ12 (External Views)	2	
EQ13 (Internal Noise Levels)	1	
EQ14 (IAQ Before and During Occupancy)	2	
EQ15 (Post Occupancy Comfort Survey: Verification)	2	21
Sustainable Site Planning and Management (SM)		
SM1 (Site Selection)	1	
SM2 (Brownfield Redevelopment)	1	
SM3 (Development Density & Community Connectivity)	2	
SM4 (Environment Management)	2	
SM5 (Earthworks-Construction Activity Pollution Control)	1	
SM6 (Classic - Quality Assessment System for Building Construction Work)	1	
SM7 (Workers Amenities)	1	
SM8 (Public Transportation Access)	1	
SM9 (Green Vehicle Priority)	1	
SM10 (Parking Capacity)	1	
SM11 (Stormwater Design - Quantity & Quality Control)	1	
SM12 (Greenery & Roof)	2	
SM13 (Building User Manual)	1	16
Material and Resources (MR)		
MR1 (Materials Reuse and Selection)	2	
MR2 (Recycled Content Materials)	2	
MR3 (Regional Materials)	1	
MR4 (Sustainable Timber)	1	

Table 2.2 continued

MR5 (Storage & Collection of Recyclables)	1	
MR6 (Construction Waste Management)	2	
MR7 (Refrigerant & Clean Agents)	2	11
Water Efficiency (WE)		
WE1 (Rainwater Harvesting)	2	
WE2 (Waste Water Recycling)	2	
WE3 (Water Efficient Landscaping)	2	
WE4 (Water Efficient Fittings)	2	
WE5 (Metering & Leak Detection System)	2	10
Innovation (IN)		
IN1 (Innovation)	6	
IN2 (Green Building Index Facilitator)	1	7
Total Score		100

2.4.2 Building Elements and Green Building Criteria

Green building construction is notorious for its cost construction premium. Certification for green building varied from certified to platinum certified building for Green Building Index Certification. Cost of implementation of green construction is higher as compared to the construction of conventional building (Nasereddin & Price, 2021). The higher certification gained by a green building the higher the construction cost imposed (Chong et al., 2017; Tatari & Kucukvar, 2011). For example, Sun et al. (2019) highlighted

that percentage of cost surcharge of green building increases 1.58%, 6.7% and 9.3% for certified, gold and diamond grade certification respectively.

Green building construction has been receiving interest among researchers. Topics which are often studied related to green building construction are green roof, comparative assessment, building health, conventional building material, engineering design, building green, indoor environment quality, low-carbon integrated power grid (Wang et al., 2021). Despite of many interest has been shown in the topic related to green building construction, thorough classification especially those related to cost premium shall be studied further (Russ et al., 2018). Classifying and categorising green building elements will provide a necessary measure to recognise the most significant green building features that contribute the most to the cost value by building stakeholders (Owoha et al., 2021).

Typical elements of green building construction are Work Below Lowest Floor Finish (WBLFF), Frame, Staircase, Roofing and Roof Plumbing, External Wall, Internal Wall and Partitions, Window, Floor Finishes, Wall Finishes, Ceiling Finishes, Sanitary Appliances, Furniture and Builders' Work in Connection With Services.

According to a research made by Halil et al. (2022), building cost contributed the most to the construction of a green building. Substructure, frame and services are some of the elements that are identified as cost significant in a building construction (Victoria et al., 2017). Chegut et al. (2019) then further identified building elements that contributed the most to the cost of construction of green buildings which are fittings and finishes asides than preliminary and design cost. This finding is also supported by Victoria et al. (2017) which noted that internal finishes can potentially become the most cost significant elements especially in a high-end building office. Other elements which may hiked up the building

cost in a more premium building construction identified are external walls, windows and external doors, roof and internal walls and partitions. Findings by Chong et al. (2017) pointed out few elements which made up the largest cost in order for a building to reach its green building status. These elements are windows and vents, internal finishes and other (elements which are not included in the BOQ but contributed significantly to the green building status).

The followings are the list of green building criteria of that needed to be achieved by a building to be recognised as a green building classified by building elements: -

Table 2.3: Building Elements and Green Building Criteria (Source: Green Building Index Guideline., 2009)

Building Elements	Green Building Criteria
WBLFF	EQ12 – External Views MR1 – Materials Reuse and Selection MR2 – Recycled Content Materials MR3 – Regional Materials MR4 – Sustainable Timber
Frame	EQ12 – External Views MR1 – Materials Reuse and Selection MR2 – Recycled Content Materials MR3 – Regional Materials MR4 – Sustainable Timber
Upper Floor	EQ12 – External Views MR1 – Materials Reuse and Selection MR2 – Recycled Content Materials MR3 – Regional Materials MR4 – Sustainable Timber

Table 2.3 continued

Staircase	EQ12 – External Views
	MR1 – Materials Reuse and Selection
	MR2 – Recycled Content Materials
	MR3 – Regional Materials
	MR4 – Sustainable Timber
Roofing and Roof Plumbing	EE1/EE5 – Minimum/Advanced EE Performance
	EQ8 – Daylighting
	EQ9 – Daylight Glare Control
	SM12 – Greenery & Roof
	WE1 – Rainwater Harvesting
	MR1 – Materials Reuse and Selection
	MR2 – Recycled Content Materials
	MR3 – Regional Materials
	MR4 – Sustainable Timber
External Wall	EE1/EE5 – Minimum/Advanced EE Performance
	EQ8 – Daylighting
	EQ9 – Daylight Glare Control
	EQ13 – Internal Noise Level
	MR1 – Materials Reuse and Selection
	MR2 – Recycled Content Materials
	MR3 – Regional Materials
	MR4 – Sustainable Timber
Internal Wall and Partitions	EQ8 – Daylighting
	EQ9 – Daylight Glare Control
	EQ13 – Internal Noise Level
	MR1 – Materials Reuse and Selection
	MR2 – Recycled Content Materials
	MR3 – Regional Materials
	MR4 – Sustainable Timber

Table 2.3 continued

Doors	EQ8 – Daylighting
	EQ9 – Daylight Glare Control
	EQ13 – Internal Noise Level
	MR1 – Materials Reuse and Selection
	MR2 – Recycled Content Materials
	MR3 – Regional Materials
	MR4 – Sustainable Timber
Windows	EQ8 – Daylighting
	EQ9 – Daylight Glare Control
	EQ13 – Internal Noise Level
	MR1 – Materials Reuse and Selection
	MR2 – Recycled Content Materials
	MR3 – Regional Materials
	MR4 – Sustainable Timber
Floor Finishes	EQ4 – Indoor Air Pollutant
	EQ13 – Internal Noise Level
	MR1 – Materials Reuse and Selection
	MR2 – Recycled Content Materials
	MR3 – Regional Materials
	MR4 – Sustainable Timber
Wall Finishes	EQ4 – Indoor Air Pollutant
	EQ13 – Internal Noise Level
	MR1 – Materials Reuse and Selection
	MR2 – Recycled Content Materials
	MR3 – Regional Materials
	MR4 – Sustainable Timber

Table 2.3 continued

Ceiling Finishes			EQ4 – Indoor Air Pollutant
			EQ13 – Internal Noise Level
			MR1 – Materials Reuse and Selection
			MR2 – Recycled Content Materials
			MR3 – Regional Materials
			MR4 – Sustainable Timber
Sanitary Plumbing	Fittings	and	WE2 – Waste Water Recycling
			WE4 – Water Efficient Fittings
			MR1 – Materials Reuse and Selection
			MR2 – Recycled Content Materials
			MR3 – Regional Materials
			MR4 – Sustainable Timber
Furniture			EQ13 – Internal Noise Level
			MR1 – Materials Reuse and Selection
			MR2 – Recycled Content Materials
			MR3 – Regional Materials
			MR4 – Sustainable Timber
Signage			EQ2 – Environmental Tobacco Smoke (ETS) Control

2.4.3 Building Green Components and Green Items

The followings are the possible items that could be applied to a building construction to obtain green building certification: -

Table 2.4: Possible Items to be Implemented to Obtain Green Building Certification
(Source: Green Building Index Guideline., 2009)

No.	Green Components	Green Items
1	EE1 – Minimum EE Performance	Autoclaved lightweight concretes, composite insulated walls, double brick wall and many other construction systems
2	EE5 – Advanced EE Performance	The use of Insulated Glazing Units and/or performance glazing such as low-e and/or spectrally selective glazing is encouraged. Roof should be insulated with suitable insulation materials to prevent heat gain into occupied spaces.
3	EQ2 - Environmental Tobacco Smoke (ETS) Control	Signages
4	EQ4 – Indoor Air Pollutant	Low VOC paint, no urea formaldehyde, composite woods and agrofibre product such as particleboard, MDF and plywood, insulation foam, draperies
5	EQ8 - Daylighting	Window, facade shading/light deflecting devices (e.g. light shelves), roof lights and atrium spaces.
6	EQ9 – Daylight Glare Control	Glazing and atrium as a base building, incorporate provisions to meet the following criteria;
7	EQ12 – External Views	Column free space, open space

Table 2.4 continued

8	EQ13 – Internal Noise Levels	Specify acoustical ceiling, furniture with sound absorbing surfaces, photocopier, fax machines away from main office area in a separate area, insulate partition cavities, mechanical equipment located away from office and conference room
9	MR1 – Materials Reuse and Selection	Fixed components such as doors, cabinetries, posts etc. that no longer serve their original function are refurbished, reconditioned and installed for a different use or in a different location. Temporary structures Formwork are reused or located from other facility or used many times before disposal.
10	MR2 – Recycled Content Materials	Using materials with recycled content .
11	MR3 – Regional Materials	Materials produced or harvested within 500km radius of project site.
12	MR4 – Sustainable Timber	Timber used shall be receiving proper certification such as by complying with the Forest Stewardship Council (FSC) and Malaysian Timber Certification Council (MTCC)
13	SM12 – Greenery & Roof	Landscaping design is incorporated to reduce heat island such as by using hardscape and greenery application or vegetated roof.
14	WE1 – Rainwater Harvesting	Rooftop rainwater harvesting system for the purpose of reduction of potable water consumption.
15	WE2 – Waste Water Recycling	On site water treatment system for the water to be reused and recycle.
16	WE4 – Water Efficient Fittings	Water efficient fittings such as automatic self-closing faucets etc. to achieve reduction of water consumption

Materials selection played an important role in determining the final cost of building construction (Hu & Skibniewski, 2021). In research made by Insja & Sihombing (2017), material has been identified as some of the most influential financial risk factor. These risk factors are material price fluctuation, cost of material distribution, late fees for materials (delivery/procurement), changing material specification and type, material damage, lost materials and excessive material quality. It is worth noting that the selection of materials also contributed to the greenhouse gas emission of a building which then determined its sustainability (Huo et al., 2020). Green materials at often are expensive to be used in a construction project. For example, Ultra-High Performance Concrete (UPHC) is widely being used for its sustainability properties. Despite of its reliability, the implementation cost is high with limited design codes and thus hinders its widespread usage. An effort to concoct an alternative to the costly material whilst retaining its benefits shall be orchestrated to further utilised the material advantages (Azmeem & Shafiq, 2018). Fittings and furnishing also contributed to the construction cost premium. One of the challenges of Rainwater Harvesting System (RWHS) in Malaysia is the competitive cost of implementation (Lani et al., 2018).

Overall, building works and construction contributed the most to the cost of green building construction (Halil et al., 2022). This includes material cost (Hu & Skibniewski, 2021; Insja & Sihombing, 2017), fittings, furnishing and finishes, external walls, windows and external doors, roof, internal walls, and partitions (Chegut et al., 2019; Victoria et al., 2017). There are five elements of green building construction according to Green Building Index that must be built within requirements for building construction to achieve green building status or certification. These five elements are Energy Efficiency (EE), Internal Environmental Quality (EQ), Sustainable Site Management (SM), Material and Resources (MR) and Water Efficiency (WE). Under these five main elements, there are fifteen items

that needed to be taken in consideration for green building construction. These fifteen items are Minimum/advanced Energy Efficiency Requirements, Environmental Tobacco Smoke (ETS) Control, Indoor Air Pollutant, Daylighting, Daylight Glare Control, External View, Internal Noise Levels, Greenery and Roof, Materials Reuse and Selection, Recycled Content Materials, Sustainable Timber, Rainwater Harvesting, Wastewater Recycling and Water Efficient Fittings. Building Elements that is to be greenified are Structural, Staircase, Roofing and Roof Plumbing, Walls, Doors and Windows, Finishes, Sanitary Fittings and Plumbing, Furniture and Signage.

The relationship between green building components and green building elements are being illustrated in Figure 2.1. The summary of the relationship is being presented in Table 2.4. These relationship is relevant to this research in which the variables are going to be gathered to reach the research objectives.

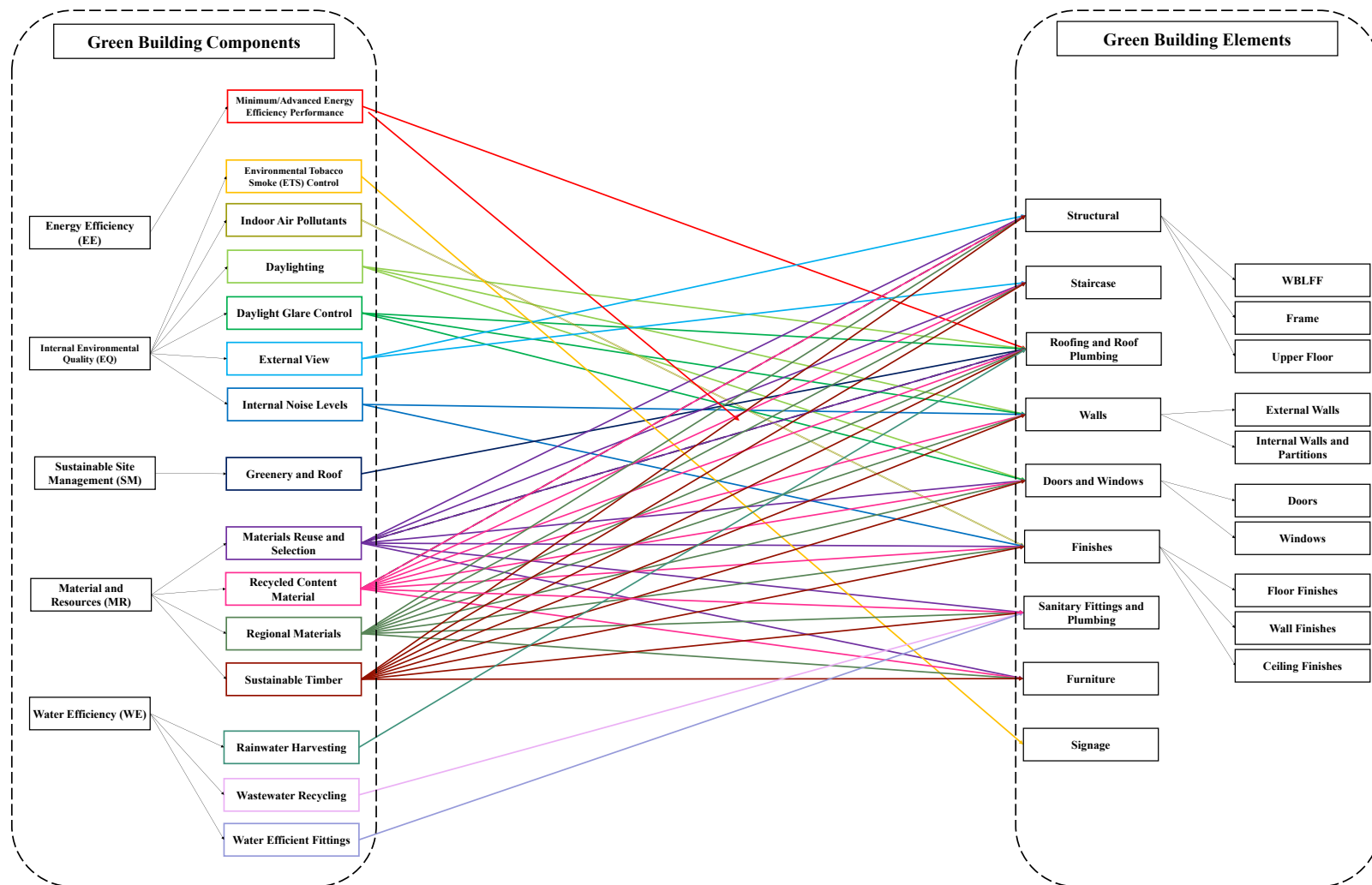


Figure 2.1: Green Building Components and Green Building Elements

Table 2.5: Summary of Green Building Elements and Elements of Green Building (GBI Guidelines, 2009).

Building Elements	Green Components	Items
Structural (WBLFF, Frame, Upper Floor)	EQ12	Design and construction for column free open space
	MR1, MR2, MR3, MR4	Materials are obtained from reusable materials, recycled materials, locally or regionally sourced and timber used are certified
Staircase	EQ12	Design and construction for column free open space
	MR1, MR2, MR3, MR4	Materials are obtained from reusable materials, recycled materials, locally or regionally sourced and timber used are certified
Roofing and Roof Plumbing	EE1/EE5	To achieve energy efficiency performance by using insulated materials to prevent heat gain for a maximised energy performance (eg: autoclaved lightweight concrete, insulated glazing)
	EQ8,EQ9	Daylight system and reduction of daylight glaring (eg: façade, shading, light shelves, glare control)
	MR1, MR2, MR3, MR4	Materials are obtained from reusable materials, recycled materials, locally or regionally sourced and timber used are certified.
	SM12	Greenery and roof related to the landscaping design (eg: hardscape and greenery application, vegetated roof, material with Solar Reflectance Index)
	WE1	Rainwater harvesting system (eg: collection of runoff rainwater, water purifying system)

Table 2.5 continued

Walls (Internal Walls and External Walls)	EE1/EE5	To achieve energy efficiency performance by using insulated materials to prevent heat gain for a maximised energy performance (eg: autoclaved lightweight concrete, insulated glazing)
	EQ8,EQ9,EQ13	Daylight system, reduction of daylight glaring and control of internal noise levels (eg: façade, shading, light shelves, glare control, acoustical ceiling, insulated partition cavities)
	MR1, MR2, MR3, MR4	Materials are obtained from reusable materials, recycled materials, locally or regionally sourced and timber used are certified
Doors and Windows	EQ8,EQ9,EQ13	Daylight system, reduction of daylight glaring and control of internal noise levels (eg: façade, shading, light shelves, glare control, acoustical ceiling, insulated partition cavities)
	MR1, MR2, MR3, MR4	Materials are obtained from reusable materials, recycled materials, locally or regionally sourced and timber used are certified
Finishes	EQ4, EQ13	Control of indoor air pollutant and control of internal noise levels (eg: using low VOC paint, no urea formaldehyde for composite woods used, agro fibre product, insulation foam and draperies, acoustical ceiling, carpet)
	MR1, MR2, MR3, MR4	Materials are obtained from reusable materials, recycled materials, locally or regionally sourced and timber used are certified

Table 2.5 continued

Sanitary and Plumbing	Fittings	MR1, MR2, MR3, MR4	Materials are obtained from reusable materials, recycled materials, locally or regionally sourced and timber used are certified
		WE2,WE4	Waste water recycling and water efficient fittings (eg: water treatment system for greywater, fittings such as shower head and faucets are water efficient)
Furniture		EQ13	Control of indoor air pollutant (eg: using low VOC paint, no urea formaldehyde for composite woods used, agro fibre product, insulation foam and draperies)
		MR1, MR2, MR3, MR4	Materials are obtained from reusable materials, recycled materials, locally or regionally sourced and timber used are certified
Signage		EQ2	Environmental Tobacco Smoke (ETS) control by installation of signages to ensure indoor smoking provision are adhered.

