IMPLEMENTATION OF THE GREEN RATING SYSTEM FOR PUBLIC SECTOR BUILDINGS IN SRI LANKA

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Declaration

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Dr(Mrs). Thilini Jayawickrama Date

Abstract

Green buildings are becoming the pioneering of sustainable development and gaining mainstream acceptance as an answer to growing global energy demands. Hence, governments worldwide take many key initiatives in implementing this concept. Rating systems encourage and promote green design. As many existing programs offer multiple levels of certification, the design/building community is encouraged to continually strive for new sustainable goals. This research attempts to identify the challenges faced by the Sri Lankan public sector in implementing green building concept. Accordingly, it has identified that the concept is still new to the public sector and considerable changes shall be made within the entire government procedures to run the green rating system to harness its potentials and implemented to a successful green building design. The research finds drawbacks in the knowledge of the green concepts within the stakeholders within a public sector building project. However, it is worth noting that the officers of the Sri Lanka Engineering Service, and Sri Lanka Architectural Service have the most comprehensive knowledge of the subject. Further, this research identifies that currently the green requirement is only for regulatory approvals. The proper implementation and execution of sustainable design concepts are not addressed to the project, making the whole system useless.

Keywords: Green Building, Green building rating system, Public Sector

Dedication

I would dedicate this thesis to my beloved family members and friends who have never failed to give me a tremendous support, for giving all not only throughout my project but also throughout my life as well.

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This research study would not be possible without the assistance, encouragement and dedication of numerous individuals and organizations who contributed in plentiful ways. Therefore, I get this opportunity to convey my gratitude to all of them.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
BREEAM	Building Research Establishment Environmental Assessment Method
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
HKBEAM	Hong Kong Building Environmental Assessment Method Plus
CoC	Certificate of Conformity
GBCSL	Green Building Council Sri Lanka
LEED	Leadership in Energy and Environmental Design
PPC	Preliminary Planning Clearance
UDA	Urban Development Authority

LIST OF APPENDICES

1 INTRODUCTION

1.1 Background

The sustainable development concept has led the world to realize how to address their needs in a more responsible manner (Abidin, 2005). There are many international debates and conferences held to develop propagate and to establish the concept of sustainable development. To highlight few are; Rio Earth Summit 1992, Maastricht Treaty 1992, Kyoto Conference on Global Warming 1997, Johannesburg Earth Summit 2002 and Washington Earth Observation Summit 2003.

Positive actions and plans have been implemented by many countries to incorporate this philosophy into their industries. Part of this philosophy is sustainable construction, which gives the construction sector the responsibility to guarantee sustainability (Abidin, 2009). The construction sector can make a positive and constitutive contribution to the protection of the environment through the concept of sustainable construction.

Apart from the numerous advantages in sustainable building practices, many disadvantages and barriers can be experienced such as resource limitations, cost constrains, and the difficulties that could be occurred within the project managers scope. Therefore, sustainable development projects always demand different perspective or a deviation from the traditional project management role, processes, and practices (Anantatmula, 2010).

Green movement around the world has put green building at the center of attention because it is able to meet the demand for buildings and at the same time limit the negative effects of the construction sector (Nguyen & Gray, 2016). The construction sector is responsible for a significant share of carbon emissions worldwide (Siva, Hoppe and Jain, 2017). According to Levin (1997), the contribution of buildings to the total environmental impact varies between 12.42% of the eight main categories of environmental stressors: use of raw materials (30%), energy (42%), water (25%) ,land (12%) and polluting emissions such as air emissions (40%), water effluents

(20%), solid waste (25%) and other discharges (13%). According to Nobel (2012), the US government sector accounts for around a third of the country's construction spending, according to the latest figures from the US Census Bureau.

Ecological design, ecologically sustainable design, and green designs are terms that describe the application of sustainability principles to building designs (Kibert, 2008). As defined by US Environment Protection Agency, “Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction” (US EPA, 2016). This practice expands and set off the classical building design concerns of economy, utility, durability, and comfort. Similarly, green buildings have also be defined as "healthy facilities designed and built in a resource-efficient manner, using ecologically based principles (Kibert, 2008).Benefits of green buildings, cost savings and improved worker productivity become more apparent.

Performance criteria and indicators for sustainable construction are needed to assess the performance of a building / facility and to measure its impact on the environment. They must be comprehensive to address specific environmental issues. Cole and Larsson (1997) defined performance criteria as basic building blocks, which define the specific characteristics of the building / facility to be evaluated.
. In this vein, the building construction industries from various countries have taken these ‘green measures’ in their strides, putting strong accent on green building construction (Hwang and Tan, 2012).

Different types of assessment tools and certification schemes have been developed around the world to rate green and monitor buildings (Siva, Hoppe, & Jain, 2017), such as Building Research Establishment Environmental Assessment Method (BREEAM) (UK), Green Building Council of Australia rating system (GBCA), Green Mark (Singapore), The German Sustainable Building Council DGNB system, Comprehensive Assessment System for Built Environment Efficiency (CASBEE) (Japan), and Pearl Rating System (Abu Dhabi). The World Green Building Council has been established as an international network organization for all the various local councils in order to communicate the knowledge of green construction methods to new facilities management teams and end users to maintain sustainability.

As governments face increasing utility bills and higher demand from public for good quality services and infrastructure, many public sector organizations in the United States and overseas are adopting policies to ensure that their facilities are designed to be green. Many of these policies are based on the U.S. Green Building Council's Leadership in Energy and Environmental Design standard (LEED) (Office of the Federal Environmental Executive, 2008) which was originally released by USGBC as a voluntary, consensus based national standard for developing high-performance, sustainable buildings (USGBC,2006). Government holds considerable influence over the movement toward building environmentally friendly buildings (Nobel, 2012). In the due course, government's influence can promote a central role a public policy goal of sustainable development, which is beneficial to both public and private interests (Nobel, 2012).

Consequently, first to implement in Sri Lanka was GREEN$^{SL®}$ Rating of Buildings by Green Building Council Sri Lanka (GBCSL) with affiliation of World Green Building Council in 2009. Recognizing the importance of state intervention to set the required policy and regulatory reform and building another initiative was initiated in 2017 by Urban Development Authority (UDA) in Sri Lanka making it mandatory to achieve green building for Government and semi government buildings in Sri Lanka.

1.2 Research Problem

Many researches have been conducted to evaluate green buildings and green rating systems (Siva, Hoppe, & Jain, 2017). Also researches have been conducted stating the significance of Government involvement in implementing Green Buildings. However, research regarding implementation of green rating system by Government entities and measuring their success of failure remain under-researched area up to date. This is mainly due to the fact that green building rating systems are often conducted by interdependent consensus-based organizations not attached to Governments.