2.5 Cost Reduction Strategies

Building cost and affordability is majorly impacted by supply and demand factors which is influenced by construction and planning process of building construction (MacAskill et al., 2021). One of the barriers that is identified to hinder the development and implementation of green building is lack of demand by industry stakeholders (Wong et al., 2021). This statement is also being supported by Eze et al. (2020) which has mentioned that green construction market is still being unexplored despite there are arrays of benefits of the implementation. Market demand and supply for green building materials must be invigorated to increase participation and supply of green building materials. Price increase and allocation is majorly determined by supply and demand curve which is also known as price theory (Nelson, 2012). In research made by Kamaruddeen et al. (2018) supported price theory by noting that level of market demand played a significant role in determining materials cost and price. Factors of development demand and supply includes Economic, Social, Policy, Technology, Environment, Industrial Practice and Awareness (Mohammed Hatem et al., 2021). Therefore, in order to control the cost of materials in green building construction to ensure widespread use is by adhering to the supply and demand theory in which creating more demand to reduce the materials cost. Through addressing the supply and demand theory, variables can be identified to reach research objectives.

2.5.1 Economic

One of the factors of development for demand and supply that will influence market price is Economic (Mohammed Hatem et al., 2021). Finance is one of the main drivers for developmental of building and infrastructural project (Sachs et al., 2019). Green finance management is imperative in determining its effectiveness and maintain the sustainability of green finance (Chen & Zhao, 2022). Green finance securities shall be adopted to ensure

widespread implementation of green construction (GBC Annual, 2020). A design of financial and financing incentive that consider a whole green building supply network in order to ensure firms coordination thus increasing interest and demand in green building construction (Gobbo et al., 2017). Green securities, green investments, climate finance, carbon finance, green insurance, green credit and green infrastructural bonds are part of green finance products of banks (Akomea-Frimpong et al., 2021; Chegut et al., 2019). Green finance includes green bonds, green bank, carbon market instruments, fiscal policy, green central banking, financial technologies and community based green funds (Debrah et al., 2022; Sachs et al., 2019). To further fortify the green finance value to reap its benefit, risks such as environmental and climate change policies, interest rates, religion, risks, social inclusion and social justice as well as banking regulations must be scrutinised (Akomea-Frimpong et al., 2021).

Fiscal policy is recognised as a method to increase rate of return for green projects and elevating private sector's share of investment in construction project which can be done through tax relief or tax credit (Sachs et al., 2019). Tax relief shall be provided for developers and contractors for use of the green building products, systems and technologies to encourage the green implementation (Hwang et al., 2017). Monetary policy can be utilised to increase demand in green construction (Kamaruddeen et al., 2018). This method also being known as window guidance in which is described as an informal guidance to regulate the supply of a credit as a way to achieve policy targets (Dikau & Volz, 2021). This method has been adopted by People's Bank of China (PBoC), a first central bank that implemented specific policy to target green bond and successful in developing green bond market (Macaire & Naef, 2022). Dikau and Volz (2021) highlighted four lessons to ensure smooth implementation of the policy obtained from PBoC experience. 1. Window guidance is to be

used to direct lending towards green economic activities, 2. window guidance and direct lending policy will diminish as financial markets mature, 3. usage of window guidance should be accompanied with monitored achievement and lastly 4. general green policy shall incorporate green window guidance. Consumer directed policy could be approached such as by ensuring compliance for green building materials or technology adoption (Ndeketeya & Dundu, 2019). New policy model which are market-oriented need to be strategized to cope with barriers of green building construction (Zhou et al., 2015).

2.5.2 Social

Next factor that correlated with creating demand for adoption of green building concept identified by Mohammed Hatem et al. (2021) is Social aspect. For consumer theory, end user is recognised as a change agent as their demand for innovation and sustainability will invigorate green construction industry which can be achieved by using market-focused approach (Warren-Myers & Heywood, 2018). When the consumer demand in certain product increases, the producers will produce more goods in order to meet the needs and as the market expands cost of goods will be lowered (Diewert, 2003). Gobbo et al. (2017) supported the previous statement with research finding that stated consumer willingness is one of the drivers that pushed green building market to be adopted and expanded.

Market orientation culture is found to promote sustainability to increase the implementation by applying competitive action focusing on meeting the consumer needs and demand (Bamgbade et al., 2017). Green marketing orientation is also required to increase consumer loyalty towards green culture (Chung, 2019). Adoption of greenness by an individual is often influenced by individual preference or self-interest and value such as altruism and fairness (Wei et al., 2021). Public-Private Partnership is identified as one of the

drivers to socially develop demand and supply for green construction (Mohammed Hatem et al., 2021; GBC Annual, 2021). Stakeholder engagement is also important throughout the process of green building planning and adoption to ensure successful implementation (Ndeketeya & Dundu, 2019). Building award system where recognition were to be given to accomplished green building construction is found to be boosting technology innovation of green building construction which will increase personal interest in green building construction (Kong & He, 2021). Therefore, it is imperative to create wants and needs by consumers through education, information and marketing to reduce material cost.

2.5.3 Policy

Policy also played an important role in the development of demand and supply (Mohammed Hatem et al., 2021). The implementation of green building shall be supported by establishment of policy and regulations related green construction (Huo & Yu, 2018). Government policy is found to be the most influential in empowering the green building construction (Ching et al., 2022). Despite of the existence of green building regulation standards, the implementation extensive implementation of it in the construction is still required especially in developing countries where this issue is the most prevalent (Lu & Lai, 2019). This correlates with the aforementioned demand and supply theory where the widespread implementation of green building policies and regulations has been adopted, the cost of the implementation will subsequently be reduced (Warren-Myers & Heywood, 2018). Kong and He (2021) divided green building policy into two which are supply-sided policy and demand-sided policy. The research found that supply-side policy has been founded to promote innovation in green building construction. In Malaysia, one of the initiatives provided by government is introduction of MyHijau, a green procurement initiative that aims towards promoting green construction in Malaysia construction industry (Alqadami et al.,

2020). The purpose of the initiative being introduced is to encourage green consumerism and purchasing among Malaysians (Huda et al., 2022). Other initiatives by government includes green procurement, eco labelling and green rating tools (Sallehuddin et al., 2019). Despite of effort that has been implemented by the public sector and government in promoting greens and sustainability, there is still less support has been obtained from industry stakeholders and corporate bodies (Khalid et al., 2013). There is a need in establishing balance between government effort with private sector to promote going green. Partnership can be supported by creating new intermediary roles to further promote green and sustainability as a form to increase implementation and demand (Masuda et al., 2022). An effective legislative process is found to be required for the enforcement of sustainable construction material usage in the industry (Durdyev et al., 2018).

2.5.4 Technology

Technology can be adopted to further increase demand in green construction (Hatem et al., 2021). A smart building concept and technology is ubiquitous in the green building and sustainable construction (Ejidike & Mewomo, 2023). Internet of Things (IoT) has been identified as a major reason for the development of green and smart buildings (Jadhav, 2016). The implementation of smart or automated system took in consideration event monitoring and building optimisation and most importantly user preference to achieve satisfaction (Alduailij et al., 2021). Price differential for the adoption of smart building technology is identified to be contributed by limited consumer demand as well as limitation of changing consumer behaviour to meet the demand (Gobbo et al., 2017) . In the wake of recent global catastrophe, Covid-19 has pushed different industry into the adaptation of automated technology which includes smart homes, smart building and smart cities and cause surge of demand (Umair et al., 2021). An effective communication infrastructure is important to be

developed especially through the adoption of technological standards and other effective communication solution to ensure further adoption of green building construction. Lower cost technologies adoption can be implemented for energy generation as a solution to the barriers of green building adoption thus increasing demand for it (Gobbo et al., 2017).

Technology can also be adopted by construction project stakeholder to adopt the green building construction. Building for Environmental and Economic Sustainability (BEES) software tool is one of the software that can be adopted for implementation of green building construction. The process involved analysis of all stages in the life of a product: raw material acquisition, manufacture, transportation, installation, use, and recycling and waste management (Lippiat, 1999). Adoption of blockchain technology into the supply chain management will aid in pricing strategy and decision making of green materials prevent operational losses (Wei et al., 2021). Blockchain technology provided low cost crisis management that will result in price reduction of product that is to be paid by the consumers. Internet of Things (IoT) can also be implemented to improve green supply chain to ensure seamless communication between construction project stakeholders (Rane et al., 2021).

2.5.5 Environment

Environment is the next factors of development for demand and supply that shall be addressed (Mohammed Hatem et al., 2021). The abundance of natural resources can be recognised as a driver for green building implementation. According to Eze et al. (2020), there are few reasons that may increase demand in green building construction that is related to the environment. They are improved daylight and reduced need for artificial lighting, reducing emission of greenhouse gas emission and to reduce internal environment toxicity.

Natural resources can be utilised by cohesively implemented it into the building architectural design strategy which includes usage of natural lighting (Liu & Ren, 2020).

Passive cooling system is the most cost effective method of green building implementation (Nzube & Lyu, 2021). Passive cooling system exploits the natural environmental orientation and location for the adoption of the system. For example, promoting natural evaporation for heat dissipation by building natural or artificial water source (Firfiris et al., 2019). Implementation of passive cooling system reduces the need of air conditioning thus reducing energy consumption (Nzube & Lyu, 2021). Firfiris et al. (2019) recognised few suitable design techniques that is to be integrated into the design of passive cooling system which are the wind direction, the average temperature, the intensity of solar radiation and also landscape morphology. Shape of the building, roof inclination and construction must also be taken into design consideration to optimised the usage of passive cooling system techniques. In a country where high annual rainwater fall is high, passive rainwater harvesting is suitable to be adopted to meet the demand of domestic water consumption (Lani et al., 2018). The design includes utilising height of the building for distribution of the water collected throughout the building without or using less energy consumption. This method is found to be cost effective in reducing cost of water consumption of a building (Kucukkaya et al., 2020).

2.5.6 Industrial Practice

Factors for the development of demand in green building construction is also influenced by Industrial Practice (Mohammed Hatem et al., 2021). This can be done by exploring full range of cost effective reduction of emissions and energy use, measures that promote the use of renewable energy (energy efficiency measures), determine optimal

balance between minimisation of energy demand and the use of renewable energy (Almeida & Ferreira, 2018). Special attention shall be given during the design stage to alleviate cost implication (Victoria et al., 2017). This can be achieved by implementation of value management with Total Quality Management (TQM) (Nasereddin & Price, 2021). Value management processes are identified to provide knowledge relating to the sustainable construction to the stakeholders. This includes highlighting financial and non-financial initiatives, providing guidelines and guidance, familiarising with environmental scoring and providing in-house training (Yu et al., 2018). The implementation of Value Management for green construction will help to alleviate design and financial risk as well as supporting green construction goal which includes promoting the use of local sustainable materials (Alsolami, 2022). Reduction building construction time frame, the overall cost of building construction will also be reduced. This can be achieved by using prefabricated building materials to reduce planning and construction period (MacAskill et al., 2021). Other techniques and model that can be utilised to reduce construction cost for green building includes target value design/target costing as a method to effectively manage green building construction (Zimina et al., 2012). Cooperation between stakeholders and manufacturing is also important in making pricing decision that will determine the cost of obtaining green construction materials (Chen et al., 2019). Optimisation is imperative to reduce cost of construction for green building construction. This can be achieved by implementing optimisation model for choosing of construction material with high-cost risk (Castro-Lacouture et al., 2009) and determining optimal balance between minimisation of energy demand and the use of renewable energy for green building adoption (Almeida & Ferreira, 2018). Contractors should adopt level of flexibility while adopting green practices on site to achieve a balance between green practices, environmental performance and economic performance (Onubi et

al., 2020). Sustainable logistics practices must be adopted to ensure cost savings such as adaptation of reverse logistics by manufacturers (Richnák & Gubová, 2021).

2.5.7 Awareness

The last factors that may affect the development of demand and supply for green building construction is awareness (Mohammed Hatem et al., 2021). Eze et al. (2020) noted that by creating demand for the green materials and services will effectively reduce the cost of them implementation of green building construction. According to consumer theory, consumer is recognised as a change agent and will influence the market To create demand based on social construct, inexperience and expectation of end user must be addressed by providing education and information related to green building construction (Warren-Myers & Heywood, 2018). Green awareness influences green consumption behaviour (Rustam et al., 2020). Consumer green awareness may motivate the growth and development of green building construction (Qiao et al., 2021). A high green awareness among the consumer will ensure better outreach of information through relevant channel by manufacturer and supplier thus increasing demand for green materials (Tao et al., 2022). Not only for the consumers, retailers of green building material pricing is affected by their environmental awareness. Higher degree of environmental awareness such as fairness that will affect not affect product quality but influences the wholesale and retail price in the market. Therefore there is a need in increasing asymmetric awareness among the stakeholders in order to for the green product cost to be competitive (Zhang et al., 2019). Green Pages Malaysia (GBC) first green product and directory for Malaysia's Building Industry is being created to increase awareness for green construction material (GBC, 2022). Retailer-led supply chain is known to be one of the method that may increase green product to achieve best environmental performance (Hong et al., 2019). Other way to increase green product awareness is through increasing

corporate image which relates to the perceived quality of green product to increase awareness and purchase of green material and product (Lestari et al., 2021). Increased awareness in environmental issues will as well increase the awareness to the green material and product, thus campaign which raises environmental issues is a viable option to promote green materials and product (Sorood et al., 2019).

2.5.8 Summary for Cost Reduction Strategies

All in all, six factors for increasing demand and supply in order to manipulate market price of green building construction has been identified, these factors are Economics, Social, Policy, Technology, Environment, Industrial Practice and Awareness. Under these factors twenty-two strategies has been identified which will encourage demand for green product or material consumption for green building. The summary for the findings under this chapter are as the followings: -

Table 2.6: Summary for Cost Reduction Strategies.

Factors	Strategies	Researchers
Economic	Green securities, green investments, climate finance, carbon finance, green insurance, green credit and green infrastructural bonds, green central banking, financial technologies, community based green fund	(Akomea-Frimpong et al., 2021; Chegut et al., 2019) Debrah et al., 2022; Sachs et al., 2019)
	Fiscal policy (eg: tax relief, tax credit)	(Sachs et al., 2019) (Hwang et al., 2017b)
	Monetary policy or window guidance policy.	(Kamaruddeen et al., 2018) (Dikau & Volz, 2021)

Table 2.6 continued

Economic (Cont')	Consumer directed and market-oriented policy	(Ndeketeaya & Dundu, 2019) (Zhou et al., 2015)
Social	Market-focused approach (green marketing, market orientation culture)	(Warren-Myers & Heywood, 2018) (Bamgbade et al., 2017) (Chung, 2019)
	Public-Private Partnership	(Mohammed Hatem et al., 2021; GBC Annual, 2021)
	Green building award for green material/construction.	(Kong & He, 2021)
Policy	Establishing new intermediary roles to aid industry stakeholders .	(Masuda et al., 2022)
	Establishing effective legislative process and enforcement.	(Durdyev et al., 2018)
Technology	Effective communication infrastructure for green materials/construction.	(Gobbo et al., 2017)
	Adoption of blockchain technology into supply chain management to assist in pricing strategy.	(Kucukkaya et al., 2020)
	Internet of Things can also be application in green supply chain to improve communication.	(Rane et al., 2021)
Environment	Incorporation of passive sustainable technology into building design (passive cooling system, rainwater harvesting system).	(Liu & Ren, 2020) (Nzube & Lyu, 2021) (Firfiris et al., 2019)
Industrial Practice	Attention given during initial design stage	(Victoria et al., 2017)

Table 2.6 continued

Industrial Practice (Cont')	Value Management for green construction project	(Nasereddin & Price, 2021) (Yu et al., 2018)
	Establish cooperation between stakeholders and manufacturer	(Chen et al., 2019)
	Implementation of optimisation model in choosing green construction material	(Castro-Lacouture et al., 2009) (Almeida & Ferreira, 2018)
	On site flexibility practice.	(Onubi et al., 2020)
	Sustainable logistics practices such as reverse logistics by manufacturers.	(Richnák & Gubová, 2021)
Awareness	Retailer-led supply chain	(Hong et al., 2019)
	Increased corporate image for green product	(Lestari et al., 2021)
	Increase awareness for environmental issue	(Sorood et al., 2019)

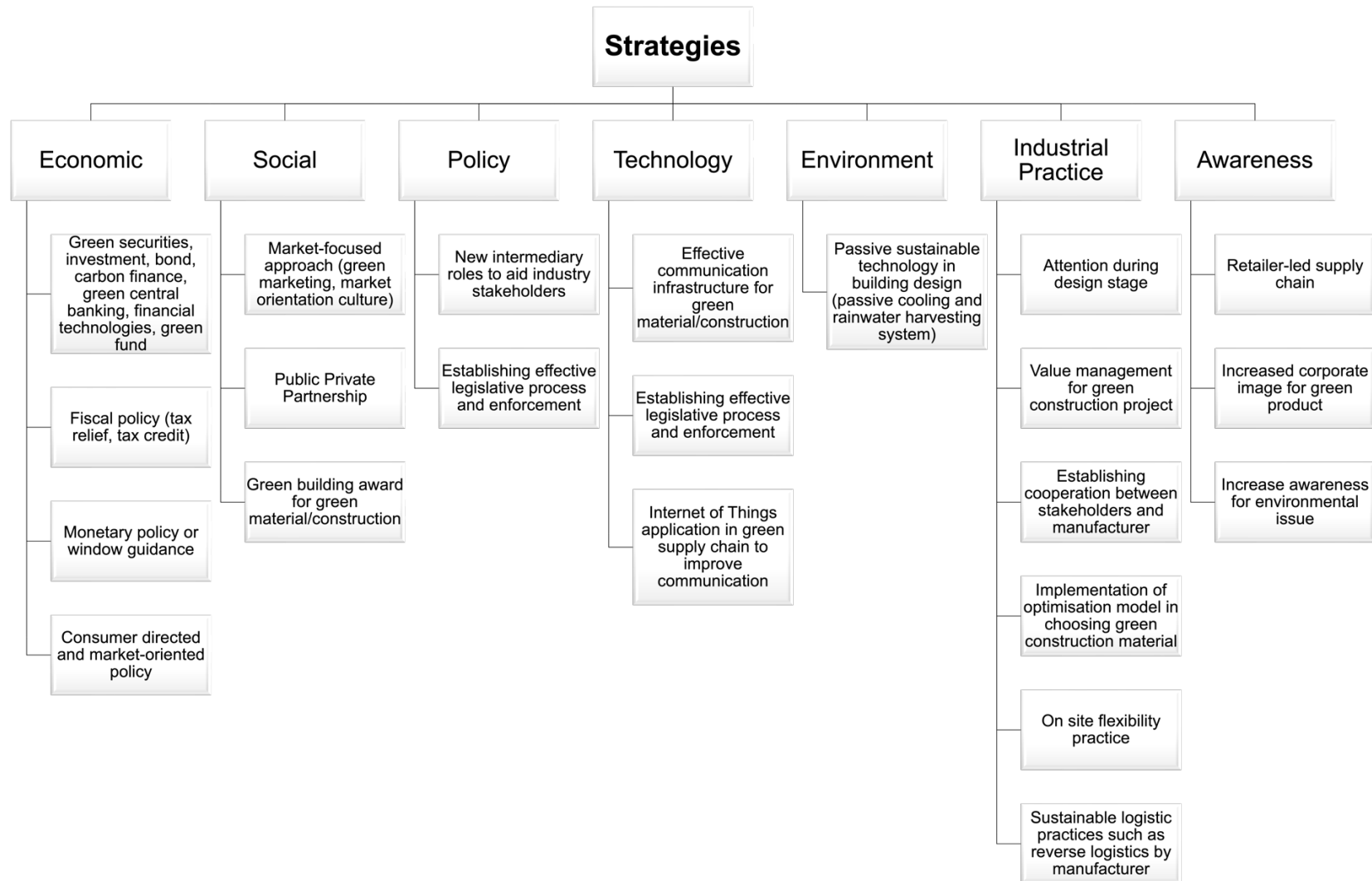


Figure 2.2: Strategies to Reduce Cost of Green Building Construction

2.6 Stakeholder's Cost Satisfaction

According to Hu and Skibniewski (2021), there are few factors which contributed to surcharge in the cost of construction for green building and these factors can be separated into direct and indirect cost factors. Direct factors are sustainable materials, sustainable equipment and systems, sustainable technologies, tendering and contract procurement, construction means of the method and design and consulting cost. Indirect factors are policies and incentives, competition among products and services, supply chain maturity, skill sets and working experience and skills and design experience of architects and engineer.