Unlike Private sector building projects, public sector building projects require numerous procedures and regulations to follow up. Therefore it is necessary to research the application of green rating system within a Government Public building sector setting.

In 2017, the Government of Sri Lanka issued a mandatory green guideline to follow in designing government buildings. It is evident that this guide on sustainable / green rating method has many grey areas.

The essence of the literature review has revealed that the similar rating systems which are used in the world are primarily focused on sustainability of the site, energy and atmospheric issues, efficient usage of water, materials and recourses utilization, indoor environmental quality, novelty and innovativeness, implications pertaining to the transportation in relation to the location, and regional priority. However available literature suggests that the rating systems should change based on a country's environmental, economic and social needs.

Therefore, it is a prime requirement to study the validity and the practicalities of the strategies used in Blue Green Sri Lanka (Green Guideline) by UDA to assess the sustainability of Government buildings in Sri Lanka. So the research problem is to study the implementation barriers of 2017 'Blue Green Sri Lanka' Green building guidelines. Do we need any modifications?

1.3 Aim and Objectives

1.3.1 Aim of the study

The study aimed to analyze the issues pertaining to the application of Blue Green Sri Lanka Green Rating System for Government buildings.

1.3.2 Research Objectives

This study is mainly focused on the following research objectives;

- To identify the key issues and challenges in implementing the 'Blue Green rating system' in public sector building projects.

- To analyze the 'Blue Green rating system' with comparison to similar rating systems used around the world as well as in local context.

- To make recommendations for the application of the 'Blue Green rating system' in public sector building projects.

1.4 Methodology

The research methodology adapted for the study is discussed under three phases. Each phase discussed separately research background, research approach, data collection and data analysis.

A literature review was conducted to form research background, which identify Green Building concepts, Green Rating system applicable in worldwide, their success and failures.

Accordingly research design was directed to select research approach and data collection method. In this research, approach was qualitative method. In the data collection method, semi-structured interview with interview guideline was conducted to get government officers comments and suggestions. The data obtained from the interviews manually evaluated to present the result.

1.5 Scope and Limitations

This research conducted within context of Public sector building projects of Sri Lanka and Green rating system (Blue Green Sri Lanka) which used in public sector building. Therefore, the results or outcome of this study shall compatible to the Blue Green Sri Lanka green rating system applied in Sri Lankan public sector buildings only.

1.6 Chapter Breakdown

This report consists of five chapters as follows.

Chapter one – Introduction

This chapter gives an overview to the research and presents the structure of the report. This includes background of the study, research problem, aim & objectives, methodology, scope & limitations and the chapter breakdown.

Chapter two - Literature Review

This chapter explores the theoretical background of research issues through a comprehensive literature review.

Chapter three – Research Methodology

Here the research methodology is discussed. This includes research design, research settings and the process of data analysis method.

Chapter four - Research Findings

In this chapter, discuss about"Blue Green Sri Lanka" green rating system which use for construction of government building

Chapter five - Conclusion and Recommendations

Finally, the conclusion of the study carried out, recommendations and further research areas that can be carried out in future will be given in this last chapter.

2 LITERATURE REVIEW

2.1 Introduction

Literature synthesis is a comprehensive approach to the research to have a better understanding about the theoretical status of the research problem. Thus, this chapter discusses the sustainable development, sustainable construction, green building and green rating systems. The objectives of this chapter is to overview and analyze the current environmental building assessment methods used in different countries in terms of their characteristics and limitations in assessing sustainability of buildings.

2.2 Sustainable development, Sustainable construction and Green Building

2.2.1 Sustainable development and Sustainable construction

Buildings and structures enabled mankind to meet their social needs for shelter, to meet economic needs for investment and to satisfy corporate objectives. However, meeting these needs usually leads to undesirable effects.This lead to a growing realization around the world to alter and improve our conventional way of development into a more responsible approach. The opportunity for improvement arrived when a new philosophy called 'sustainable development' was introduced in 1987 in Brundtland Report (WCED, 1987). Sustainable development is the development that "fulfills the requirements of the present without compromising the ability of future generations to fulfill their own requirements" (WCED,1987).

Sustainable development is often presented as being divided into the economy, environment and society (Hardi and Zdan, 1997). Similarly, in the present, the concept of sustainable construction rules three main pillars. Those are environmental protection, social well-being and economic prosperity (Elkington,1997).

The protection of the environment concerns the built environment and the natural environment. The built environment refers to activities carried out as part of the construction project itself. If this is not part of the construction project, it should have a significant negative impact on the environment. Environmental sustainability is also involved in the extraction of natural resources. Social well-being interests with the benefits of employees and future users. This fact is mainly related to human feelings: safety, satisfaction, safety and comfort and human contributions: skills, health, knowledge and motivation (Parkin, 2000).

Finally, economic sustainability relates to micro and macro economic benefits. Microeconomics focuses on the factors or activities that monetary gains can generate through construction, while the public and government benefits of project success are related to macroeconomics (Abidin, 2005).

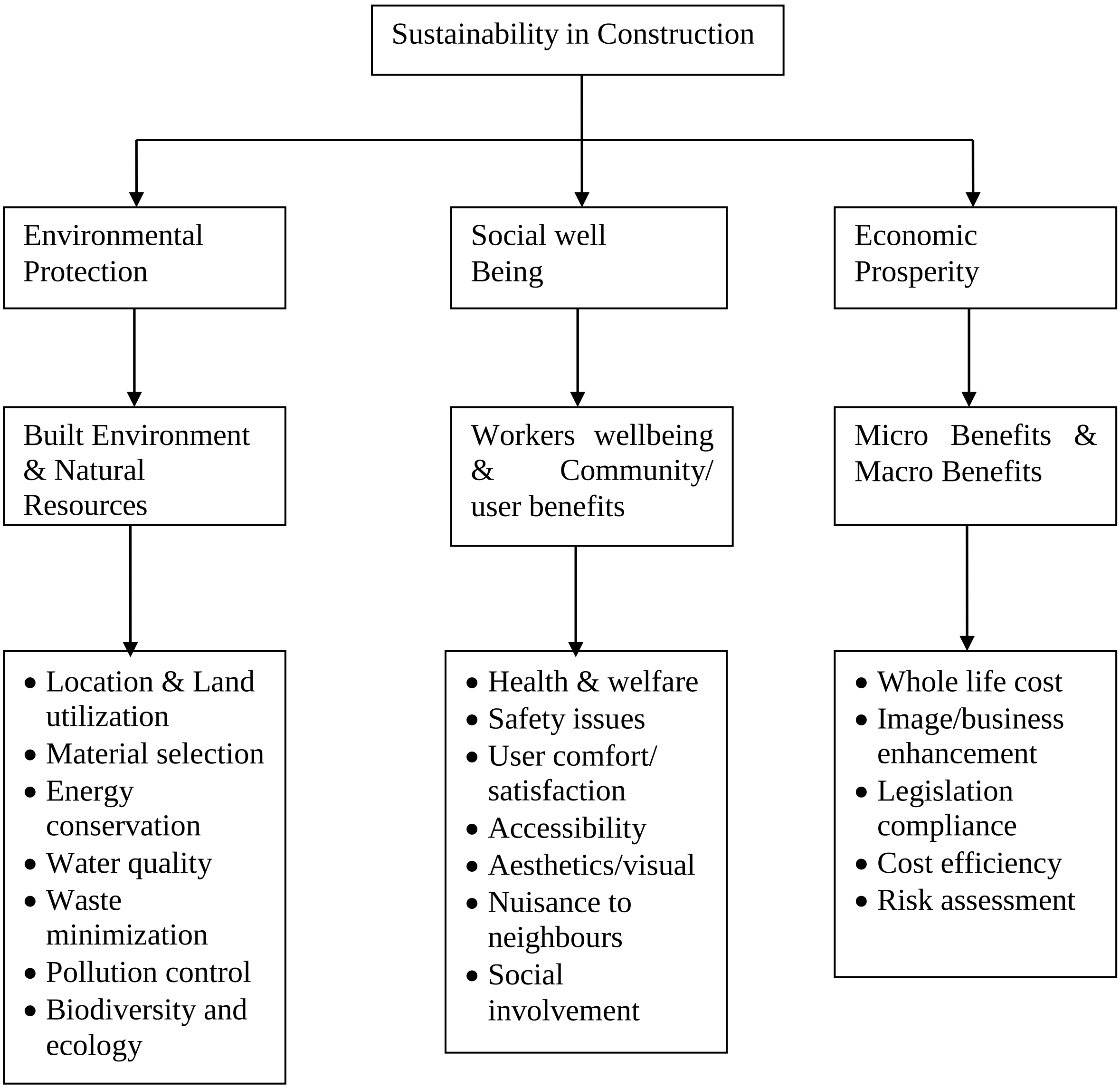

Figure 2-1: The Sustainability in Construction (Abidin, 2005)

2.2.2 Green Building

Green building is important because of the conventional buildings, land use of the people, the environment, and our shared natural resources. The cumulative impact of the design, construction, and operation of built environment has profound implications for human health, the environment, and the economy (Dissanayake, 2015).

The green building concept focuses on saving water, energy and materials when construction and maintaining buildings that can reduce or eliminate negative impacts on the environment and residents. It can be emphasized that the application of the green building concept can lead to a deduction of 35% carbon emissions, 40% water consumption, 50% energy consumption and 70% solid waste. (Jayalath, 2010).

As defined by US Environment Protection Agency, “Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction”(US EPA, 2016). This practice enlarges and complements the classical building design concerns of economy, utility, durability, and comfort.

The Green Building Council of South Africa (GBCSA) describes a green building as a “resource-efficient, energy-efficient and environmentally responsible building that reduces its direct and indirect impact on the environment throughout its life, from the beginning of construction, during occupancy, and when it is later demolished” (Abimbola, 2014). Yet it is also known as a high performance building. In essence, green buildings effort to solve measurable problems associated with conventional buildings.

Designers and users of buildings are linked to building performance (Cooper 1999, Kohler 1999, Finnveden & Moberg 2005). Considerable efforts have been made to develop systems to measure the environmental performance of a building throughout its life. They are designed to evaluate the effectiveness of each development in terms of balance between energy, environment and ecology, taking into account both social and technological aspects of projects (Clements-Croome, 2004).

Sustainability indicators are needed to determine the performance of buildings in relation to the environment. social, socio-cultural and economic criteria have emerged at regional, national and global levels (Al Waer and Sibley 2005). In recent years as a base to judge in the performance of buildings across a broad range of sustainable considerations beyond established single performance criteria such as energy have been emerged in building rating tools (Al Waer and Sibley 2005).

2.3 Rating Systems For Green Building

The growing awareness of the potential of sustainable construction to create a positive impact on environmental issues is the promotion of green buildings in the foreground. As a result, more and more local authorities are adopting green building standards and regulations or providing financial incentives and approvals for sustainable development (Nguyen and Gray, 2016).

The practice of green building is based for green building assessment. To make this more feasible, the establishment or adaptation of regional specific indicator frameworks for the assessment of green buildings should be initiated from within the region, with more active green building practices. These exercises not only provide us with opportunities and opportunities to collect regional ecological baseline data for the indicator framework, but also demonstrate the level, scope and accessibility of regional green building technology and indicate the core of regional environmental issues that are important for implementation. region-specific weighting system (Ding, 2007).

Rating systems interpret the most important tools for measuring and comparing green buildings. The system contains systematic frameworks for defining performance criteria, so that the actors in the construction sector can be better measured. In addition, it outlines the shift to more sustainable forms of design, construction and operation of buildings (Campbell, 2006).

Therefore, a green building rating system is a powerful and effective framework for measuring building environmental performance and integrating sustainable development into building and construction processes. Green building rating system can be used as a design tool by setting sustainable design priorities and objectives, developing appropriate sustainable design strategies and determining performance measures to guide the sustainable design and decision-making processes. It can also be used as a management instrument to organize and structure environmental concerns during the design, construction, and operations phases (Ali & Al Nsairat, 2009).

Different types of assessment tools and certification schemes have been developed around the world to rate green and monitor buildings(Siva, Hoppe, & Jain, 2017), The first such comprehensive building performance assessment method is the Building Research Establishment Environmental Assessment Method (BREEAM) in 1990.

Since then, there had been a huge development in the number of methods throughout the world and a corresponding increase in research on building rating systems. Some renown assessment methods or tools are U.S. Leadership in Energy and Environmental Design (LEED), Hong Kong Building Environmental Assessment Method Plus (BEAM) which is formally known as HKBEAM, Japan's rating ssystem CASBEE, and China's Green Building Label (GBL). The existence of the wide category of building assessing systems gives confirmation that no single system has come out as the green building industry standard in the world (Cole, 2006).