Quoting Sinambela et al. (2022), green product and price has influence on repurchase intention among consumers. Reduction in product cost and improving customers perception of benefits for the product may increase customers' satisfaction (Kshetri, 2019). Improved product image is found to be increasing satisfaction among green consumers and to reach this, green strategies shall be pursued to increase corporate image thus customer satisfaction (Commer et al., 2019). In previous sub-chapter, few strategies were gathered from literature review which covers few factors to increase demand and supply of green product to achieve competitive green material cost. these factors are economic, social, policy, technology, environment, industrial practice and awareness (Mohammed Hatem et al., 2021). Satisfaction is one of the most important factors that determine customers' loyalty more than fluctuating cost (Samudro et al., 2019). For an organisation to be competitive, increasing customer satisfaction and reducing product cost are some of the measures that can be taken to ensure loyalty and continuous demand (Ghoumrassi & Tigu, 2017).

Consumers are willing at spending more money towards green products due to the benefits (Mukaromah et al., 2019). Satisfaction is viewed as buying decision and pre-buying

experiences, a performance attribute and consume-use experience (Drosos et al., 2020). Customer satisfaction can be evaluated through multicriteria evaluation problem where satisfaction towards product depends on a set of satisfaction criteria (Grigoroudis & Politis, 2018).

Price contributed to customer's loyalty and satisfaction. Satisfaction to product is influenced by positive perception to the product and the price is in accordance with benefits obtained (Wantara et al., 2019). Price satisfaction is an influential factor which will contribute to consumerism growth (Boniface et al., 2012). Price satisfaction is affected by transparency, price quality ratio, relative price, reliability and price fairness (Lymperopoulos et al., 2013; Matzler et al., 2006).

2.6.1 Price Transparency

Price transparency will contribute to the lower product price and less product price variation (Gried, 2021). Martin (2018) described transparency of price as reduction of uncertainty in production cost in which the producer's cost will influence consumer purchasing decision. Theoretically, price transparency will reduce price, price dispersion, producer's profit and customer costs (Martin, 2018). Price transparency for green product is found to have moderate influence for green product satisfaction (Yaseen Bhutto et al., 2019). 1-4% cost reduction may occur due to the consumer actively participating in gathering cost information through cost transparency. This will also increase competition by supplier in green construction industry (Whaley, 2019). The result of price transparency is found to increase consumers' satisfaction. Some of the effort for price transparency in green building construction includes government's subsidies (Khosroshahi et al., 2021).

2.6.2 Price-Quality Ratio

Next is price-quality ratio where product demand depends on the dynamic and relationship between cost and quality (Voros, 2019). Park et al. (2020) found that scarcity reduces price sensitivity for product. For example, due to high demand and less supply, consumer will focus on obtaining the material instead of on the cost of materials, also known as desire for abundance. User satisfaction is also related to the price-quality ratio. Customer will have desire to pay more for high quality product deliverance (Mori, 2021). To tackle issues related to price-quality ratio, improving operational efficiency is found to be reliable to soften price increase whilst increasing product quality (Voros, 2019). Price-quality will increase satisfaction among consumers (Asaad & El-Sayegh, 2021; Zhan, 2019).

2.6.3 Relative Price

Relative price is purchasing power parity divided by the nominal exchange rate (Inklaar & Timmer, 2014). This relationship can be expressed in a form of equation where $\text{Relative Price} = (\text{Price Good A} / \text{Price Good B})$ or $(\text{Price Good A} / \text{Price of All Other Goods})$ (Ruby, 2020.). Tax treatment and policy instrument are recognised mediator to issues related to goods relative price (Jones, 1994).

2.6.4 Price Reliability

Price reliability is obtained when the consumers are certain that price of goods are stabilised without any sudden changes of price occurred in the market (Matzler et al., 2006). The rise and fall of price in the market is inevitable but minimisation of the impact shall be tackled by finding balance between supply and demand (Ogura & Tsuda, 2020). Price fluctuations is found to be one of the contributing factors towards project cost overrun causing dissatisfaction among project stakeholders (Durdyev, 2020). Construction industry

is fragmented in nature and to achieve cohesive supply chain integration is imperative to be applied to overcome construction price volatility (Hamledari & Fischer, 2021). Green bond market is less persistence to financial crisis as compared to conventional bond. Therefore, there is a need of intervention towards this issue to support goal of green economy and construction (Adekoya et al., 2021).

2.6.5 Price Fairness

Price fairness is found to affect consumers' satisfaction on delivery of goods and services (Agus Khoironi et al., 2018). Price fairness is determined by few factors which are differences between seller's price and competitor price, price is acceptable and reasonable, and price is in accordance with product or service performance (Opata et al., 2019). It affects product adoption and satisfaction to the consumers (Adekoya et al., 2021; Haryanto et al., 2018).

2.6.6 Summary of Stakeholder's Satisfaction

All in all, five factors for Stakeholder's Satisfaction are Price Transparency, Price-Quality Ratio, Relative Price, Reliability, and Price Fairness. Under these factors fifteen Stakeholder's Satisfaction has been identified as the followings: -

Table 2.7: List of Factors Which Affects Stakeholders' Satisfaction

Factors	Stakeholders' Satisfaction
Price	Certainty of production cost for green materials.
Transparency	Green materials cost can be obtained.
	Subsidies for green materials by the government.
	Scarcity of green product led to cost surplus.
Price-Quality Ratio	Green materials cost is in accordance with the quality.
	Cost spent on green materials has increased product efficiency.
	Tax treatment for green materials.
Relative Price	Policy instruments implemented for green materials.
	Price differences between green material and non-green materials.
Reliability	Green materials price stability.
Reliability	Cohesiveness of supply chain integration.
	Green bond market implementation.
Price Fairness	Price differences between green material and non-green materials.
	Price differences between seller's price and competitor's price for green materials.
	Reliable price for green materials.

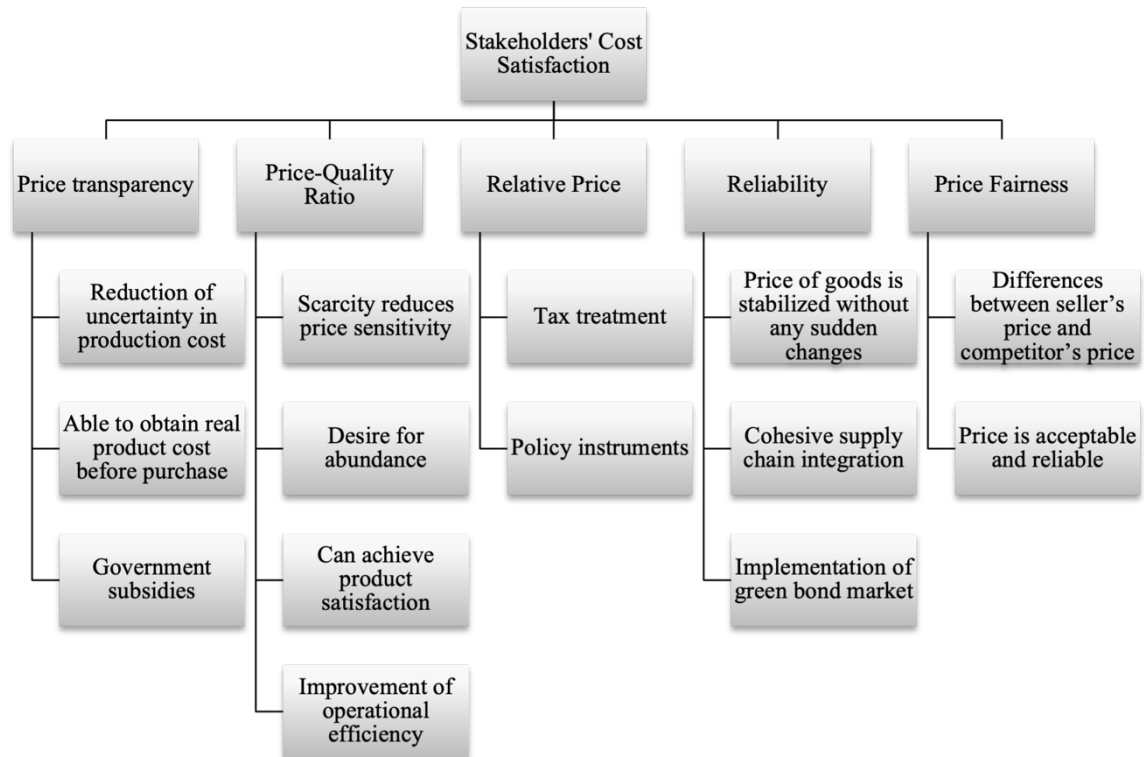


Figure 2.3: Stakeholders' Cost Satisfaction Summary

2.7 Conceptual Framework

From the literature review, conceptual framework for economic of green building construction then being constructed. The variables are identified to achieve the aim of the research which is expected to encourage and motivation the industry stakeholders to invest in green building construction. Proposition that could be drawn are as the followings:-

Proposition 1: There is a significant relationship between the Economic Building Elements and the Industry Stakeholder Satisfaction.

Proposition 2: Expensive Building Elements moderates the significant relationship between the Economic Building Elements and the Industry Stakeholder Satisfaction.

Proposition 3: Strategies in Minimizing Cost moderates the significant relationship between the Economic Building Elements on Industry Stakeholder Satisfaction.

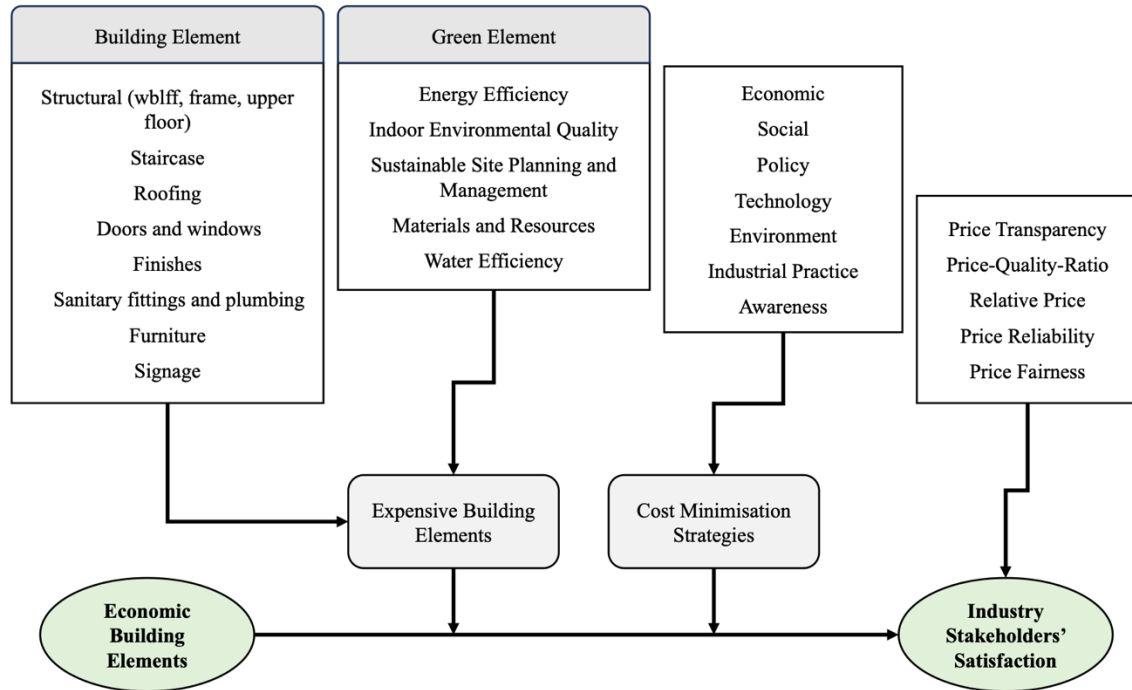


Figure 2.4: Conceptual Framework of Economic of Green Building Construction

2.8 Summary

Under this chapter economic of green building construction can be obtained and Building elements and green components can be identified. There are five elements of green building construction according to Green Building Index that must be built within requirements for building construction to achieve green building status or certification. These five elements are Energy Efficiency (EE), Internal Environmental Quality (EQ), Sustainable Site Management (SM), Material and Resources (MR) and Water Efficiency (WE). Under these five main elements, there are fifteen items that needed to be taken in consideration for green building construction. These fifteen items are Minimum/advanced Energy Efficiency Requirements, Environmental Tobacco Smoke (ETS) Control, Indoor Air

Pollutant, Daylighting, Daylight Glare Control, External View, Internal Noise Levels, Greenery and Roof, Materials Reuse and Selection, Recycled Content Materials, Sustainable Timber, Rainwater Harvesting, Wastewater Recycling and Water Efficient Fittings. Building Elements that is to be greenified are Structural, Staircase, Roofing and Roof Plumbing, Walls, Doors and Windows, Finishes, Sanitary Fittings and Plumbing, Furniture and Signage.

Next, strategies that can be taken to reduce cost can be gathered. Six factors for increasing demand and supply in order to manipulate market price of green building construction has been identified, these factors are Economics, Social, Policy, Technology, Environment, Industrial Practice and Awareness. Under these factors twenty-two strategies has been identified which will encourage demand for green product or material consumption for green building.

Finally, stakeholders' cost satisfaction can be extracted from the literature review. Five factors for Stakeholder's Satisfaction are Price Transparency, Price-Quality Ratio, Relative Price, Reliability, and Price Fairness. Under these factors fifteen Stakeholder's Satisfaction has been identified.

From the literature review, conceptual framework is able to be constructed to reach the research objectives. Questionnaire then is to be developed to further reach the research objectives.

CHAPTER 3

METHODOLOGY

3.1 General

For this chapter, methodology to achieve research aims and objectives of this research will be discussed.

In this chapter, the methods used to analysed research aims, objectives and problems stated in previous chapter are being laid out. According to Jonker and Pennink (2009), methodology and research design is being described as base of action that required to be taken. Research questions shall be answered and justified by taking in consideration of any practical conditions regarding on its application. A statement to ‘why’ a study is being constructed or the goal of a study is being known as research purpose. Hill (1973) described research purpose as a method to describe a concept and to explain or predict a solution to a solution that indicates the type of study to be conducted. Figure 3.1 illustrates the process of research methodology to achieve research objectives for this research.

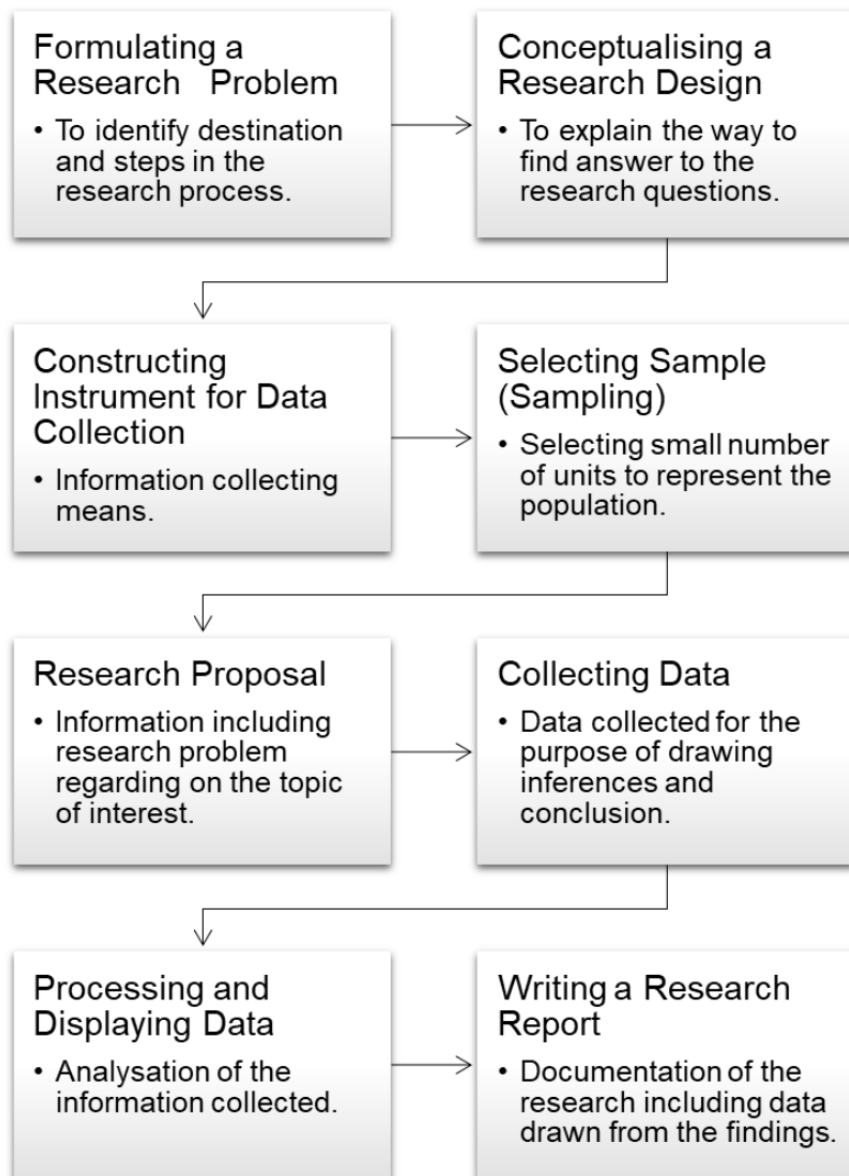


Figure 3.1: Process of Research Methodology (Source: Kumar, 2011)

There are 3 different type study perspective which are exploratory, descriptive and explanatory. The study perspective involved in this research is recognised as a descriptive purpose in which it portrays an accurate profile of persons, events or situations (Saunders et al., 2009). Descriptive research has several definitions or purposes which may offer an accurate and systematic description of ‘something’ which may be an event, phenomena and characteristics (Dulock, 1993).

For this research, the purpose is to reach the four objectives which includes identifying the green building elements and examine the most expensive elements in green building construction, recommending the strategies in minimising the overall cost of green building, studying the relationship between minimised elemental cost towards stakeholders' satisfaction and formulating Cost Reduction-Client Satisfaction Framework of green building construction.

Extensive application of literature review is being conducted to identify the most expensive elements in green building construction, green building cost minimisation strategies and stakeholders' cost satisfaction. Questionnaire being adopted to determine the most expensive elements in green building construction, green building cost minimisation strategies and stakeholders' cost satisfaction. Next framework of green building construction will further be formulated to achieve research objectives.

3.2 Research Design and Strategy

Research approach is a systematic and orderly approach taken towards the collection and analysis of data so that data can be obtained from the collected data (Babbie, 2013). To achieve research's aim, a systematic and appropriate technique must be determined (Wright & Losekoot, 2010). Creswell (2003) laid two factors, which are the characteristics of the topic as well as the time taken to conduct the research and approaches to research which are quantitative, qualitative and even mixed-method approach. Suitable method from different research approaches must be taken into consideration the aims of research to be achieved (Al Kilani & Kobziev, 2016).

Research strategy is being defined by Zainal (2007) as general plan of a researcher on achieving the answer to the research questions. Wedawatta, Ingirige and Amaratunga

(2011) stated that three conditions of a research strategy are the type of question, the control of the researcher has over behavioural events and the focus of current occurrence to past events. The point of having a research strategy is to prevent the research from being conducted in a haphazard manner and with more systematic approach (Al Kilani et al., 2016).

This research is being design by using descriptive correlation research to achieve research objectives. Quantitative research is being used as it will enable researcher to find out if a phenomenon has or has not happened by putting existing theoretical knowledge to test. Chosen method is survey by using questionnaire in which questions are controlled and standardised. For the construction of the questionnaire, analysis of literature review is being exercised to establish a common understanding of the topic that is being researched and to identify any existing gap.

For this research, literature review is being conducted to develop conceptual framework and questionnaire development. Preliminary interview then being conducted for the purpose of variables validation and to improve framework. Main data collection then being done before coming out with data analysis to come up with final research framework.

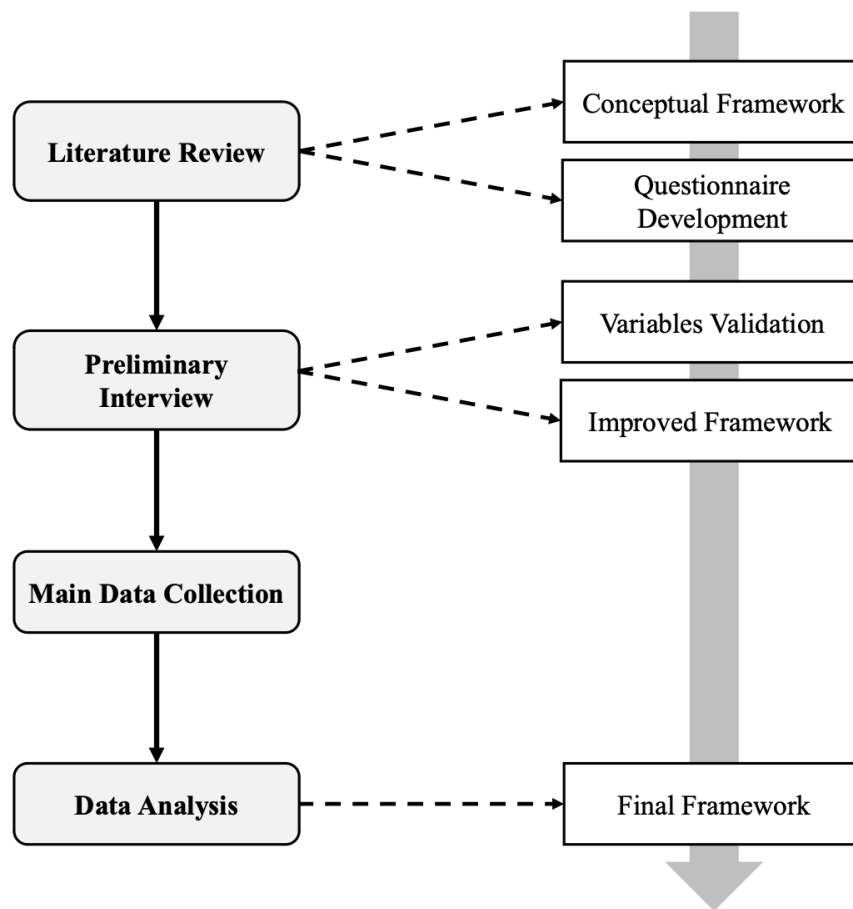


Figure 3.2: Process to Achieve Research Objective

3.3 Research Title, Identification of Problems and Research Objectives

For the purpose of the research, the title must be chosen, and issues related to the field of research must be identified. To develop more knowledge and information regarding on the issues, few journal articles are being read at an initial stage. Cost Reduction-Client Satisfaction Framework of Green Building Construction is being selected as the topic.

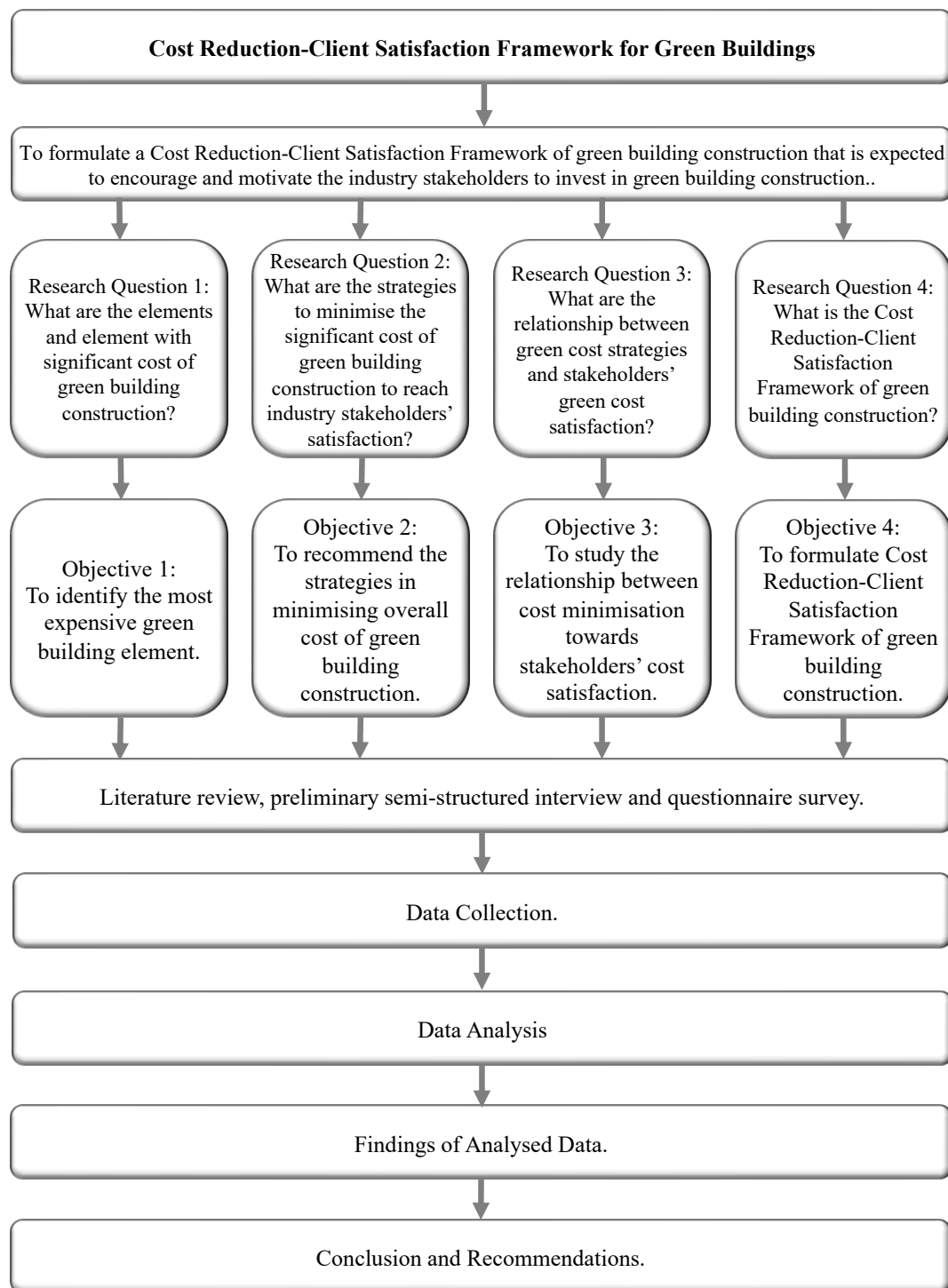


Figure 3.3: Research Framework for Cost Reduction-Client Satisfaction Framework of Green Building Construction.

Problems related to the topic chosen is being identified and objectives are being developed. The first objective is to identify the most expensive green building element. The second objective is to recommend the strategies in minimising overall cost of green building construction. The third objective is to study the relationship between minimised elemental cost towards stakeholders' satisfaction. The fourth objective is to formulate Cost Reduction-Client Satisfaction Framework of green building construction.

3.4 Literature Review

Literature review is a comprehensive review of general topic related to the research (Denney & Tewksbury, 2013). The purpose of literature review includes to better understand the theories and body of knowledge related to the area of research. Literature review is an ongoing process throughout the research which further provides clarity towards understanding the research topic.

Literature review of this research is related to the identification of the most expensive green building element, strategies in minimising overall cost of green building construction and impact of cost minimisation towards stakeholders' cost satisfaction. Sources gathered for the literature review comprise of research papers, books, articles, conference paper, manual and other related readings related to the final account preparation.

3.5 Data Collection

An effective method of data collection is needed so that a more reliable data that will cover all the details which is relevant to the research questions. There are few different methods to collect data for research (Al Kilani et al., 2016). There are six sources for the purpose of data collecting which are, documentation, archival records, focus group interviews, direct observation, participant observation and physical artifacts. Al Kilani et al.

(2016) stated that there are three common methods of data collections which are interviews, documentation and questionnaire.

3.5.1 Research Instrument

For this research, main data is being collected by using self-administered questionnaire, distributed in digital form by using Google Form through email. Hardcopy form of the questionnaire is being distributed to construction personnel in Kuala Lumpur, Selangor and Kuching. Questions for the questionnaire is being generated from literature review. The questions are being separated into four different sections which are Section A, B, C and D.

a. **Section A – Demographic Information**

Related to the respondent's background which includes position in construction contract, organisation, experience in construction industry, experience in green construction and green building construction training/education.

b. **Section B – Green Building Elemental Cost**

Green building elemental cost are being identified during literature review. Green building elemental cost are being listed and questions are being structured to be answered by respondents. The variables are then validated through preliminary interview. Likert scale with seven-point scale is being used as shown in Table 3.1.

Table 3.1: Seven Point Likert Scale for Green Building Elemental Cost

Scale	Indication
1	Very Low Cost
2	Low Cost
3	Fairly Low Cost
4	Neither Low Nor High Cost
5	Fairly High Cost
6	High Cost
7	Very High Cost

c. Section C – Green Building Cost Reduction Strategies

Green building cost reduction strategies are being identified during literature review. Green building cost strategies are being listed and questions are being structured to be answered by respondents. The variables are then validated through preliminary interview. Likert scale with seven-point scale is being used as shown in Table 3.2.

d. Section D – Green Building Cost Satisfaction

Green building cost satisfaction are being identified during literature review. Green building cost satisfaction are being listed and questions are being structured to be answered by respondents. The variables are then validated through preliminary interview. Likert scale with seven-point scale is being used as shown in Table 3.2.

Table 3.2: Seven Point Likert Scale for Green Building Cost Reduction Strategies and Cost Satisfaction

Scale	Indication
1	Highly Disagree
2	Disagree
3	Fairly Disagree
4	Neither Agree Nor Disagree
5	Fairly Agree
6	Agree
7	Highly Disagree

3.5.2 Research Sampling

When a small group are from by selecting number from bigger groups to represent it, a sampling is being obtained (Kumar, 2011). This population of this research is registered middle to top management of organisation that has involved in green construction. The sampling method chosen for this research is purposive sampling. Purposive sampling ensures the reliability of data to achieve research objectives by choosing respondents with the right knowledge and judgement to fill the questionnaire (Dattalo, 2008).

The selection of respondents chosen for this research must fulfilled few criteria to gather reliable information and data for the purpose of data collection. Those criteria are, must be working as a middle to top management of organisation and has participated in green building construction.

The first criterion for this research is the respondents must be working as a middle to top management of organisation. The list of population of registered members are being obtained from online open access database of the organisation in May 2021. These organisations are, Lembaga Arkitek Malaysia for Architect and Interior Designer,

Construction Industry Development Board for Certified Construction Project Management and Board of Quantity Surveyors Malaysia for Quantity Surveyors.

For the second criterion, the respondents must be experienced in green construction. As being reported by BERNAMA in 2018 in which 40% building in Malaysia are green buildings. There is a decrease in application for green building certification since 2018 compared to the present years in Malaysia construction industry. In 2018, 32 buildings in Malaysia received green certification as opposed to only 28 buildings received green certification in Jun 2022 (Ha et al., 2023). This has shown a 12.5% decrease of green building certification in Malaysia. Therefore, from these information the number construction personnel who has involved in the green building construction is rounded and assumed to be at 30%. The numbers for the calculation are being illustrated in Table 3.3.

Table 3.3: Research Population

Profession	Category	Number	
Green Building Professionals	Active Facilitator	115	
	Other Facilitators	996	1111
Architect	Registered Architect	2287	
	Graduate Architect	2654	4941
Interior Designer	Registered Interior Designer	600	
	Graduate Interior Designer	35	635
Certified Construction Project Manager	Construction Manager	Project 179	179
Quantity Surveyor	Provisional	3324	
	Technologist	100	
	Professional	623	
	Consultant	1084	5131
Total			11997
Assume 30%			3600

To further streamlined the number of respondents required for this research, research sample is then being calculated with Raosoft Software. The sample size is being determined by using Raosoft Software at 8% margin error and 90% confidence level. By using the software, the sample size for this research was determined to be at 133 respondents.

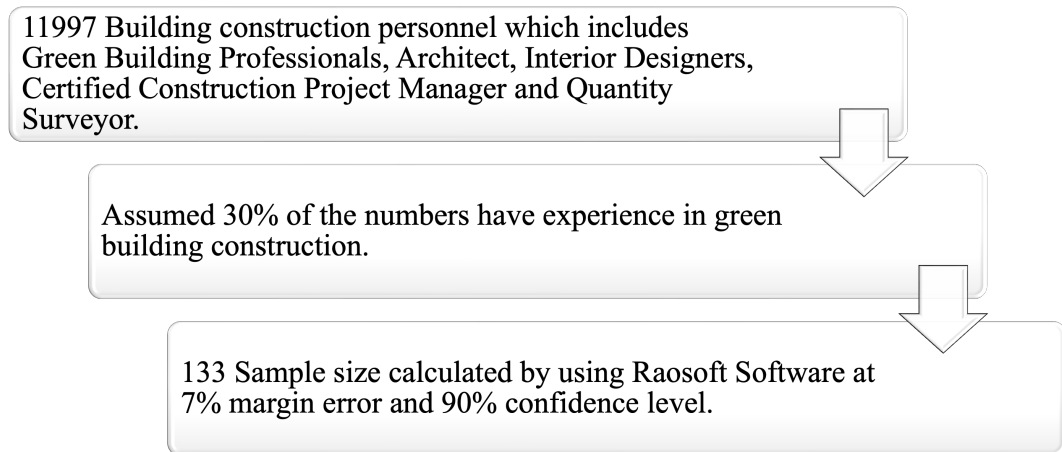


Figure 3.4: Narrowing Down Population Size to Sample Size

3.6 Data Analysis

This research took both inductive and deductive approach in consideration as mentioned by Saunders, Lewis and Thornhill (2009), as there is an advantage in combining these research approaches. Although taking both approaches in consideration, more emphasise will be put on inductive approach for this research as more understanding towards meanings humans attach to events can be deduced. Through the combination of these two methods, by using deductive approach an existing theory can be tested whilst new theory can be deduced through inductive approach.

The collected questionnaires that have been answered by the respondents are going to be analysed by using Microsoft Excel and SPSS Software to identify the frequency, mean and standard deviation value that is useful to achieve research objectives.

Findings will be further be categorised by using Average Index Analysis. Level of agreement ranging from Very Low to Very High will be used.

Table 3.4: Average Index Analysis

Average Index	Level
0.00 – 1.00	Very Low
1.01 – 2.00	Low
2.01 – 3.00	Fairly Low
3.01 – 4.00	Neither High Nor Low
4.01 – 5.00	Fairly High
5.01 – 6.00	High
6.01 – 7.00	Very High

Correlation analysis by using correlation matrix will also being conducted by using SPSS to seek for correlation between green building cost reduction strategies (Section B) and green building cost satisfaction (Section C). The significance of correlation analysis to be conducted in this research is to analyse the correlation between green building cost reduction strategies and green building cost satisfaction. This is useful to determine cost reduction strategies that is more likely to be related to green building cost satisfaction.

To determine if there is any correlation between green building cost reduction strategies and green building cost satisfaction, Spearman's Coefficient, ρ , is being used. Spearman ρ is being used for the purpose of correlating between issues and challenges and

quantity surveyors' competencies because it is suitable to be used to correlate ordinal variable (Baak et al., 2018).

The correlation is being interpreted by using the negative and positive relationship. Ranging from -1 to +1 relationship, both values indicates perfect negative and positive relationship. Value of 0 is equal to no correlation existed. Monotonic relationship that is positive, when one variable increase, the other variable will also increase. Whereas if the value is negative, implies that when one variable increase, the other decrease (Schober & Schwarte, 2018).

3.7 Summary

In Chapter 3, the research methodology for the purpose of conducting this research has been identified and proposed. This research adopted quantitative method as its main data collection. For the purpose of questionnaire validation, interview has been conducted to further improve the main tools of data collection for this research. This is to be discussed in the next chapter (Chapter 4: Preliminary Interview). As we wanted a thorough understanding on green building construction, building with Platinum certification rating were dissected as it has achieved the highest possible score for GBI.

In summary, the process started with the choosing of the topic, development of research questions and objectives, problem statement and literature review related to the green building construction which includes the most expensive building elements, strategies for cost reduction and stakeholders' cost satisfaction as being shown in Table 3.5.

Table 3.5: Summary of Methodology for Cost Reduction-Client Satisfaction Framework of Green Building Construction

Research Question	Research Objectives	Data Collection	Data Analysis
What are the elements and element with significant cost of green building construction?	To identify the most expensive elements of green building construction.	Literature review, semi-structured preliminary interview and questionnaire survey	Framework analysis, Content Analysis and Descriptive Analysis, Exploratory Factor Analysis (SPSS)
What are the strategies to minimise the significant cost of green building construction to reach industry stakeholders' satisfaction?	To recommend strategies in minimising overall cost of green building construction.	Literature review, semi-structured interview and questionnaire survey.	Framework analysis, Content Analysis and Descriptive Analysis, Exploratory Factor Analysis (SPSS)
What are the relationship between green cost strategies and stakeholders' green cost satisfaction?	To study the relationship between minimised elemental cost towards stakeholders' satisfaction.	Literature review, semi-structured interview and questionnaire survey.	Framework analysis, Content Analysis and Descriptive Analysis, Exploratory Factor Analysis (SPSS)
What is the Cost Reduction-Client Satisfaction Framework of green building construction to achieve stakeholders' satisfaction?	To formulate a Cost Reduction-Client Satisfaction Framework of green building construction.	Literature review, semi-structured interview and questionnaire survey.	Framework analysis, Content Analysis and Descriptive Analysis, Exploratory Factor Analysis (SPSS), Correlation Analysis

CHAPTER 4

PRELIMINARY INTERVIEW

4.1 General

The work under this chapter was done to validate the variables in the previous chapter before carrying out the main data collection. The method administered was semi-structured interview. The headings included for the question are Demographic Information, Project Details, Green Building Elemental Cost, Green Building Cost Reduction Strategies and Green Building Cost Satisfaction.