Then again, building rating system needs a standard set of criteria. As the result of that the same system can be used many times to be able to assess buildings and to have correspondent results; on the other hand, much criticism has been reinforced against the standardized criteria and their necessities for lack of addressing local or regional issues, goals and contexts. Early adjustments of building measuring systems to local and regional conditions was addressed in 1998 at the Green Building Challenge Conference (Cole, 1999).

Several considerations for adaptation were proposed, for example, assessing building energy consumptions relative to standard local codes and usage and rewarding higher levels of performance on water or materials in specific regions where these resources are lacking or unavailable. An inclination of re-developing green building rating systems was seeking more chances for locally developed weighting especially in those developing countries where there was lack of advanced building assessment tools.

International or national building assessment systems can provide a starting point for communities interested in developing more contextual systems and improving matching sustainable building products. It can also set targets for green buildings and determine what is possible if barriers to green building are removed (Todd, Crawley, Geissler and Lindsey, 2001). They also provide input to external assessors, so that communities do not have to assess and certify green performance. Adapting international and national building assessment systems to local contexts is therefore an economic way for cities or regions to follow green building programs if they do not have a system or support current building policies. Green therefore suitable for the co existence of different systems.

Below section, discuss about BREEAM, LEED, CASBEE and GREENSL® Rating System comparing the Blue Green Sri Lanka (green guideline). Following discussion is based on, as the BREEAM is first rating system while LEED is widely used in most of the countries and the basis for most of the rating systems. CASBEE - Japan's rating system selected as it is used in Asian region. GREENSL® Rating System is Sri Lanka's first rating system.

2.3.1 BREEAM- Building Research Establishment Environmental Assessment Method

BREEAM was the first environmental building assessment method that the most commonly used (Larsson, 1998). The Building Research Establishment developed the system in 1990 together with private developers in the UK. It was established as a credit award system for new office buildings.

Since 1990, the BREEAM system has been continuously updated and stretched out to admit assessment of such buildings as existing offices, supermarkets, new homes and light industrial buildings (Yates & Baldwin, 1994). However, must be acquired through a licensed assessor. Crawley and Aho (1999) propose that the system is successfully alerting building owners and professionals to the importance of environmental issues in construction. BREEAM affects worldwide, with Canada, Australia, Hong Kong and other countries using the BREEAM methodology in developing their own environmental building assessment methods.

The intention of this system is to set a list of environmental criteria against which building performances are checked and evaluated. This assessment can be carried out at the initial stages of a project and the investigation results can be applied into the design development stage of buildings. The changes can be made accordingly to satisfy pre-designed criteria (Johnson, 1993).

BREEAM has four measuring instruments that can be applied to different levels of the life cycle of a building. BREEAM Design and Procurement (D & P) can be applied during the design phase of a renovation of a new construction or expansion project. Once construction is complete to verify the D & P assessment, the post-construction review (PCR) is performed. The Fit Out assessment is used in major renovations of existing buildings, and a management and operational assessment (M & O) assesses a building's performance during operation (Saunders, 2008).

In addition, BREEAM grants credits of nine types that meet a set of performance criteria that, if met, would reduce the negative impact of the building on the environment and increase its environmental benefits. . Each category whose total number of credits granted is multiplied by an environmental weighting factor, taking into account the relative importance of this category. The category scores are then analyzed together to generate an overall score on a successful, good, very good, excellent and outstanding scale. A system with a star rating of 1 to 5 is also provided. The BREEAM International certification levels / systems also use star rating systems: they are categorized as less than 1 star: 30%; 2 stars: - good: 45%; 3 stars: - 55%; 4 stars: excellent: 70%; 5 stars - excellent: 85% (Saunders, 2008).

Major categories of BREEAM Design and Procurement are as follows, (BREEAM, 2006; BRE Ltd., 2006; Cole, 2001)

- Management
- Health & Wellbeing
- Energy
- Transport
- Water
- Materials
- Land Use
- Ecology
- Pollution

The strength and weakness of BREEAM are discussed as follows, (Michael, 2013).

Strengths

- It allows comparison and benchmarking of different buildings,
- It can be independently assessed,
- It is fixed to European and U.K. legislation and U.K. culture.
- It can evaluate any building with the BREEAM modified version.

Weakness

- It needs very exact requirements,
- The weighing system is complicated,
- A market profile is required
- Has a high cost of compliance.

2.3.2 CASBEE- Comprehensive Assessment System for Building Environmental Efficiency

Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) developed in Japan by the Japan Sustainable Building Consortium. It is a cooperative academic, industrial and government initiative charged with creating a nationally authorized green building rating system which was launched in 2004 with four basic assessment tools that corresponds to the individual stages of the building lifecycle, i.e. pre-design, new construction, existing buildings and renovation.

(CASBEE 2009; Saunders 2008).

Furthermore, the system requires documentation of quantifiable sustainable design achievements that are assessed by trained, first-class architects, which have passed the CASBEE assessor examination. Since 2011, it has become mandatory in 24 Japanese municipalities. CASBEE is structured to have several schemes that depend on the size of a building and address the four main building life phases (Bernardi,2017)

The Building Environmental Efficiency (BEE) value which represents the buildings total environmental performance value is at the core of CASBEE's assessment method. The BEE value differentiate between a building's environmental load (L),specify as the negative impact on the environment outside the virtual enclosed space, and the building's quality performance (Q), outlined as the improvement of environmental quality within the enclosed virtual space. The indoor and outdoor environments are separated by a hypothetical boundary, which is delineate by the site edge and other elements (CASBEE 2008a).

The above assessment process reward applicants that effectively utilize an integrated strategy for indoor air quality: source control, ventilation, and an operation and management plan. When the strategy is the more aggressive or strenuous, the higher the performance level awarded on a scale of 1 to 5, with 5 being the highest level (CASBEE 2008b).

Major categories of CASBEE are as follows, (CASBEE, 2004; CASBEE, 2006)

- Building Environmental Quality and Performance (Q)
  a) Indoor environment
  b) Quality of services
  c) Outdoor environment on site

- Building Environmental Loadings(L)
  a) Energy

b) Resources and materials
c) Reuse and reusability
d) Off-site environment

The strength and weakness of CASBEE are discussed as follows, (Michael, 2013).
Strengths

- It is highly comprehensive,
- Versatile, with compulsory necessities to be satisfied.

Weakness

- There are no external benchmarks, recertification baseline model or energy model.

2.3.3 LEED- Leadership in Energy and Environmental Design

In 1998, the LEED ® Green Building Rating System was introduced based substantially on the BREEAM system (Nguyen & Altan, 2011). Robert Watson of the United States Green Building Council (USGBC) in 1993 pioneered LEED rating system. It consists of a suite of rating systems for the design, construction and operation of high performance green buildings, homes and neighborhoods. The LEED Green Building Rating System is a voluntary standard for sustainable buildings, which facilitates consistent application of sustainable design principles and serves as a measure of accomplishment (Buttler and Stoy, 2009; LEED 2012).