4.2 Preliminary Interview

To further increased understanding of the topic and to validate variables obtained from the literature, preliminary interview was conducted. Findings from the preliminary interview were then used for the improvement of the questionnaire survey to achieve the aims and objectives of this present study.

4.2.1 Methodology

Purposive sampling ensures the reliability of data to achieve research objectives by choosing respondents with the right knowledge and judgement to fill the questionnaire (Dattalo, 2008). Purposive sampling is a strategy of data collection method where data will only be gathered from sample with specific characteristics for a more reliable data for the research (Campbell et al., 2020). The utilisation of purposive sampling improve the rigour of the study and increasing the trustworthiness of the result. Therefore it is the right sampling method that is to be implemented for this section of the research.

The selection of respondents chosen for this research must fulfilled few criteria to gather reliable information and data for the purpose of achieving research objectives. There are 19 Green Building Index Platinum certified green building project in Malaysia. Out of 19 green construction project, four respondents has agreed to participate in the research. The reason why only Platinum certified building were chosen is they have achieved the highest achievable rating for GBI. To achieve the highest possible score, the highest maximum green building elements must be equipped to the building. By choosing Platinum certified buildings, more green element aspects can be analysed for this research.

A sheet containing the question for the interview were being forwarded through email before the interview process being conducted. A semi-structured interview has been designed to ensure focused during the interview whilst allowing the researcher to explore more ideas related to the study (Adeoye-Olatunde & Olenik, 2021). One of the interview being conducted online through Google Meet and the other three through face-to-face interview. The interview is being conducted in mixture of English and Malay Language and being recorded with the respondents' consent. Next, the interview then being transcribed and then being translated to English Language before being analysed. The transcript then being analysed manually and themes were being identified.

The interview being separated into five sections which are: -

- a) Demographic Information
- b) Project Details
- c) Green Building Elemental Cost
- d) Green Building Cost Reduction Strategies

e) Green Building Cost Satisfaction

4.3 Findings

Findings under this chapter are being separated into few sub-headings which are Demographic Information and Project Details, Green Building Elemental Cost, Green Building Cost Reduction Strategies and Green Building Cost Satisfaction.

4.3.1 Demographic Information and Project Details

Purposive sampling is being exercised for this part of this research. This method required researcher to exercise their judgment in choosing the most relevant data to achieve the objective of the research (Staller, 2021). By choosing this method the most reliable data can be obtained focusing on the ‘how’ and ‘why’ of the research as opposed to focusing on the quantity of the respondents (Guetterman, 2015). The respondents were chosen through their participation in Platinum certified green building construction, the highest green building rating awarded by Green Building Index. Therefore, the interview was conducted with those who has the experience in the construction of Platinum certified green building construction. As per shown in Table 4.1, respondents are from different project background but are experienced in green building construction. Platinum certified building were being chosen because to reach the rating, highest possible score must be achieved during the building construction, thus more green building elements has been adopted for the building construction. Therefore, their expertise is sufficient to provide a reliable data for this research. Furthermore, quantitative analysis was exercised after the interview.

Table 4.1: Demographic Information and Project Details

Item			Respondent	Respondent	Respondent	Respondent
			1	2	3	4
Position in the company/construction project.	the	Green	Green	Building	Facility	Head Unit
			Building	Construction	Manager	(Building &
			Manager	Personnel		Landscape)
Number of green construction project.		green	Second	Second	First	First

4.3.2 Green Building Elemental Cost

Overall, building works and construction contributed the most to the cost of green building construction (Halil et al., 2022). This includes material cost (Hu & Skibniewski, 2021; Insja & Sihombing, 2017), fittings, furnishing and finishes, external walls, windows and external doors, roof, internal walls and partitions (Chegut et al., 2019; Victoria et al., 2017). There are five green components as per GBI guidelines for a green building construction to achieve which are Energy Efficiency, Indoor Environmental Quality, Sustainable Site Planning and Management, Materials and Resources and Water Efficiency. Significant points for these different building elements are shown in Table 4.2 below.

Table 4.2: Green Building Elemental Cost

Item	Significant Points
Energy Efficiency	There is differences between the cost of conventional chiller and green chiller (R1)
	Solar panels installed on the rooftop implied additional cost (R2)
	Energy efficient chiller implied high cost during installation and maintenance (R3)
	System needed high maintenance cost despite of there is no problem in term of cost of equipping the building with the system initially (R4)

Table 4.2 continued

Energy Efficiency (Cont')		System is behind in terms of technology therefore required higher maintenance cost (R4)
Indoor Environmental Quality		Building requirement doesn't affect much to the cost (R1) Acoustical requirement impact slightly to the cost (R1) Finishes do not required high maintenance cost (R3) Passive system such as painting does not incur high cost for implementation and maintenance, not much difference in cost between non-green material (R4)
Sustainable Planning and Management	Site and	Solar panel installed on the rooftop required additional cost but also contribute income to the building (R1)
Materials and Resources	and	Logistics issues can be prevented by obtaining materials nearby (R1) Usage of regional materials are low in cost and increase building value (R2) Materials used to achieve GBI points needed to be obtained from oversea thus increasing the construction cost (R4) –rubber paver block hard to be maintained due to safety reason
Water Efficiency		May affect the construction cost. This item can be designed in accordance to the client's budget (R1) Maintenance cost under this item (waste water harvesting and recycling) are slightly high in cost (R3)

4.3.3 Green Building Cost Reduction Strategies

The followings are summarisation of findings for green building cost reduction strategies.

Table 4.3: Green Building Cost Reduction Strategies

Item	Respondent
Economic	Increasing interest among developer to incorporate green into their building thus increasing demand for green construction (R1)
Social	Demand among end users and increasing their awareness will affect the implementation cost of green construction (R2)
Environment	Passive design shall be incorporated to suit client's budget will reduce cost of green building (R1) Passive design required low maintenance cost and easy to be maintained thus will increase interest of implementation (R3)

4.3.4 Green Building Cost Satisfaction

Awareness is found to be one of the key factors to green building cost satisfaction by the stakeholders.

'Stakeholders' satisfaction on cost of green building construction depends on the green awareness' – R1

Value of green construction is imperative in determining the satisfaction of construction project stakeholders towards green cost satisfaction.

*'Despite of the high implementation cost, the value that green construction brings to the building brings **satisfaction.**' – R3*

Attractive remuneration will increase interest in green construction by the developer thus increasing green building construction participation.

*'End user reaped the benefits of green construction throughout the building lifecycle, but not for developer. Therefore, a more **attractive remuneration that will increase the interest** need to be formulated.'* – R1

4.4 Summary

Literature review has been done extensively to identify variables related to green construction elements and green construction cost. Platinum certified building were being chosen because to reach the rating, highest possible score must be achieved during the building construction, thus more green building elements has been adopted for the building construction. Therefore, their expertise is sufficient to provide a reliable data for this research. Furthermore, quantitative analysis was exercised after the interview. Variables obtained from literature review then being included in the preliminary interview to be validated by building construction experts. All in all, the variable obtained from the literature has been validated and conceptual framework being constructed. The research then being validated through quantitative analysis in the next chapter.

CHAPTER 5

FINDINGS AND DISCUSSION

5.1 General

Analysis of findings are being carried out in this chapter based on data that have been collected from the respondents. Data collection was being done by utilising questionnaire survey distributed to middle to top management level of those who had involved in certified green building construction in Malaysia. Findings analysis was carried out to achieve four objectives which are: -

- a) To identify the most expensive elements in green building construction.
- b) To recommend the strategies in minimising the overall cost of green building construction.
- c) To study the relationship between cost minimisation towards stakeholders' cost satisfaction.
- d) To formulate Cost Reduction-Client Satisfaction Framework of green building construction.

The questionnaire is being separated into few sections which are Section A – Demographic Information, Section B – Green Building Elemental Cost, Section C – Green Building Cost Reduction Strategies and Section D – Green Building Cost Satisfaction.

5.2 Response Analysis

For this research, 320 questionnaires were being distributed online and another 200 were distributed in hardcopy form to middle to top management. Mail and social medias have been used for the purpose of questionnaire online distribution. Response rate is at 23% in which out of 520 questionnaires distributed, 128 questionnaires were being filled and returned. The number is slightly lesser than sample size but is sufficient to be analysed as it is able to represent the whole population based on the strategy used to obtain the sample (Lakens, 2022).

Accepted response rate varied between different researchers. According to Morton, Bandara, Robinson and Atatoa Carr (2012), response rate of 20% is sufficient to obtain a result which is reliable. Mealing et al. (2010) on the other hand reduced the percentage, stated that for self-administered postal questionnaire, 18% response rate is acceptable to be analysed without compromising the research results.

Therefore, in order to achieve research objectives, 24% response rate obtained with the total number of 128 respondents, is acceptable to be analysed.

5.3 Section A: Demographic Information

This section provides demographic background of the respondents. The report is being presented in table formed with the data being analysed by using SPSS Version 29.0 which includes the frequency and percentage of the data. Microsoft Excel also being used to present the findings obtained in bar chart.

5.3.1 Position in Construction Project

In Table 5.1, the frequency and percentage of respondents' position in construction project are being illustrated. Most of the respondents worked as Quantity Surveyor with 78.1% respondents then followed by Engineer at 10.9%. Architect, Executive, Green Building Consultant and Project Manager are at 1.6% each. Senior Procurement Executive, Drafter, Geomatic Engineer, Project Executive, Senior Project Manager and Sustainability Consultant are at 0.8% each. It is found that Quantity Surveyor contributed the most to the insight and findings of this research.

Table 5.1: Respondents' Position in Construction Project

Item	Frequency	Percentage (%)
Architect	2	1.6%
Senior Procurement Executive	1	0.8%
Drafter	1	0.8%
Engineer	14	10.9%
Executive	2	1.6%
Geomatic Engineer	1	0.8%
Green Building Consultant	2	1.6%
Project Executive	1	0.8%
Project Manager	2	1.6%
Quantity Surveyor	100	78.1%
Senior Project Manager	1	0.8%
Sustainability Consultant	1	0.8%

5.3.2 Organisation

Organisation in which the respondents are attached to are being illustrated in Table 5.2. Most of them worked in Private Sector at 78.1%, followed by Consultant Firm at 18.0% and lastly, Public Sector at 3.9%.

Table 5.2: Respondents' Organisation

Item	Frequency	Percentage (%)
Consultant	23	18.0%
Private Sector	100	78.1%
Public Sector	5	3.9%

5.3.3 Experience in Construction Industry

In Table 5.3, the frequency and percentage of respondents' position in construction project are being illustrated. The scales are being divided into four with the lowest to be less than 5 years working experience and the most to be more than fifteen years working experience. From the data, it is shown that 57.8% of the respondents has less than 5 years of experience in construction industry, made up the biggest percentage of the data. The second biggest percentage would be those with 5 – 15 years of experience at 22.7%. The smallest percentage would be 11 – 15 years of experience at 3.1%. those with 15 years and above of experience in construction industry are at 16.4%.

Table 5.3: Respondents' Experience in Construction Industry

Item	Frequency	Percentage (%)
Less than 5 years	74	57.8%
5 - 10 years	29	22.7%
11 – 15 years	4	3.1%
15 years and above	21	16.4%

5.3.4 Experience in Green Construction

Respondents with only one green construction project made up the largest percentage at 75.8%. Followed by 2 – 5 green construction projects at 12.5% and the smallest with 5 green and above green construction projects. The figures are being reflected in Table 5.4.

Table 5.4: Respondents' Experience in Green Construction

Item	Frequency	Percentage (%)
One green construction project	97	75.8%
2 - 5 green construction project	16	12.5%
5 and above green construction projects	15	11.7%

5.3.5 Green Building Construction Training

From Figure 5.1, the most frequent type of green building construction training that the respondents have received is tertiary education (Undergraduate/Master's/Doctorate) with the total number of 72 respondents. The next training with the most frequency is workshop training organised by company. The least type of training that they have received is N/A where the respondents acknowledged other type of training related to green construction but they did not specify the type of training involved. This will not affect research findings as they have received other type of training that has not being listed out in the questionnaire survey.

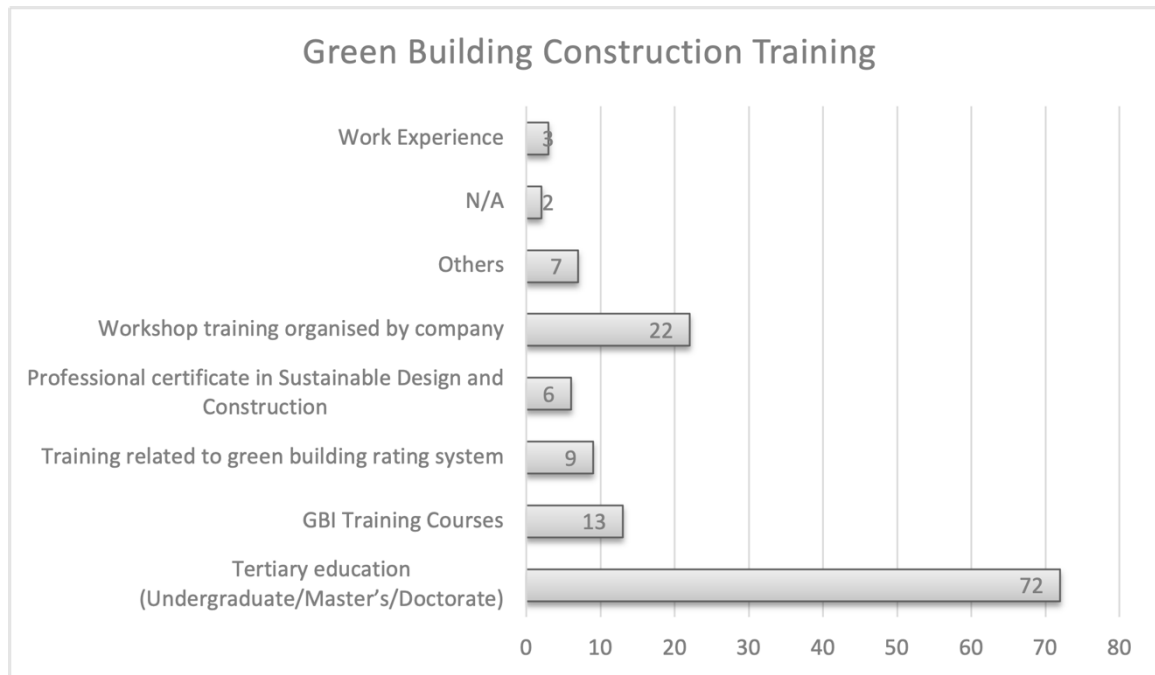


Figure 5.1: Respondents' Green Building Construction Training

5.4 Section B: Green Building Elemental Cost

This section is being designed to obtain information related to green building elemental cost.

Under this section, frequency distribution of the data obtained from the questionnaire will be discussed. This includes the application of frequency count, frequency percentage, mean and standard deviation to analyse the data.

There are eleven questions related to green building elemental cost being included in the questionnaire. They are being separated into five different categories as which are Energy Efficiency (EE), Indoor Environmental Quality (IEQ), Sustainable Site Planning and Management (SM), Materials and Resources (MR) and Water Efficiency (WE). The questions were being measured by using 7-point Likert Scale ranging from 'Very Low Cost' to 'Very High Cost'.

5.4.1 Frequency Distribution for Green Building Elemental Cost

For this Section, respondents were being required to choose the Green Building Elemental Cost based on 7-point Likert scale of ‘Very Low Cost’ to ‘Very High Cost’. List green building elements were being obtained from journal, articles and documents to extract and categorises the green building elements.

From Table 5.5, it can be concluded that most items under green building elemental cost are fairly high in cost, followed by high in cost and neither high nor low in cost.

From the Table 5.5, the frequency distribution for Green Building Elemental Cost were divided by five different categories which are Energy Efficiency (EE), Indoor Environmental Quality (IEQ), Sustainable Site Planning and Management (SM), Materials and Resources (MR) and Water Efficiency (WE).

Based on Table 5.5, Sustainable Site Planning and Management (SM) has the highest mean (5.13) in which most of the respondent (34.8%) agree that cost of greenery and roof related to the landscaping design (e.g.: hardscape and greenery application, vegetated roof, material with Solar Reflectance Index) for; roof and roofing plumbing (SM1) is high in cost. 28.91% respondent believe it is fairly high in cost and other 10.16% respondent believe it is very high in cost. While some respondent (10.93%) thinks otherwise, with 8.59% respondent state it is fairly low in cost and 2.34% state that it is very low in cost.

Moreover, Indoor Environmental Quality (IEQ) category place second highest with mean (5.11). Specifically, the cost of installation for daylight system and reduction of daylight glaring (e.g.: façade, shading, light shelves, glare control) for: roofing and roof plumbing. (IEQ3). 70.31% of the respondents agree it is in high costing. Which 12.50% state

it is very high in cost, 32.81% state it is high in cost and remaining 25% state it is fairly high in cost. However, 12.5% of respondent disagree stating that it is in low costing. 9.38% respondent state it is fairly low in cost while 1.56% respondent state that it is low in cost and very low in cost respectively.

The lowest in mean (3.80%) also in Indoor Environmental Quality (IEQ) category. Specifically, the cost of Environmental Tobacco Smoke (ETS) control by installation of signages to ensure indoor smoking provision are adhered for; signage. The respondents believe signage cost is low. Although 23.44% of the respondent state it is neither high nor low, 42.97% of respondent state it is low costing. Which 21.09% state it is fairly low in cost, 12.50% state it is low in cost and other 9.38% respondent state it to be very low in cost.

To put it briefly, based on the respondent roofing and roof plumbing is the highly building element.