Project teams interested in LEED certification, must initially register the project with the GBCI on its Web site (www.gbci.org) where they can access software tools, critical communications and other essential information, that will help with the certification method (USGBC 2009d). It is the U.S. market leader and the most widely use rating system by Federal and state agencies in the US. (Hirigoyen, Ratcliffe, and Davey-Attlee 2008).

LEED system currently consists of Green Building Design & Construction; Green Interior Design & Construction; Green Building Operations & Maintenance; Green Neighborhood Development; Green Home Design and Construction. Presently, there are nine different interpretations of the LEED rating system: new commercial construction and major renovations; multiple buildings and on-campus building projects; existing building operations and maintenance; commercial interiors projects; core and shell development projects; homes; neighborhood development; schools; and retail. The most widely used version is LEED-NC for new construction. Buildings that satisfy or exceed the green requirements posed by the LEED rating systems are formally certified by USGBC. There are four levels of formal certification based on the number of points a project receives: Certified, Silver, Gold, and Platinum. LEED has been recognized as a national standard for rating green building design and construction in the United States, Canada, and many other countries (USGBC, 2012).

The LEED building certification system is a point based system. Building projects gain points for satisfying green building criteria for specific credits. Projects also may earn Regional Priority bonus points for applying green building schemes that address important local environment issues. (USGBC, 2009).

Major categories of LEED; (USGBC, 2009)

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Innovation and Design Process

There are strengths and weaknesses of LEED are as follows: (Michael, 2013)

Strength

- Strong marketing gets the message through, lots of information available, and
- No need for assessor and training.
- It is based on American ASHRAE standards (American Society of Heating, Refrigerating and Air Conditioning Engineers),

Weaknesses

- Paper-based, rigid, complex
- Intense documentation is required,
- The certification can be costly and take up to four months to complete,
- Fails to address life cycle assessment,
- No independent audit of the assessment
- Main building functions and forms are difficult to assess.

2.3.4 Green Building Council Sri Lanka - GREENSL® Rating System

Most of the leading countries have their own green building councils to conduct their green rating for building structures. The different state councils of these countries follow a standardized rating system to measure the environmental acceptability of these buildings through green rating system. Therefore, it is a major and timely need for Sri Lanka to build such a rating system to evaluate the environmental acceptability of buildings (GBCSL, 2009).

As a result of an emerging trend towards applying the greener concepts for built environment, the Green Building Council of Sri Lanka (GBCSL) came into existence and it launched in November 2009 as a non-profit organization. By encouraging the adoption of green building practices, it committed to developing a sustainable building industry in Sri Lanka. It is exclusively supported by both industry and government institutions across the country. The GBCSL is now granted with "Emerging Member Status" by the World Green Building Council, which represents about 80 countries ranging from developed to developing nations worldwide.

In the development process of making Sri Lanka sustainable, the establishment of the GREENSL® rating system is a vital milestone. Accordingly, the rating system has to improve for Sri Lanka to guarantee that construction of buildings is conforming to the environment (GBCSL, 2009)

Furthermore, it is important to note that the considerations for those rating systems will change from country to country. It differs as the environmental conditions; level of development and the availability of resources vary from place to place. The main purpose of the GREENSL® Rating System is to encourage the design of buildings in an environmentally acceptable manner. This will be a major step towards taking it a sustainable practice in development of buildings to utilize the natural resources and make efficient designs to utilize nature for the improvement of the mankind.

The GREENSL® Rating System for Built Environment is a set of performance standards for certifying Built Environments in the form of commercial or institutional buildings and high-rise residential buildings of all sizes, both public and private. All structures defined as Built Environments in standard building codes, are preferable for certification under the GREENSL® Rating System for Built Environment and include offices, retail and service establishments, institutional buildings (libraries, schools, museums, churches, etc.), hotels, and residential buildings of 4 or more habitable stories (GBCSL, 2009).

The GREENSL® Rating System for Built Environment furnishes owners and operators of buildings an entry point into the GREENSL® certification process and is applicable to the following; Building designs, processes, systems upgrades, minor space-use changes, and minor facility alterations or additions; and Building designs new to GREENSL® certification as well as buildings previously certified under GREENSL®. Accreditation for major renovations, Schools or Core & Shell may be either ground up new constructions or buildings that have undergone major renovations. Although it is rating system, it is a voluntary green guideline.

According to the following scales; will be considered when the Certifications from the GREENSL® Rating System for Built Environment will be awarded as follows Certified 40–49 points ,Silver 50–59 points, Gold 60–69 points, Platinum 70 points and above.
GREENSL® Rating System for Built Environment addresses eight aspects; (GBCSL, 2009).

- Management (MN)
- Sustainable Sites (SS)

- Water Efficiency (WE)
- Energy and Atmosphere (EA)
- Materials and Resources (MR)
- Indoor Environmental Quality (EQ)
- Innovation and Design Process (ID)
- Social and Cultural Awareness (SC)

GREEN Rated building by GBCSL will have an equivalent efficiency as a LEED rated building. (www.gbcsl.com)

2.3.5 Blue Green Sri Lanka rating system

The Blue Green Sri Lanka (Green Guideline) was launched 2017 by urban development authority (UDA) under the ministry of municipal and the western development.

This is the first time Sri Lanka putting on the green building concept in the first step in all public buildings and semi government buildings. It is identified as the necessity of setting the guidelines and following up in seven scopes for the optimal and efficient use of energy, which is the largest consumption of the Sri Lankan economy. Sri Lanka expects to achieve results through converting buildings to green buildings. At the same time, by advancing through sustainable green concepts, is this guideline follows in designing, planning, construction, demolition, reconstruction, operation and maintenance.

There three main processes in the UDA to get the building approval.

- Preliminary Planning Clearance (PPC)
- Development Permit (Construction Approval)

An approval for the Proposed Buildings has to be obtaining from the relevant local authority. Along with the application and supporting documents should also be submitted.(Large Buildings with more than 4000sq.ft. of floor area should be submitted to the UDA for approval, Smaller building can approved from Local authority)

- Certificate of Conformity (CoC)

The application has to be forwarded to the relevant local authority with required information and documents listed on the Development permit.

Every public sector required to obtain green building approval as part of development permit. This will be verified and at the stage of CoC.