Table 5.5: Frequency Distribution for Green Building Elemental Cost

Item ID	Percentage (%)							Mean	S.D	Level
	VLC	LC	FLC	NLH	FHC	HC	VHC			
EE1	0.78	2.34	7.03	22.66	32.03	25.00	10.16	4.98	1.23	FH
EE2	1.56	2.34	10.94	23.44	35.16	21.09	5.47	4.73	1.23	FH
IEQ1	0.00	0.78	7.81	24.22	35.94	21.09	10.16	4.99	1.12	FH
IEQ2	2.34	0.00	16.41	29.69	25.78	17.97	7.81	4.62	1.30	FH
IEQ 3	1.56	1.56	9.38	17.19	25.00	32.81	12.50	5.11	1.33	H
IEQ 4	1.56	1.56	13.28	20.31	35.16	20.31	7.81	4.78	1.27	FH
IEQ 5	1.56	2.34	12.50	21.88	35.16	15.63	10.94	4.77	1.32	FH
IEQ 6	0.78	0.00	15.63	21.88	29.69	21.88	10.16	4.86	1.26	FH
IEQ 7	3.13	1.56	14.84	22.66	30.47	18.75	8.59	4.66	1.38	FH
IEQ 8	9.38	12.50	21.09	23.44	16.41	13.28	3.91	3.80	1.61	N
SM1	2.34	0.00	8.59	15.63	28.91	34.38	10.16	5.13	1.27	H
MR1	0.78	2.34	10.16	17.19	28.13	31.25	10.16	5.04	1.28	H
MR2	0.78	3.13	10.94	25.78	31.25	25.78	2.34	4.70	1.17	FH
MR3	0.78	0.78	5.47	18.75	35.94	34.38	3.91	5.07	1.05	H
MR4	0.78	0.78	10.16	19.53	39.84	24.22	4.69	4.88	1.11	FH
MR5	0.78	3.91	9.38	21.88	34.38	24.22	5.47	4.80	1.23	FH
MR6	0.78	2.34	16.41	21.09	26.56	28.91	3.91	4.73	1.26	FH
MR7	0.78	2.34	10.94	25.00	36.72	19.53	4.69	4.72	1.16	FH
MR8	6.25	6.25	16.41	19.53	34.38	15.63	1.56	4.23	1.43	FH
WE1	0.78	3.91	11.72	18.75	24.22	31.25	9.38	4.93	1.35	FH
WE2	0.78	0.00	16.41	15.63	32.03	23.44	11.72	4.95	1.29	FH

7 Point Likert Scale: Very Low Cost (VLC), Low Cost (LC), Fairly Low Cost (FLC), Neither Low Nor High Cost (NLH), Fairly High Cost (FHC), High Cost (HC), Very High Cost (VHC)

Level of Agreement: Very Low (VL), Low (L), Fairly Low (FL), Neither High Nor Low (N), Fairly High (FH), High (H), Very High (VH)

5.4.2 Ranking of Green Building Elemental Cost

The list of Green Building Elemental Cost is being ranked and analysed in this section. Table 5.6 showed the rank list of elemental cost being arranged in descending order from very high cost to very low cost.

From Table 5.6, it can be observed that three green building elemental cost placed on the top of the list in the ranking are all Roofing and Roof Plumbing respectively (SM1) with 5.13 mean, (IEQ 3) with 5.11 mean, and (MR3) with 5.07 mean. Signage (IEQ8) ranked last with lowest mean of 3.08.

From the findings in Table 5.6 below, Roofing and Roof Plumbing found to be high in cost, followed by Structural (WBLFF, Frame, Upper Floor). Signage is the lowest in cost according to the respondents.

Table 5.6: Ranking of Green Building Elemental Cost

Item ID	Building Elements	Mean	Level	Rank
SM1	Roofing and Roof Plumbing	5.13	H	1
IEQ3	Roofing and Roof Plumbing.	5.11	H	2
MR3	Roofing and Roof Plumbing.	5.07	H	3
MR1	Structural (WBLFF, Frame, Upper Floor).	5.04	H	4
IEQ1	Structural (WBLFF, Frame, Upper Floor).	4.99	FH	5
EE1	Roofing and roof plumbing.	4.98	FH	6
WE2	Sanitary Fittings and Plumbing.	4.95	FH	7
WE1	Roofing and Roof Plumbing.	4.93	FH	8
MR4	Walls (External Walls, Internal Walls and Partitions).	4.88	FH	9
IEQ6	Finishes (Wall, Floor and Ceiling).	4.86	FH	10
MR5	Doors and Windows.	4.80	FH	11
IEQ4	Walls (External Walls, Internal Walls and Partitions).	4.78	FH	12
IEQ5	Doors and Windows.	4.77	FH	13
EE2	Walls (External Walls, Internal Walls	4.73	FH	14
MR6	Finishes (Floor, Wall and Ceiling).	4.73	FH	15
MR7	Sanitary Fittings and Plumbing.	4.72	FH	16
MR2	Staircase.	4.70	FH	17

Table 5.6 continued

IEQ 7	Furniture	4.66	FH	18
IEQ2	Staircase.	4.62	FH	19
MR8	Furniture.	4.23	FH	20
IEQ 8	Signage	3.80	N	21

Level of Agreement: Very Low (VL), Low (L), Fairly Low (FL), Neither High Nor Low (N), Fairly High (FH), High (H), Very High (VH)

5.5 Section C: Green Building Cost Reduction Strategies

This section is being designed to obtain strategies for green building cost reduction. Under this section, frequency distribution of the data obtained from the questionnaire will be discussed. This includes the application of frequency count, frequency percentage, mean and standard deviation to analyse the data.

There are twenty-one questions related to green building cost reduction strategies being asked under this section. They are being separated into seven categories which are Economic, Social, Policy, Technology, Environment, Industrial Practice and Awareness. One unstructured question on other strategies for cost reduction of green building construction being included this section.

The questions were being measured by using 7-point Likert Scale ranging from ‘Highly Disagree’ to ‘Highly Agree’.

Table 5.7: Green Building Cost Reduction Strategies

Categories	Subcategories	Item ID
Economic	Green finance (e.g.: green securities, green investments, green insurance, green credit, green central banking, community based green fund)	SE1
	Fiscal policy (e.g.: tax relief, tax credit)	SE2

Table 5.7 continued

Economic (Cont')	Monetary policy or window guidance policy.	SE3
	Consumer directed and market-oriented policy	SE4
Social	Market-focused approach (e.g.: green marketing, market orientation culture)	SS1
	Public-Private Partnership for green construction	SS2
	Green building award for green material/construction.	SS3
Policy	Establishing new intermediary roles to aid industry stakeholders.	SP1
	Establishing effective legislative process and enforcement.	SP2
Technology	Improved communication infrastructure (i.e.: Internet of Things) for green materials/construction.	ST1
	Adoption of blockchain technology into supply chain management to assist in pricing strategy.	ST2
Environment	Incorporation of passive sustainable technology into building design (passive cooling system, rainwater harvesting system).	SEN1
Industrial Practice	Attention given during initial design stage.	SI1
	Value Management for green construction project.	SI2
	Establish cooperation between stakeholders and manufacturer.	SI3
	Implementation of optimisation model in choosing green construction material.	SI4
	On site flexibility practice.	SI5
	Sustainable logistics practices such as reverse logistics by manufacturers.	SI6
Awareness	Retailer-led supply chain.	SA1
	Increased corporate image for green product.	SA2
	Increase awareness for environmental issue.	SA3

5.5.1 Frequency Distribution for Green Building Cost Reduction Strategies

For this Section, respondents were being required to choose the Green Building Elemental Cost based on 7-point Likert scale of 'Highly Disagree' to 'Highly Agree'. List green building elements were being obtained from journal, articles and documents to extract and categorises the green building cost reduction strategies.

For the table above, the Green Building Elemental Cost reduction strategies that can be implemented based on the respondent answer. There are few alternatives provided, they are being separated into seven categories which are Economic, Social, Policy, Technology, Environment, Industrial Practice and Awareness.

Based on Table 5.8, Industrial Practice has the highest degree of agree specifically in Attention given during initial design stage (SI1) with 82.03% followed by Value Management for green construction project (SI2) with 80.47%. The lowest degree of agree for the cost reduction strategies is in economic category specifically in monetary policy or window guidance policy (SE3). Although it has a sum of 66.4% respondent who fairly agree, agree and highly agree towards the strategy with only 9.38% which 0.78% disagree and 8.59% fairly disagree respectively. The percentage of neither agree nor disagree is high with 24.22% compared to other strategies that been asked to the respondent.

The table indicates that none of the strategies have a high degree of disagree compared to the sum of people agree to the strategies. This solely due to the respondent thought on which strategies and approach that they find more suitable and reliable compared to other alternative listed.

Table 5.8: Frequency Distribution for Green Building Cost Reduction Strategies

Item	Percentage (%)							Mean	Standard Deviation	Level
ID	HD	D	FD	NAD	FA	A	HA			
SE1	0.78	0.78	3.91	19.53	39.06	25.00	10.94	5.14	1.11	H
SE2	0.00	0.00	10.16	19.53	28.91	28.13	13.28	5.15	1.18	H
SE3	0.00	0.78	8.59	24.22	27.34	25.78	13.28	5.09	1.20	H
SE4	0.78	0.78	9.38	19.53	31.25	21.09	17.19	5.12	1.29	H
SS1	0.00	3.91	5.47	21.88	28.91	23.44	16.41	5.12	1.30	H
SS2	0.78	3.91	6.25	13.28	32.81	27.34	15.63	5.18	1.32	H
SS3	0.00	1.56	7.03	14.06	25.00	30.47	21.88	5.41	1.26	H
SP1	0.78	3.13	4.69	17.19	29.69	21.09	23.44	5.29	1.36	H
SP2	0.78	3.13	7.03	20.31	23.44	21.88	23.44	5.22	1.42	H
ST1	1.56	2.34	2.34	19.53	25.00	28.91	20.31	5.32	1.33	H
ST2	2.34	2.34	5.47	14.06	30.47	25.78	19.53	5.23	1.39	H
SEN1	1.56	0.78	5.47	13.28	20.31	34.38	24.22	5.5	1.32	H
SI1	0.00	1.56	6.25	10.16	24.22	31.25	26.56	5.57	1.25	H
SI2	0.00	2.34	5.47	11.72	24.22	29.69	26.56	5.53	1.28	H
SI3	0.78	3.13	10.16	12.50	20.31	33.59	19.53	5.27	1.41	H
SI4	0.78	2.34	5.47	14.84	29.69	25.78	21.09	5.32	1.31	H
SI5	1.56	4.69	8.59	14.06	23.44	29.69	17.97	5.14	1.47	H
SI6	0.00	3.91	6.25	17.97	26.56	28.13	17.19	5.2	1.31	H
SA1	0.78	0.78	10.94	19.53	24.22	17.19	26.56	5.23	1.42	H
SA2	0.00	1.56	6.25	15.63	28.91	25.00	22.66	5.38	1.25	H
SA3	0.78	1.56	8.59	15.63	14.84	30.47	28.13	5.46	1.41	H

7 Point Likert Scale: Highly Disagree (HD), Disagree (D), Fairly Disagree (FD), Neither Agree Nor Disagree (NAD), Fairly Agree (FA), Agree (A), Highly Agree (HA)

Level of Agreement: Very Low (VL), Low (L), Fairly Low (FL), Neither High Nor Low (N), Fairly High (FH), High (H), Very High (VH)

5.5.2 Ranking of Green Building Cost Reduction Strategies

The list of Green Building Cost Reduction Strategies is being ranked and analysed in this section. Table 5.9 showed the rank list of strategies being arranged in descending order from highly agree to highly disagree.

From Table 5.9, it can be observed that three cost reduction strategies placed on the top of the list in the ranking are Attention given during initial design stage (SI1), Value Management for green construction project (SI2) and Incorporation of passive sustainable technology into building design (passive cooling system, rainwater harvesting system) (SEN1). Monetary policy or window guidance policy (SE3) ranked last with lowest mean 5.09.

Table 5.9: Ranking of Green Building Cost Reduction Strategies

Item ID	Strategies	Mean	Level	Rank
SI1	Attention given during initial design stage.	5.57	H	1
SI2	Value Management for green construction project.	5.53	H	2
SEN1	Incorporation of passive sustainable technology into building design (passive cooling system, rainwater harvesting system).	5.50	H	3
SA3	Increase awareness for environmental issue.	5.46	H	4
SS3	Green building award for green material/construction.	5.41	H	5
SA2	Increased corporate image for green product.	5.38	H	6
ST1	Improved communication infrastructure (i.e.: Internet of Things) for green materials/construction.	5.32	H	7
SI4	Implementation of optimisation model in choosing green construction material.	5.32	H	8

Table 5.9 continued

SP1	Establishing new intermediary roles to aid industry stakeholders.	5.29	H	9
SI3	Establish cooperation between stakeholders and manufacturer.	5.27	H	10
SA1	Retailer-led supply chain.	5.23	H	11
ST2	Adoption of blockchain technology into supply chain management to assist in pricing strategy.	5.23	H	12
SP2	Establishing effective legislative process and enforcement.	5.22	H	13
SI6	Sustainable logistics practices such as reverse logistics by manufacturers.	5.20	H	14
SS2	Public-Private Partnership for green construction	5.18	H	15
SE2	Fiscal policy (e.g.: tax relief, tax credit)	5.15	H	16
SE1	Green finance (e.g.: green securities, green investments, green insurance, green credit, green central banking, community based green fund)	5.14	H	17
SI5	On site flexibility practice.	5.14	H	18
SE4	Consumer directed and market-oriented policy	5.12	H	19
SS1	Market-focused approach (e.g.: green marketing, market orientation culture)	5.12	H	20
SE3	Monetary policy or window guidance policy.	5.09	H	21
<i>Level of Agreement: Very Low (VL), Low (L), Fairly Low (FL), Neither High Nor Low (N), Fairly High (FH), High (H), Very High (VH)</i>				

5.5.3 Recommendations of Strategies for Cost Minimisation of Green Building Construction

This question is optional to be answered by the respondents. There are eight keywords obtained from the analysis which are local manufacturing, government

intervention, material, awareness, technology, passive design, procurement and initial planning. The information gathered are as being shown in Table 5.10.

Table 5.10: Keywords Related to Strategies for Cost Minimisation of Green Building Construction by Respondents

Keywords	Respondent	Recommendations
Local	R10	More supplies in the market
	R11	Local manufacturer should be proactive in producing green product
Manufacturing	R16	Reduce raw materials cost
	R25	By implementing serious implementation on environmental friendly materials
	R39	Most of the material that relate to green building need to be import from outside, to reduce the cost, produce local material
	R49	Suppliers taking initiative to reduce green const. materials cost / government subsidies
	R65	Increase local competent providers and builders rather than depending on outsourcing for long duration
	R73	More supply for green building material.
	R79	Choose sustainable & locally available materials that are cost effective.
	R81	Using local suppliers and implementing schedule/flexible working hours from home and office to reduce unnecessary electrical usage.
Government Intervention	R5	Material subsidization by government
	R43	The most important is the role of government to encourage the developer to implement green and give incentive to developer
	R69	Incentive by government for all green construction's contractors

Table 5.10 continued

	R39	Government should plan to produce local material for further development and reduce cost of construction
	R49	Suppliers taking initiative to reduce green const. materials cost / government subsidies
Material	R3	Recycle industrial material
	R58	By reusing the construction waste material. Instead of throwing it away, reusing the material will help to reduce construction pollution.
	R68	Cutting energy, water and construction material usage
	R79	Consider recycled or salvaged materials, which can often be obtained at lower cost.
Awareness	R83	Spread awareness about advantages of Green Building Index among citizen.
	R86	Spread awareness of green buildings and strong enforcement of rules and regulations are needed to ensure wider compliance to environmental standard.
	R95	Better knowledge & Research on the topic to enable big company players to take part in Green Building construction which improve competition in the market leading to lower/more competitive pricing.
Technology	R28	Building Information Modelling application
	R71	Automatic electric system to minimize and control electricity usage due to natural lighting system is used in green building
Passive Design	R4	By using natural light (Sunlight) , using solar panel to produce renewable energy (long term investment) and planting trees (shelter during sunny day)
Procurement	R42	Through competitive design Request-for-Proposal project.

Initial Planning	R79	Additionally, conduct a life-cycle cost analysis to evaluate the long-term benefits and potential savings of different materials.
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5.6 Section D: Green Building Cost Satisfaction

Under this section, frequency distribution for green building cost satisfaction obtained from the questionnaire will be discussed. This includes the application of frequency count, frequency percentage, mean and standard deviation to analyse the data.

There are fourteen questions related to green building cost satisfaction being asked under this section. They are being separated into five categories which are Price Transparency, Price-Quality Ratio, Relative Price, Price Reliability and Price Fairness.

The questions were being measured by using 7-point Likert Scale ranging from 'Highly Disagree' to 'Highly Agree'.

5.6.1 Frequency Distribution for Green Building Cost Satisfaction

For the table above, the frequency distribution for Green Building Elemental Cost Satisfaction among the respondent. The satisfaction are being separated into five categories which are Price Transparency, Price-Quality Ratio, Relative Price, Price Reliability and Price Fairness. One unstructured question on other cost satisfaction related to green building construction.

Based on Table 5.12, Price-Quality Ratio category has the highest agree percentage with 31.25% specifically on Cost spent on green materials has increased product efficiency (CQ3). With 17.97% respondent highly agree and 16.41% fairly agree with it. Although

21.09% of the respondent neither agree nor disagree, there are few who disagree and fairly disagree with 6.25% and 7.03% respectively.

Besides that, respondent degree of agree on green materials cost is in accordance with the quality (CQ2) also high with 63.29%. Shows that the higher the cost of the green material the higher the quality of it. However, there are 15.63% of respondent who against the belief. While 21.09% of all the respondent have neither agree nor disagree to it.

Table 5.11: Frequency Distribution for Green Building Cost Satisfaction

Item ID	Percentage (%)							Mean	Standard Deviation	Level
	HD	D	FD	N	FA	A	HA			
CT1	0.78	5.47	17.19	17.97	25.78	17.19	15.63	4.77	1.50	FH
CT2	1.56	8.59	11.72	14.06	23.44	23.44	17.19	4.88	1.60	FH
CT3	2.34	8.59	17.97	15.63	12.50	27.34	15.63	4.72	1.69	FH
CQ1	0.78	4.69	12.50	19.53	20.31	26.56	15.63	4.96	1.47	FH
CQ2	0.00	6.25	9.38	21.09	17.97	28.13	17.19	5.04	1.46	H
CQ3	0.00	6.25	7.03	21.09	16.41	31.25	17.97	5.13	1.44	H
CR1	1.56	7.03	10.16	29.69	20.31	14.84	16.41	4.70	1.52	FH
CR2	3.13	3.13	16.41	24.22	25.78	14.06	13.28	4.62	1.49	FH
CRE1	0.78	9.38	14.06	29.69	19.53	16.41	10.16	4.48	1.46	FH
CRE2	1.56	8.59	15.63	17.19	33.59	12.50	10.94	4.54	1.48	FH
CRE3	1.56	7.03	10.94	23.44	22.66	20.31	14.06	4.76	1.51	FH
CF1	1.56	6.25	17.19	21.09	16.41	17.19	20.31	4.77	1.63	FH
CF2	0.78	7.03	15.63	17.19	25.78	17.19	16.41	4.77	1.53	FH
CF3	3.13	3.91	20.31	13.28	20.31	20.31	18.75	4.80	1.65	FH

7 Point Likert Scale: Very Low Cost (VLC), Low Cost (LC), Fairly Low Cost (FLC), Neither Low Nor High Cost (NLH), Fairly High Cost (FHC), High Cost (HC), Very High Cost (VHC)

Level of Agreement: Very Low (VL), Low (L), Fairly Low (FL), Neither High Nor Low (N), Fairly High (FH), High (H), Very High (VH)

5.6.2 Ranking of Green Building Cost Satisfaction

The list of Green Building Cost Satisfaction is being ranked and analysed in this section. Table 5.13 showed the list of satisfaction being ranked according to the mean.

From Table 5.13, it can be observed that Cost spent on green materials has increased product efficiency (CQ3) ranked 1 out of all building elements in the cost satisfaction with mean 5.13. Followed by Green materials cost is in accordance with the quality (CQ2) with mean 5.04. Next Scarcity of green product led to cost surplus (CQ1) ranked third with mean

4.96. The three cost satisfaction placed on the top of the list were all in Price Quality-Ratio aspect. Green materials price stability (CRE1) ranked last with lowest mean 4.48.