The rating system of the Blue Green Sri Lanka consists four marking categories. The categories are determined based on the points that are obtained by the project. The total points available are 100. The four rating levels and required points to obtain a rating are as follows. Green Platinum – 70 marks above, Green Gold – 60-69 marks, Green Silver – 50-59 marks, Green Certified – 40-49 marks.

The guideline and scoring system (Appendix-1) has been examined in internationally admitted methodology and seven fields. These fields are,

- Energy efficiency
- Sustainable site planning and management
- Building materials and resources
- Quality of internal environment of the building
- Water efficiency
- Green innovation
- Socio – cultural compatibility

2.4 Comparison Of International Green Rating Systems with Sri Lankan Rating systems

The table 2-1 shows type of involvement while BREEAM, CASBEE, and LEED have dedicated sub schemes or modules to cover all the four types of involvement (Bernardi , 2017).

Table 2-1.Type of involvement covered by the selected schemes.

Rating system	New building	Existing Building	Building under Refurbishment	Urban planning Projects
BREEAM	•	•	•	•
CASBEE	•	•	•	•
LEED	•	•	•	•
GREENSL®	•			
Blue Green Sri Lanka	•			

For Sri Lankan rating systems, there are no sub schemes. Every building cover only one scheme.

Rating system can be used to certify the environmental performances of different types of buildings, such as residential, office, commercial, industrial, and educational buildings, and all other buildings that do not fit into any of these building types are grouped in the field called other types of buildings. It can be seen in Table 2-2 that BREEAM, CASBEE can be used with all building types. LEED do not include industrial buildings in their evaluation.

GBCSL rating system define it can be apply for the offices, retail and service establishments, institutional buildings (libraries, schools, museums, churches, etc.), hotels, and residential buildings of 4 or more habitable stories. However, Blue Green Sri Lanka does not mention special building typology. It should apply for all type government buildings.

Table 2-2. Building type assessed by the selected schemes.

Rating system	Residential Buildings	Office Buildings	Commercial Buildings	Industrial Buildings	Educational Buildings	Other Type of Buildings	Urban Planning
BREEAM	●	●	●	●	●	●	●
CASBEE	●	●	●	●	●	●	●
LEED	●	●	●	N/A	●	●	●
GREENSL®	●	●	●	N/A	●	●	●
Blue Green Sri Lanka	All types government and semi government buildings						

Regarding the life cycle phase of a building (Table 2-3), BREEAM and CASBEE cover all the four considered life cycle phases of a building. LEED does not evaluate pre design or design (Bernardi , 2017).

Table 2-3 . Life cycle phase of the building assessed by the selected schemes.

Rating System	Pre design and Design	Construction	Post-Construction	Use/Maintenance
BREEAM	●	●	●	●
CASBEE	●	●	●	●
LEED	N/A	●	●	●

Regarding the life cycle phase of a building, BREEAM, CASBEE, cover all the four considered life cycle phases of a building. LEED does not evaluate predesign or design. Blue Green Sri Lanka does not mention special lifecycle phases; however, it should apply in design stage.

According to literature findings BREEAM, CASBEE and GREENSL require accredited professional or licensed assessor. Blue Green Sri Lanka does not require such accredited professional.

2.5 Green Adaptations study in Public Sector

Why Build Green in the Public Sector? The building sector is responsible for a significant share of energy-related carbon emissions across the world (Siva, Hoppe, & Jain, 2017). According to Nobel, (2012), it makes sense that the government holds considerable influence over the movement toward building environmentally friendly buildings. In the due course findings indicate that the government's influence can promote a central role a public policy goal of sustainable development, which is beneficial to both public and private interests.

As governments face increasing utility bills and higher demand from public for good quality services and infrastructure, many public sector organizations in the United States and overseas are adopting policies to ensure that their facilities designed to be green (Nobel, 2012). In line with this, many governments worldwide seek to become role model in initiating green initiatives. Public sector organizations interested in developing their own policies can benefit from the lessons learned by these early adopters of green building policies as they design more programs that are effective (Nobel, 2012). Therefore, public sector becomes the forerunner in implementing such practices. As such, green adaptations in public sector are a vital fact to study and follow up.

2.6 Summary

This chapter overview literature on sustainable development, sustainable construction, green building and green rating systems worldwide. It further analyses and compares international green rating systems like BREEAM, LEED and CASBEE with Sri Lankan green systems GREENSL and Blue Green Sri Lanka in terms of their characteristics and limitations in assessing sustainability of buildings. Subsequently it brings down the importance to have a rating system applicable to public sector building projects and how it can help nation at large.

3 RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, the research methodology adapted for the study is discussed under three phases. Each phase is discussed separately according to their related applications.

3.2 Research Design

According to Owens (2002), a research is required to have a research design before collecting data and analyzing. This should not be mistaken for a work plan as it only includes the procedure to be followed in order to complete the project. However, it should be originated from the research design. The research design aims to ensure that the initial question problem is answered unambiguously with the evidence obtained.

Furthermore, in order to obtain significant evidence, the type of the evidence required to answer the problem shall be specified. For an instance, the question to test a theory or to evaluate a phenomenon, the type of information or evidence required shall need to be clearly specified. In consequence, research design deals with a logical problem. If explained further; an architect needs to know the requirement of the developer of which type of building he needs to develop and its uses before working on the building plan. So the Work plan also flows from this concept. Likewise, selection of sample, method of data collection and design of question to be asked all depend on which type of information you need to answer the research question (Owens, 2002).

The logical sequence of research design for this study can be explained under three phases (Figure 3.1).