Table 5.12: Ranking of Green Building Cost Satisfaction

Item ID	Cost Satisfaction	Mean	Level	Rank
CQ3	Cost spent on green materials has increased product efficiency.	5.13	H	1
CQ2	Green materials cost is in accordance with the quality.	5.04	H	2
CQ1	Scarcity of green product led to cost surplus.	4.96	FH	3
CT2	Green materials cost can be obtained.	4.88	FH	4
CF3	Reliable price for green materials.	4.8	FH	5
CF2	Price differences between seller's price and competitor's price for green materials.	4.77	FH	6
CF1	Price differences between green material and non-green materials.	4.77	FH	7
CT1	Certainty of production cost for green materials.	4.77	FH	8
CRE3	Green bond market implementation.	4.76	FH	9
CT3	Subsidies for green materials by the government.	4.72	FH	10
CR1	Tax treatment for green materials.	4.7	FH	11
CR2	Policy instruments implemented for green materials.	4.62	FH	12
CRE2	Cohesiveness of supply chain integration.	4.54	FH	13
CRE1	Green materials price stability.	4.48	FH	14

Level of Agreement: Very Low (VL), Low (L), Fairly Low (FL), Neither High Nor Low (N), Fairly High (FH), High (H), Very High (VH)

5.7 Cost Reduction Strategies and Stakeholders' Satisfaction

As previously mentioned, there are seven categories of cost reduction strategies that can be done for green building construction. these categories are Economic, Social, Policy, Technology, Environment, Industrial Practice and awareness. Cost reduction strategies is identified as an independent variable for this research.

There are five categories under stakeholders' price satisfaction which are Price Transparency, Price-Quality Ratio, Relative Price, Price Reliability and Price Fairness. Stakeholders' satisfaction is being identified as dependent variable for this research.

Table 5.15 shows correlation summary between cost reduction strategies and the stakeholders' satisfaction for green building construction. The rationale of conducting and method used to analyse the correlation between cost reduction strategies and the stakeholders' satisfaction for green building construction for this research has been explained in the previous chapter (Chapter 3).

Positive correlation observed indicates that cost reduction strategies will resulted in increase of stakeholders' satisfaction for green building construction. Negative correlation observed indicates cost reduction strategies will resulted in decrease of stakeholders' satisfaction for green building construction.

5.7.1.1 Economic Strategies and Stakeholders' Satisfaction

There are 13 pairs of correlation that can be observed between Economic strategies and Stakeholders' Satisfaction. Highly significant positive correlation at 0.01 level between SE1 and CQ3. Significant positive correlation at 0.05 level can be observed between Economic strategies and Stakeholders' Satisfaction. Item SE1 correlated with six items which are CT1, CT2, CQ1, CQ2, CR1 and CRE1. Item SE2 correlated with one item, Q3.

Item SE3 showed correlation between three items, CT1, CT2 and CQ2. Lastly, item SE4 correlated with two items which are CT1 and CQ3. Negative correlation can be observed between item SE2 and CQ3, CF1 and CF3. Despite of there are negative correlations reported, the relation is not significant. From the analysis, it can be deduced that Economic Strategies will significantly impacted Stakeholders' Satisfaction under the item Price Transparency, Price Quality Ratio and Price Reliability.

5.7.1.2 Social Strategies and Stakeholders' Satisfaction

There are 13 pairs correlation that can be observed between Social strategies and Stakeholders' Satisfaction. Highly significant positive correlation at 0.01 level between SS2 and CQ3. Significant positive correlation at 0.05 level can be observed between Social Strategies and Stakeholders' Satisfaction. Item SS1 correlated with one item CF2. Item SS2 correlated with two items which are CT1 and CT2. Item SS3 shows correlation with item CQ1, CQ2, CQ3, CR1 and CR2. These results shows that Social Strategies correlates with Stakeholders' Satisfaction related to Price Transparency, Price Quality Ratio, Relative Price, Price Reliability and Price Fairness.

5.7.1.3 Policy Strategies and Stakeholders' Satisfaction

Policy Strategies are correlated with 18 items under Stakeholders' Satisfaction. Highly significant positive correlation at 0.01 level can be observed between SP1 and CT1, CQ3, CRE1, CF1 and CF2. SP2 also shows highly significant correlation with three items which are CT1, CR1, CR2. Significant positive correlation at 0.05 level can be observed between SP1 and CT2, CT3, CQ1, CQ2, CR1, CR2, CRE2 and CRE3. SP2 is correlated with two items which are CT2 and CQ3. From the observation, Policy Strategies correlates with all categories of Stakeholders' Satisfaction.

5.7.1.4 Technology Strategies and Stakeholders' Satisfaction

Technology Strategies are correlated with 14 items under Stakeholders' Satisfaction. Highly significant positive correlation at 0.01 level can be observed between ST1 and CQ3. ST2 shows highly significant correlation with four items which are CQ3, CR1, CRE2 and CF2. Significant positive correlation at 0.05 level can be observed between ST1 and CT1, CQ1 and CR1. ST2 is correlated with five items which are CT3, CQ1, CQ2, CRE3 and CF1. Technology Strategies correlates with all categories of Stakeholders' Satisfaction.

5.7.1.5 Environment Strategies and Stakeholders' Satisfaction

Environment Strategies shows highly significant positive correlation at 0.01 level for SEN1 with CT1 and CQ2. Significant positive correlation at 0.05 level can be observed between SEN1 and CT2, CQ1, CQ3, CR1, CR2 and CF2. These results shows that Environment Strategies correlates with Stakeholders' Satisfaction related to Price Transparency, Price Quality Ratio, Relative Price and Price Fairness.

5.7.1.6 Industrial Practice Strategies and Stakeholders' Satisfaction

There are 47 pairs of correlation that can be observed between Industrial Practice Strategies and Stakeholders' Satisfaction. Highly significant positive correlation at 0.01 level for SI2, SI3, SI4 and SI6 with at least one the items from Stakeholders' Satisfaction with a total of eleven pairs. Significant positive correlation at 0.05 level can be observed for all items under Industrial Practice Strategies with items under Stakeholders' Satisfaction. Despite of there are negative correlations reported, the relation is not significant. From the analysis, it can be deduced that Industrial Practice Strategies will significantly impacted Stakeholders' Satisfaction.

5.7.1.7 Awareness Strategies and Stakeholders' Satisfaction

There are 17 pairs of correlation that can be observed between Awareness Strategies and Stakeholders' Satisfaction as shown in the following Table 5.14. Significant positive correlation at 0.05 level can be observed for all items under Industrial Practice Strategies with at least one item under Stakeholders' Satisfaction. From the analysis, it can be deduced that Awareness Strategies will significantly impacted Stakeholders' Satisfaction categories except for Relative Price.

Table 5.13: Correlation Summary Between Cost Reduction Strategies and the Stakeholders' Satisfaction

		CT1	CT2	CT3	CQ1	CQ2	CQ3	CR1	CR2	CRE1	CRE2	CRE3	CF1	CF2	CF3
SE1	C.	.209*	.205*	0.141	.182*	.200*	.289**	.184*	0.146	.207*	0.155	0.161	0.136	0.16	0.123
	S	0.018	0.02	0.114	0.04	0.024	0.001	0.038	0.099	0.019	0.081	0.07	0.127	0.071	0.168
SE2	C.C	0.075	0.078	0.033	-0.017	0.166	.174*	0.07	0.05	0.089	0.108	0.148	-0.081	0.005	-0.028
	S	0.4	0.38	0.711	0.85	0.062	0.05	0.435	0.579	0.315	0.224	0.096	0.366	0.952	0.753
SE3	C.C	.222*	.216*	0.17	0.112	.182*	0.144	0.092	0.015	0.168	0.15	0.123	0.085	0.121	0.025
	S	0.012	0.014	0.055	0.208	0.04	0.104	0.303	0.868	0.058	0.092	0.166	0.339	0.175	0.779
SE4	C.C	.189*	0.153	0.064	0.096	0.159	.177*	0.007	0.048	0.048	0.089	0.104	0.021	0.061	0.014
	S	0.033	0.085	0.471	0.283	0.074	0.045	0.936	0.594	0.592	0.319	0.243	0.811	0.493	0.872
SS1	C.C	0.151	0.055	0.123	0.138	0.136	0.094	0.119	0.103	0.119	0.125	0.132	0.159	.179*	0.129
	S	0.088	0.534	0.168	0.119	0.125	0.289	0.181	0.245	0.182	0.159	0.139	0.073	0.043	0.147
SS2	C.C	.184*	0.08	.185*	.180*	0.145	.179*	.229**	.191*	0.101	0.147	.226*	0.125	0.13	0.135
	S	0.038	0.37	0.037	0.042	0.102	0.044	0.009	0.031	0.255	0.097	0.01	0.16	0.144	0.128
SS3	C.C	0.107	0.06	0.162	.197*	.203*	.191*	.193*	.174*	0.073	0.136	0.163	0.067	0.09	0.061
	S	0.23	0.502	0.068	0.026	0.022	0.031	0.029	0.05	0.413	0.125	0.066	0.451	0.314	0.491
SP1	C.C	.272**	.177*	.220*	.216*	.205*	.265**	.213*	.191*	.266**	.219*	.205*	.276**	.245**	0.171
	S	0.002	0.045	0.012	0.014	0.02	0.002	0.016	0.031	0.002	0.013	0.02	0.002	0.005	0.054

Table 5.15: continued

SP2	C.C	.282**	.176*	0.16	0.146	0.166	.221*	.234**	.238**	0.142	0.024	0.145	0.139	0.141	0.07
	S	0.001	0.047	0.071	0.099	0.061	0.012	0.008	0.007	0.11	0.792	0.102	0.118	0.111	0.432
ST1	C.C	.192*	0.132	0.15	.199*	.183*	.283**	.199*	0.14	0.137	0.129	0.168	0.143	0.157	0.074
	S	0.03	0.137	0.092	0.024	0.039	0.001	0.024	0.115	0.122	0.146	0.058	0.107	0.078	0.406
ST2	C.C	0.173	0.134	.194*	.208*	.224*	.241**	.247**	0.154	0.153	.255**	.196*	.187*	.234**	0.134
	S	0.051	0.131	0.028	0.019	0.011	0.006	0.005	0.082	0.084	0.004	0.027	0.035	0.008	0.132
SEN1	C.C	.239**	.205*	0.12	.186*	.233**	.207*	.206*	.218*	0.13	0.027	0.116	0.114	.181*	0.062
	S	0.006	0.02	0.178	0.036	0.008	0.019	0.019	0.013	0.145	0.759	0.192	0.199	0.041	0.486
SI1	C.C	.200*	0.081	0.104	0.104	0.133	0.044	-0.06	0.046	0.128	0.057	0.09	.196*	.201*	0.069
	S	0.023	0.363	0.244	0.245	0.135	0.625	0.501	0.608	0.149	0.526	0.312	0.026	0.023	0.438
SI2	C.C	.222*	0.142	.202*	.211*	0.17	0.144	0.02	0.106	.174*	.208*	.185*	.276**	.272**	0.144
	S	0.012	0.11	0.022	0.017	0.055	0.106	0.826	0.233	0.05	0.018	0.037	0.002	0.002	0.106
SI3	C.C	.235**	0.136	.199*	.201*	.190*	.180*	.196*	.251**	.182*	0.134	.185*	0.172	.213*	0.096
	S	0.008	0.126	0.024	0.023	0.031	0.042	0.026	0.004	0.039	0.13	0.036	0.052	0.016	0.282
SI4	C.C	.238**	0.116	.189*	0.168	0.143	.237**	0.053	0.11	.176*	.220*	.232**	.221*	.288**	.178*
	S	0.007	0.193	0.032	0.058	0.108	0.007	0.555	0.216	0.047	0.013	0.008	0.012	0.001	0.045
SI5	C.C	.217*	0.139	.180*	0.141	0.148	0.166	.185*	.185*	0.149	0.156	.224*	0.153	.184*	0.05
	S	0.014	0.117	0.042	0.113	0.095	0.061	0.036	0.036	0.094	0.078	0.011	0.086	0.037	0.577

Table 5.15: continued

SI6	C.C	.268**	.186*	.242**	.176*	.193*	.246**	0.14	0.1	.183*	.197*	.225*	.197*	.210*	0.13
	S	0.002	0.036	0.006	0.047	0.029	0.005	0.114	0.26	0.039	0.026	0.011	0.025	0.017	0.144
SA1	C.C	.279**	.195*	0.17	.203*	.233**	.334**	.213*	0.117	.207*	0.17	0.122	0.144	.235**	0.125
	S	0.001	0.027	0.055	0.022	0.008	0	0.016	0.188	0.019	0.056	0.169	0.104	0.008	0.16
SA2	C.C	.207*	0.12	0.149	.257**	.196*	.302**	0.171	0.142	0.15	0.129	.177*	0.139	.196*	0.12
	S	0.019	0.177	0.093	0.003	0.026	0.001	0.054	0.11	0.091	0.148	0.046	0.117	0.027	0.178
SA3	C.C	.254**	0.165	0.145	.184*	0.166	.222*	0.097	0.02	.181*	0.084	0.136	0.126	0.12	0.105
	S	0.004	0.062	0.103	0.037	0.06	0.012	0.275	0.822	0.041	0.345	0.127	0.157	0.177	0.24
**. Correlation is significant at the 0.01 level (2-tailed).															
*. Correlation is significant at the 0.05 level (2-tailed).															
C.C: Correlation Coefficient															

5.8 Discussion

From the analysis, few research findings to reach the research objectives have being obtained. Key building elements, green components, strategies and stakeholders' satisfaction can be identified.

From the findings, it can be found that building elements that contributed the most to the cost of construction for green building are Roofing and Roof Plumbing as being supported by Lani et al. (2018) and Structural (WBLFF, Frame and Upper Floor) (Halil et al., 2022). Top green components that contributed to the cost would be under the category of Sustainable Site Planning and Management (SM), Indoor Environmental Quality (IEQ) and Materials and Resources (MR). For Site Planning and Management, the process of implementing greenery and roof related to landscaping design is found to be high in cost as being supported by Lani et al. (2018). Example of the items are hardscape and greenery application, vegetated roof and material with Solar Reflectance Index. Items under Indoor Environmental Quality that contributed most to the cost is daylight system and reduction of daylight glaring such as façade, shading, light shelves and glare control. Materials and Resources contributed to the cost by ensuring the materials obtained are from reusable materials, locally and regionally sourced timbre are certified which is also supported by Hu and Skibniewski (2021) and Insja and Sihombing (2017) which stated that material cost contributed the most to the cost of green building construction.

Findings of this research found that building exterior contributed the most to the cost of green building construction which are building roof and façade. Roof and façade contributed the most to the cost of green building construction. Despite of contributing the most to the cost of green building construction, the outside of green building will attribute

greatly on building green status (Rodrigues & Freire, 2021). Building raw materials contributed the most to the cost of building construction. Less costly materials can be easily obtained but to fulfil green requirement required by GBI, few criteria needed to be fulfilled. For example sourcing materials from local manufacturer which may not producing their materials in bulk thus increasing their production cost thus increasing the material cost. Sustainable green building materials are also high in production cost and the range can be limited (Rased et al., 2023).

Based on the findings, key strategies to reduce cost of green building construction includes industrial practice, environment, awareness, social and technology (Mohammed Hatem et al., 2021). Under industrial practice three strategies that can be implemented are giving attention during initial stage (Victoria et al., 2017), process of value management (Nasereddin & Price, 2021) and implementation of optimisation model in choosing green construction material (Castro-Lacouture et al., 2009). For environment, passive sustainable technology can be implemented into the building design (Liu & Ren, 2020). Awareness especially in environmental issue and green product are strategies that can be implemented to reduce the cost. Under social, green building award will increase interest in the implementation of green building construction thus reducing the cost of green building construction (Zhang et al., 2019). Lastly, technology can also be implemented to reduce the cost of green construction by improving communication for green materials and construction. This can be achieved by the usage of Internet of Things (IoT) (Jadhav, 2016).

Key stakeholders' satisfaction includes increasing product efficiency (Voros, 2019), green materials quality (Mori, 2021), making green materials abundant or preventing scarcity (Park et al., 2020), readily available cost data (Martin, 2018) and reliable price for

green materials (Opata et al., 2019). These are the key stakeholders' satisfaction that have been addressed by this research.

Overall, positive correlation can be observed between cost strategies and stakeholders' satisfaction. Positive correlation indicates that when cost strategies is improved stakeholders' satisfaction can also be improved. From the findings it can be concluded that materials quality and availability will increase stakeholders' satisfaction. Ensuring material availability in the market will reduce the cost of production hence increase cost satisfaction by the industry stakeholders.

From the research findings, it can be concluded that Green building design and green components played large roles in determining the budgeting of building construction (Halil et al., 2022). Proper planning on materials and methods of construction need to be taken in consideration (Heigermoser et al., 2019). This proper planning and management need to be conducted especially for roof and structural building elements as being found in this research. Certain green components will also increase the cost of construction of green building therefore green items such as green roof, installation of façade to reduce daylight glaring and certified materials to fulfil green certification needed to be scrutinised.

Effective strategies especially those involving industrial practice need to be needed to be implemented to reduce the cost premium of green building construction (Mustaffa et al., 2021). This involves changing the mindset and working culture to incorporate designs and activities that will help to reduce the cost of green construction (Holbeche, 2019). By giving additional attention during initial design stage, implementation of Value Management and optimisation model for green materials contingency cost of the implementation of green building construction will significantly be reduced.

Additionally, more attention must be devoted to the key factors driving stakeholder's cost satisfaction (Tkachenko & Pervukhina, 2020). These factors are product efficiency, green product quality, availability of green materials in the market, readily available cost data for green materials and reliable price. By being attentive towards these factors, the implementation of green construction will be increasing in demand.

Industry stakeholders' cost satisfaction for green building is closely related to the cost of green building construction. Implementation of strategies to reduce the cost of green building construction will further increase green cost satisfaction and increase interest in green building construction.

From this research, preventive measures such as by being attentive during initial stage for previously mentioned building element and green element is imperative for satisfactory green building construction. Implementation of the previously discussed strategies is important to reduce the cost of green building construction and ensure industry stakeholders' satisfaction.

The final framework for this research is illustrated in Figure 5.2.