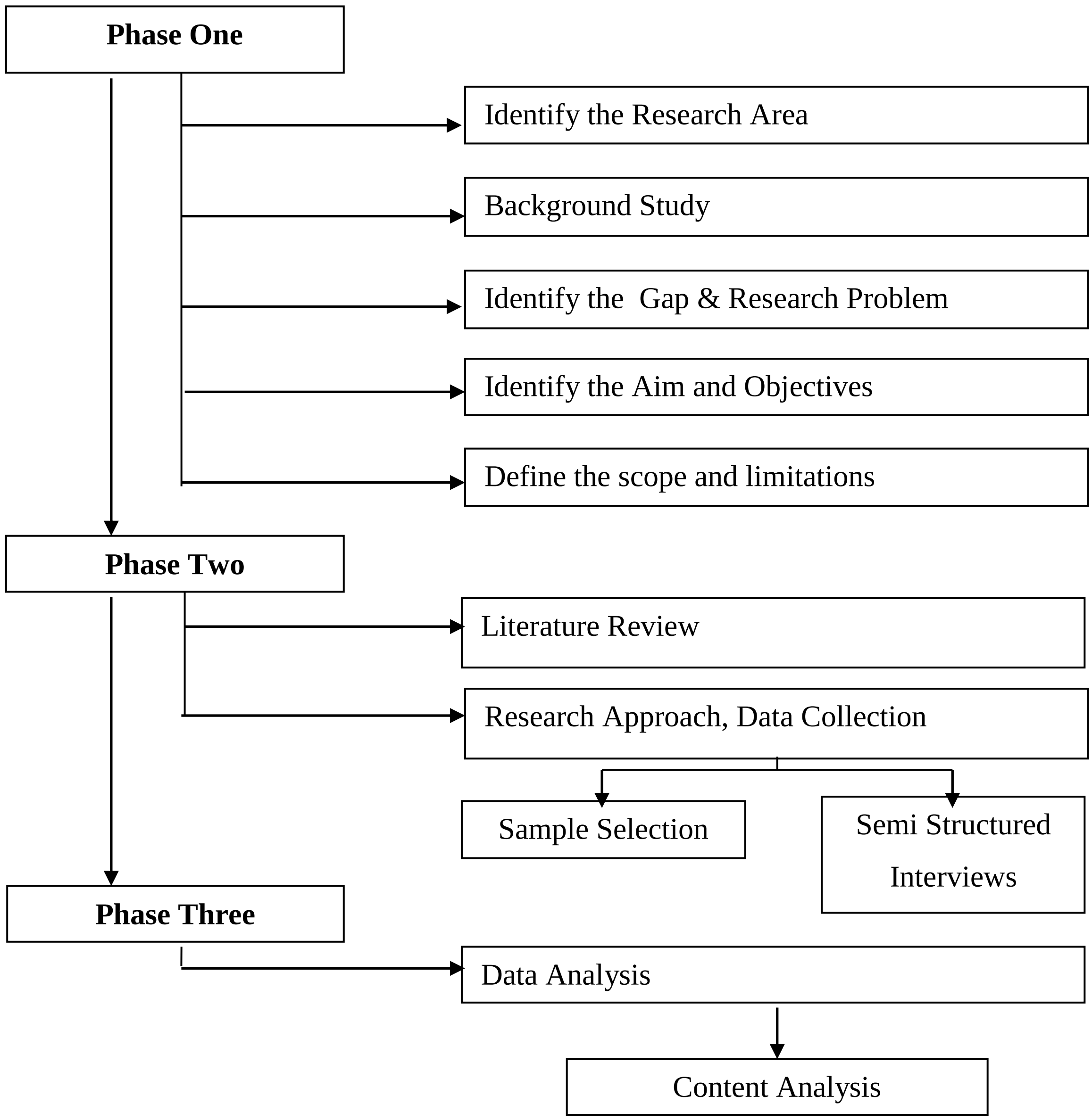

Figure 3-1 Research Design

3.3 Phase One

In phase one, firstly the research area was identified as the "Green Rating system" which has been introduced by UDA to public sector building in Sri Lanka. Then a background study was carried out for further clarification of the selected area. The find out the research gap and according to that research problem was established. Define the aim, objectives, and scope limitation of the research area.

3.4 Phase Two

In phase two literature review, approach, and selection of sample and the method of conducting semi-structured interviews with the guideline.

Therefore, the main purpose of this phase was to identified the approach & data collection technique.

3.4.1 Literature Review

The initial step was to identify the green building concepts and green rating systems used in other countries. Secondly, what are the green rating systems used in Sri Lanka and to compare with other rating systems.

Whatever findings and justifications identified through the literature review is clearly elaborated under chapter two of this study.

3.4.2 Research Approach

Research types can be classified into three categories as Quantitative, Qualitative and Mixed method. Aims of the quantitative research are to measure the quantity or amount and compare it with past records and tries to project for future period. Various types of experiments, surveys have been identified as quantitative research approach. The main objective of the above research type is to developed and employs mathematical models, theories or hypothesis pertaining to phenomena. (Creswell,2009)

Furthermore, qualitative researches are refers to the meanings, definitions, characteristics, symbols, metaphors, and description of things. Study research, ethnography, action research and grounded theory approach can be taken under qualitative approaches are coming under this category. However this research type is much more subjective and uses very different methods of collecting information. Such as in-depth interviews, ex – individuals (small no of people) or relatively small no of focus groups. Though this research type is open ended and exploratory.

In this research, survey method under the qualitative approach has been identified as the most appropriate approach.

3.4.2.1 Justification of Research Approach

Since the purpose of this research found out the ground condition of what was identified in the literature review, it requires the depth insight regarding the research problem. According to Yin (2009), when detailed information is required, a qualitative research can provide a distinct advantage. Accordingly qualitative research approach enables the researcher achieve the objectives of the research while answering the questions of "what is happening at the moment", "how and why it is happening", "how would proposed system affect current practices and outcomes" and "what are the things that has to be improved". Therefore, qualitative research approach was selected for this research study.

3.4.3 Data collection method and sampling

3.4.3.1 Interviews

In order to carry out the approach, Semi Structured Interviews with guideline were selected as the data collection method. All the factors identified through the literature review were considered in developing the base for interview guideline (Appendix - 2).

Semi structured interviews focused the officers of the Sri Lanka Administrative Service, Sri Lanka Accountancy service, Sri Lanka Engineering Service, and Sri Lanka Architectural Service and Quantity surveyors. Interviews were targeted to the officers of the Sri Lanka Administrative Service has been focused with an objective of examining their knowledge and the issues that they are facing with the current administrative rules and regulations related to building sector. Similarly, several other questions were developed targeting the officers of the Sri Lanka Accountancy service, Sri Lanka Engineering Service, and Sri Lanka Architectural Service and Quantity Surveyors.

3.4.3.2 Sample Selection

The success of interviews depends mainly on the careful selection of the panel of experts. The experts should have extensive working experience public sector buildings in the Sri Lankan construction industry, should be currently or recently directly and indirectly involved in the construction and should have knowledge of overall construction process.

Therefore, the target population, from which the sample was selected, is the prominent professionals who have already engaged in construction work within Sri Lanka. Most of the public sector building projects are done by the government officers and only very few are given as contract to the private consultancy firms. The government officers who are in the capacity of using the Blue Green rating system and those who are affected by the introduction of the above mandatory condition have incorporated in this study. This sample comprised of five different professions in the government sector. They are Sri Lanka Administrative Service, Sri Lanka Accountancy Service, Sri Lanka Engineering Service, Sri Lanka Architectural Services, and the Quantity surveying professionals. Five members from the each above mentioned professions were interviewed with the guideline and collected the data for the research. Accordingly, total 25 officers were interviewed for data collection purpose.