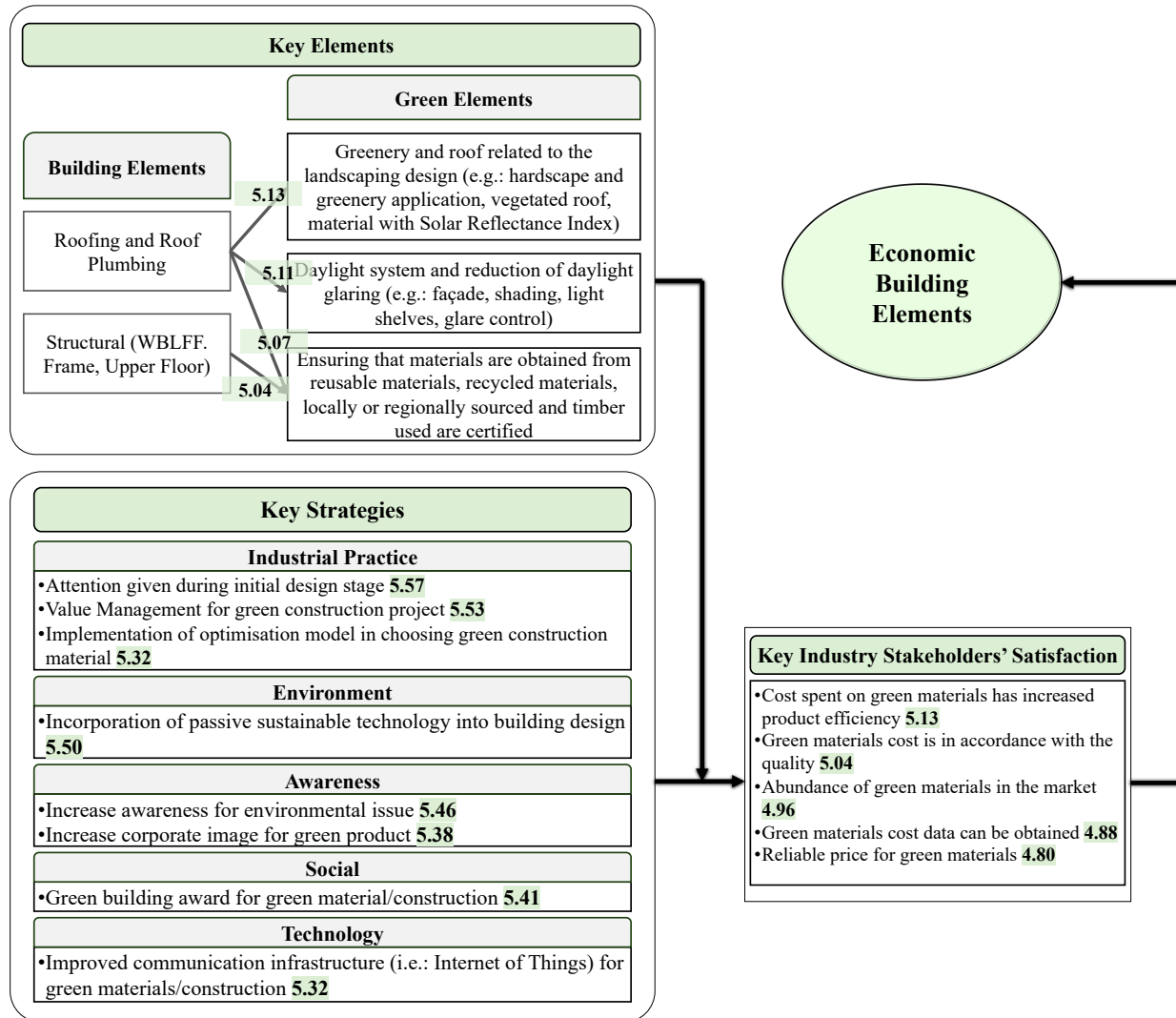


Figure 5.2: Cost Reduction-Client Satisfaction Framework of Green Building Construction

5.9 Summary

In conclusion, findings of the research have been established in this chapter. From the findings, it can be concluded that by identifying which of building elements that contributed the most to the building cost, strategies that has been identified can be used to reduce the cost of construction. By reducing the cost of construction, stakeholders' cost satisfaction can be improved. By improving the satisfaction of green building stakeholders, green building construction will be increased.

All of the research objectives are reached by conducting survey, utilising the use of self- administered questionnaire. Data obtained then being analysed by using SPSS and being presented in the form of a table for easy understanding. Conclusion is to be drawn and recommendations to be discussed in the next chapter.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 General

This research aims at formulating a Cost Reduction-Client Satisfaction Framework of green building construction that is expected to encourage and motivate the industry stakeholders to invest in green building construction. This research was conducted to achieve four objectives to identify the most expensive elements in green building construction, to recommend the strategies in minimising the overall cost of green construction, to study the relationship between cost minimisation towards stakeholders' cost satisfaction and to formulate Cost Reduction-Client Satisfaction Framework of green building construction. Therefore, each objective can be concluded as follows: -

To identify the most expensive elements in green building construction is the first objective of the research. For this objective, questionnaire was being distributed to middle to top management team who has experience in green building construction. Twenty one items have been identified. They are being separated into five different categories as which are Energy Efficiency (EE), Indoor Environmental Quality (IEQ), Sustainable Site Planning and Management (SM), Materials and Resources (MR) and Water Efficiency (WE) (Green Building Index Guidelines). The questions were being measured by using 7-point Likert Scale ranging from 'Very Low Cost' to 'Very High Cost'.

The most expensive building elements in green building construction being arranged in descending order are as the followings:-

- Roofing and Roof Plumbing
- Structural (WBLFF, Frame and Upper Floor).

The most expensive green components in green building construction being arranged in descending order are as the followings:-

- Greenery and roof related to the landscaping design (e.g.: hardscape and greenery application, vegetated roof, material with Solar Reflectance Index) – Sustainable Site Planning and Management (SM).
- Daylight system and reduction of daylight glaring (e.g.: façade, shading, light shelves, glare control) – Indoor Environmental Quality (IEQ).
- Ensuring that materials are obtained from reusable materials, recycled materials, locally or regionally sourced and timber used are certified – Materials and Resources (MR).

It can be concluded that these building elements and green components contributed the most to the cost of green building construction (Halil et al., 2022) . Roofing is found to be contributing the most to green building construction (Lani et al., 2018). It is then being followed by structural elements as being supported by Victoria et al. (2017). By tackling the cost of the construction for these elements, the cost of green building construction can be reduced. Therefore, the most expensive elements of green building construction has been identified and the research objective has been met.

The second objective for this research is to recommend strategies in minimising the overall cost of green construction Twenty one items have been identified. They are being

separated into seven categories which are economic, social, policy, technology, environment, industrial practice and awareness (Mohammed Hatem et al., 2021). The questions were being measured by using 7-point Likert Scale ranging from 'Highly Disagree' to 'Highly Agree'.

The key strategies in minimising the overall cost of green construction being arranged in descending order are as the followings:-

- Industrial Practice
 - Attention given during initial design stage.
 - Value Management for green construction project.
 - Implementation of optimisation model in choosing green construction material.
- Environment
 - Incorporation of passive sustainable technology into building design.
- Awareness
 - Increase awareness for environmental issue.
 - Increase corporate image for green product.
- Social
 - Green building award for green material/construction

- Technology
 - Improved communication infrastructure (i.e.: Internet of Things) for green materials/construction.

It can be concluded that green building cost reduction strategies listed are relevant to the construction industry. By increasing the demand for green construction, it will improve the price competitiveness of green construction thus it will affect the cost of green building construction. This relationship has been recognised by Nelson (2012) where price demand played an important aspect in determining material cost and price. Therefore, the strategies aforementioned which largely implemented the theory of demand and supply will influence the cost of construction for green building construction (Kamaruddeen et al., 2018).

List of industry stakeholders' green building cost satisfaction are being listed in the questionnaire. There are fourteen questions related to green building cost satisfaction being asked under this section. They are being separated into five categories which are Price Transparency, Price-Quality Ratio, Relative Price, Price Reliability and Price Fairness (Lympelopoulous et al., 2013; Matzler et al., 2006).

Key strategies were being identified and ranked in descending order as the followings: -

- Cost spent on green materials has increased product efficiency.
- Green materials cost is in accordance with the quality.
- Abundance of green materials in the market.
- Green materials cost data can be obtained.

- Reliable price for green materials.

The correlation between cost reduction strategies and the stakeholders' satisfaction for green building construction are found to be existed and are mostly positively correlated. Positive correlation indicates that when level of agreement for cost reduction strategies exists, cost satisfaction for green construction will also increase (Schober & Schwarte, 2018).

6.2 To Formulate Cost Reduction-Client Satisfaction Framework of Green Building Construction

All in all, key elements were being identified to improve the initial framework constructed. Key building elements, green components, strategies and stakeholders satisfaction were being identified and framework for Economic of Green Building Construction then being built as in the Figure 5.2.

Economic building elements are being moderated by two variables which are Green Building Elements and Key Strategies. These two variables will affect key industry stakeholders' satisfaction. In return it will affect demand in green building construction and affect the cost of green building construction (Kamaruddeen et al., 2018).

6.3 Recommendations for Future Research

The developed framework can be further validated to increase the reliability of the variables and to strengthens its efficiency in addressing the cost issues of green building construction. Framework validation can be done through conducting a focus group discussion among green building construction experts (Gugiu et al., 2021).

Next, further researches related to industry stakeholders' competencies throughout the process of green building construction shall be studied. In particular, the competency of Quantity Surveyors competencies in preparing estimates and other duties related to their job scope. It might be beneficial to improve quantity surveyors' competencies during the process of in green building construction and to avert any cost issues that may arise (Chandramohan et al., 2022).

Lastly, research scope shall be broadened to include building occupants and end users to solicit different perspectives related to green building construction cost. Their raw insights might even shed new light for the continuous innovation of green building construction in Malaysia and beyond, elevating the sustainability of this once-deemed dirty, difficult and dangerous industry.

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APPENDICES



UNIVERSITI MALAYSIA SARAWAK FACULTY OF BUILT ENVIRONMENT

This research is being conducted for the completion of Master of Science in Built Environment with a title **Economic Framework of Green Building Construction**.

The aim of this research is to formulate an economic framework of green building construction which is expected to encourage and motivate the industry stakeholders to invest in green building construction. The scope of this study are **project stakeholders (project manager, quantity surveyor, engineer and etc.) with experience and knowledge of green building construction cost in Malaysia**.

Respondents are being required to fill in the blank and tick (/) the answers based on respondents' own thought, experience and judgement. This questionnaire will take between 3-4 minutes to be completed and consisted of few sections:-

Section A – Demographic Information

Section B – Green Building Elemental Cost

Section C – Green Building Cost Reduction Strategies

Section D – Green Building Cost Satisfaction

By filling in the questionnaire, respondents has consented the use of any information provided. The information are confidential and strictly for research purposes only.

Your cooperation is greatly appreciated and will largely determine the success of this study.

Regards,
Nur Khairina.

SECTION A : DEMOGRAPHIC INFORMATION

This section gathers demographic information of the respondent. Please **tick (/)** the answer(s) which is/are the most relevant.

1. Position in construction project

- ☐ Architect
- ☐ Engineer
- ☐ Project Manager
- ☐ Quantity Surveyor
- ☐ Others: _____

2. Organisation

- ☐ Public Sector
- ☐ Private Sector
- ☐ Consultant
- ☐ Others: _____

3. Experience in construction industry

- ☐ Less than 5 years
- ☐ 5 -10 years
- ☐ 11-15 years
- ☐ 15 years and above

4. Experience in green construction

- ☐ One green construction project
- ☐ 2-5 green construction projects
- ☐ 5 green construction projects and above

5. Green building construction training/education (Please select multiple if applicable)

- ☐ Tertiary education (Undergraduate/Master's/Doctorate)
- ☐ GBI Training Courses
- ☐ Training related to green building rating system
- ☐ Professional certificate in Sustainable Design and Construction
- ☐ Workshop training organised by company
- ☐ Others: _____

SECTION B: GREEN BUILDING ELEMENTAL COST

This section gathers information related to the cost of green building items under building elements based on respondent's experience. From the scale of very low cost to very high cost, please **tick (/)** the scale that is the most relevant.

The indication for the questions is according to the following scales: -



1 2 3 4 5 6 7

Energy Efficiency

1. Cost to achieve maximised energy performance by using insulated materials to prevent heat gain (e.g.: autoclaved lightweight concrete, insulated glazing) for:-

- a) Roofing and roof plumbing.

☐	☐	☐	☐	☐	☐	☐
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- b) Walls (External Walls, Internal Walls).

☐	☐	☐	☐	☐	☐	☐
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Indoor Environmental Quality

2. Cost to design and construct a column free open space for:-

- a) Structural (WBLFF, Frame, Upper Floor).

☐	☐	☐	☐	☐	☐	☐
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- b) Staircase.

☐	☐	☐	☐	☐	☐	☐
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3. Cost of installation for daylight system and reduction of daylight glaring (e.g.: façade, shading, light shelves, glare control) for:-

- a) Roofing and Roof Plumbing.

☐	☐	☐	☐	☐	☐	☐
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4. Cost of installation for daylight system, reduction of daylight glaring and control of internal noise levels (e.g.: façade, shading, light shelves, glare control, acoustical ceiling, insulated partition cavities) for:-

- a) Walls (External Walls, Internal Walls and Partitions).

☐	☐	☐	☐	☐	☐	☐
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- b) Doors and Windows.

☐	☐	☐	☐	☐	☐	☐
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5. Cost to control of indoor air pollutant and internal noise levels (e.g.: using low VOC paint, no urea formaldehyde for composite woods used, agrofibre product, insulation foam and draperies, acoustical ceiling, carpet) for:-

- a) Finishes (Wall, Floor and Ceiling).

☐	☐	☐	☐	☐	☐	☐
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6. Cost to control indoor air pollutant (e.g.: using low VOC paint, no urea formaldehyde for composite woods used, agrofibre product, insulation foam and draperies) for:-

- a) Furniture.

☐	☐	☐	☐	☐	☐	☐
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	1	2	3	4	5	6	7
7. Cost of Environmental Tobacco Smoke (ETS) control by installation of signages to ensure indoor smoking provision are adhered for:-							
a) Signage.	☐	☐	☐	☐	☐	☐	☐
Sustainable Site Planning and Management							
8. Cost of greenery and roof related to the landscaping design (e.g.: hardscape and greenery application, vegetated roof, material with Solar Reflectance Index) for:-							
a) Roofing and Roof Plumbing.	☐	☐	☐	☐	☐	☐	☐
Material and Resources							
9. Cost to ensure that the materials are obtained from reusable materials, recycled materials, locally or regionally sourced and timber used are certified for:-							
a) Structural (WBLFF, Frame, Upper Floor).	☐	☐	☐	☐	☐	☐	☐
b) Staircase.	☐	☐	☐	☐	☐	☐	☐
c) Roofing and Roof Plumbing.	☐	☐	☐	☐	☐	☐	☐
d) Walls (External Walls, Internal Walls and Partitions).	☐	☐	☐	☐	☐	☐	☐
e) Doors and Windows.	☐	☐	☐	☐	☐	☐	☐
f) Finishes (Floor, Wall and Ceiling).	☐	☐	☐	☐	☐	☐	☐
g) Sanitary Fittings and Plumbing.	☐	☐	☐	☐	☐	☐	☐
h) Furniture.	☐	☐	☐	☐	☐	☐	☐
Water Efficiency							
10. Cost for the installation of rainwater harvesting system (e.g.: collection of runoff rainwater, water purifying system) for:-							
a) Roofing and Roof Plumbing.	☐	☐	☐	☐	☐	☐	☐
11. Cost for waste water recycling and water efficient fittings (e.g.: water treatment system for greywater, fittings such as shower head and faucets are water efficient) for:-							
a) Sanitary Fittings and Plumbing.	☐	☐	☐	☐	☐	☐	☐

SECTION C: GREEN BUILDING COST REDUCTION STRATEGIES

This section gathers information related to the cost reduction strategies of green building construction based on respondent's experience. From the scale of highly disagree to highly agree, please **tick (/)** the scale that is the most relevant.

The indication for the questions is according to the following scales: -



	1	2	3	4	5	6	7
<u>Economic</u>							
1. Green finance (e.g.: green securities, green investments, green insurance, green credit, green central banking, community based green fund)	☐	☐	☐	☐	☐	☐	☐
2. Fiscal policy (e.g.: tax relief, tax credit)	☐	☐	☐	☐	☐	☐	☐
3. Monetary policy or window guidance policy.	☐	☐	☐	☐	☐	☐	☐
4. Consumer directed and market-oriented policy	☐	☐	☐	☐	☐	☐	☐
<u>Social</u>							
5. Market-focused approach (e.g.: green marketing, market orientation culture)	☐	☐	☐	☐	☐	☐	☐
6. Public-Private Partnership for green construction	☐	☐	☐	☐	☐	☐	☐
7. Green building award for green material/construction.	☐	☐	☐	☐	☐	☐	☐
<u>Policy</u>							
8. Establishing new intermediary roles to aid industry stakeholders .	☐	☐	☐	☐	☐	☐	☐
9. Establishing effective legislative process and enforcement.	☐	☐	☐	☐	☐	☐	☐
<u>Technology</u>							
10. Improved communication infrastructure (i.e.: Internet of Things) for green materials/construction.	☐	☐	☐	☐	☐	☐	☐
11. Adoption of blockchain technology into supply chain management to assist in pricing strategy.	☐	☐	☐	☐	☐	☐	☐
<u>Environment</u>							
12. Incorporation of passive sustainable technology into building design (passive cooling system, rainwater harvesting system).	☐	☐	☐	☐	☐	☐	☐

	1	2	3	4	5	6	7
Industrial Practice							
13. Attention given during initial design stage.	☐	☐	☐	☐	☐	☐	☐
14. Value Management for green construction project.	☐	☐	☐	☐	☐	☐	☐
15. Establish cooperation between stakeholders and manufacturer.	☐	☐	☐	☐	☐	☐	☐
16. Implementation of optimisation model in choosing green construction material.	☐	☐	☐	☐	☐	☐	☐
17. On site flexibility practice.	☐	☐	☐	☐	☐	☐	☐
18. Sustainable logistics practices such as reverse logistics by manufacturers.	☐	☐	☐	☐	☐	☐	☐
Awareness							
19. Retailer-led supply chain	☐	☐	☐	☐	☐	☐	☐
20. Increased corporate image for green product	☐	☐	☐	☐	☐	☐	☐
21. Increase awareness for environmental issue	☐	☐	☐	☐	☐	☐	☐
22. Other strategies that can be taken to reduce the cost of green building construction.							

SECTION D: GREEN BUILDING COST SATISFACTION

This section gathers information related to the green building cost satisfaction based on respondent's experience. From the scale of highly unsatisfied to highly satisfied, please **tick (/)** the scale that is the most relevant.

The indication for the questions is according to the following scales: -



	1	2	3	4	5	6	7
<u>Price Transparency</u>							
1. Certainty of production cost for green materials.	☐	☐	☐	☐	☐	☐	☐
2. Green materials cost can be obtained.	☐	☐	☐	☐	☐	☐	☐
3. Subsidies for green materials by the government.	☐	☐	☐	☐	☐	☐	☐
<u>Price-Quality Ratio</u>							
4. Scarcity of green product led to cost surplus.	☐	☐	☐	☐	☐	☐	☐
5. Green materials cost is in accordance with the quality.	☐	☐	☐	☐	☐	☐	☐
6. Cost spent on green materials has increased product efficiency.	☐	☐	☐	☐	☐	☐	☐
<u>Relative Price</u>							
7. Tax treatment for green materials.	☐	☐	☐	☐	☐	☐	☐
8. Policy instruments implemented for green materials.	☐	☐	☐	☐	☐	☐	☐
<u>Price Reliability</u>							
9. Green materials price stability.	☐	☐	☐	☐	☐	☐	☐
10. Cohesiveness of supply chain integration.	☐	☐	☐	☐	☐	☐	☐
11. Green bond market implementation.	☐	☐	☐	☐	☐	☐	☐
<u>Price Fairness</u>							
12. Price differences between green material and non-green materials.	☐	☐	☐	☐	☐	☐	☐
13. Price differences between seller's price and competitor's price for green materials.	☐	☐	☐	☐	☐	☐	☐
14. Reliable price for green materials.	☐	☐	☐	☐	☐	☐	☐
15. Other cost satisfaction related to green building construction.							

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