Tables 3-1,3-2,3-3,3-4 and 3-5 show all the respondents of interviewers' experience, qualifications and profession.

Table 3-1 Officers of Administrative service

No	Profession	Grade	Year of experience
01	Secretary of the Ministry	Class I	More than 25
02	Director of the some professional service	Class I	More than 15
03	Secretary of Education ministry, Provincial council	Class I	More than 25
04	Director (Administration)	Class II	More than 10
05	Chief Secretary, Provincial council	Class I	More than 25

Table 3-2 Officers of Accountancy Service

No	Profession	grade	Year of experience
06	Accountant	Class I	More than 25
07	Accountant- Deputy chief secretary office (Engineering service) – Provincial council	Class III	More than 5
08	Accountant – Department of buildings	Class III	More than 5
09	Accountant- Education ministry – Provincial council	Class II	More than 10
10	Accountant - Chief Secretary office, Provincial council	Class II	More than 10

Table 3-3 Officers of Engineering Service

No	Profession	grade	Year of experience
11	Chief engineer of provincial building department	Class I	More than 20
12	Senior electrical engineer	Class II	More than 10
13	Electrical engineer	Class III	More than 5
14	Service Engineer	Class III	More than 5
15	Divisional Engineer	Class II	More than 10

Table 3-4 Officers of Architectural Service

No	Profession	grade	Year of experience
16	Senior Architect	Class I	More than 20
17	Senior Architect	Class I	More than 20
18	Architect- Buildings department	Class III	More than 10
19	Architect- Provincial council	Class III	More than 15
20	Architect- Provincial council	Class I	More than 20

Table 3-5 Quantity Surveyors

No	Profession	grade	Year of experience
21	Quantity surveyor	Class I	More than 20
22	Quantity surveyor	Class II	More than 12
23	Quantity surveyor - Buildings department	Class III	More than 10
24	Quantity surveyor - Provincial council	Class III	More than 10
25	Quantity surveyor - Provincial council	Class III	More than 5

3.5 Phase Three

3.5.1 Data Analysis

After collecting data, the next important step of the research is analyzing the collected data. According to Tulli (2014), data analysis requires categorization of data, presentation and statistical interpretation.

As the research study focus on the Blue Green rating system to public sector building in Sri Lanka through the collection of views from the government officers, content analysis was selected as the suitable analysis technique for the research study.

The data, collected from 25 officers was categorized under five services according to their profession. The explanations under one category were summarized and presented in this research. The ideas of the professionals, about the major areas in the marking scheme (Appendix -1) were also presented.

3.5.2 Content Analysis

Content analysis is the qualitative analysis method, which analyzes data and interprets its results as a quantifying fact. Basically, the content analysis is categorization and arrangement of speech, written text, interviews, images, or other forms of communication. In this research, content analysis was carried out manually.

3.6 Summary

This chapter has mainly discussed about the research design, research approach, data collection and data analysis. Qualitative method as the research approach with semi-structured interviews as the data collection technique. The data analysis technique adapted for the study is content analysis. The next chapter, chapter four describes the Findings of this study and the findings are analyzed about green rating system which mandatory to public sector building in Sri Lanka.

4 RESEARCH FINDINGS & DATA ANALYSIS

4.1 Introduction

This chapter in the beginning presents the survey findings collected through the semi-structured interviews. Then under data analysis, the responses from each type of professionals' i.e. Administrative service, Accountancy service, engineering service, architectural service and quantity surveyors will be evaluated and summarized.

4.2 Research Findings

Semi structured interviews have been used to gather the necessary information for the study. All the data that was recorded were carefully analyzed and the summary of the analysis was used to derive conclusions.

According to the interview guideline (Appendix 2), there are five parts. The aim of part one was to categories the professionals based on their profession, professional experience, and qualification and grading of employment in government sector. The aim of the part two was to measure involvement of interviewees in government sector construction works, their capacity in decision making in respect to such works and their awareness in 'The Blue Green Sri Lanka – green building guidelines for government constructions'. Part three aimed to abstract the application of main aspects of the green guideline in construction, their limitations, effectiveness and viability. Part four was expected to get the comments and opinions over the significance of this type of studies and the impact over the development of similar regulations. Part five was generally discussed about its remarks.

The interview guideline that has been developed for this study is primarily focusing on following issues. These issues are the essence of all green rating systems around the globe and the spirit of the Blue Green Sri Lanka (Green Guideline,2017). They are namely Energy efficiency, sustainable site planning and management, materials and recourses management, quality of the building environment, water efficiency, , green innovation, socio cultural compatibility.

4.2.1 Involvement of the Selected Professionals in Construction Related Works

Based on the interviews it was found that the; involvement of officers in Administrative and Accountancy have less direct involvement to construction works. Other professionals including Architect, Engineers and Quantity Surveyors are directly involved to construction works and aware of their relevant scope of engagement in the construction process.

4.2.1.1 Administrative service officers

Administrative service and Accountancy service appreciated the concept that directs through these regulations. One officer from above services who is presently engaged with Government Construction works directly as per his appointment showed enough knowledge and awareness over the green rating system. However, they lack knowledge in the rating process and guidelines.

Administrative service officers offer a wide range of services throughout the country. As a consequence, officers whose scope includes any construction works only have the knowledge in construction process. This includes representation of corporate public sector clientele of which they responsibility in signing MOU, contracts and monitoring physical and financial progress. Among the interviewees, only one officer is directly engaged in the works in relation to the construction works.

Other administrative officers in general are only aware of the administrative and logistical matters in relation to the relevant professional services. The appointment of Architects and other professionals in the all island service is also under the purview of these administrative officers. However, in general they lack the awareness of actual work scope and capacity of professionals such as Architects, Engineers and Quantity Surveyors.

4.2.1.2 Accountancy service officers

In accountancy service, the interviewers are from different departments in the Government Sector have participated in the process as accountants. They have both direct and indirect engagement to the Construction Works of the Government Sector Buildings. Those who are having indirect involvement are at the positions of policy decision-making positions. They mainly involved in the master budget planning and similar document handling. On the other hand those who are directly involved in the government constructions as per their current employment have to looked after almost all the aspects in relation to the financial aspects of the building works such as tendering process, issuing payment certificates, bill certification, general and internal auditing, financial progress review, budget allocation and transfer.

4.2.1.3 Engineering Service Officers

From the interviewers, the interviewed group consists of civil engineers, electrical engineers, structural engineers and services engineers representing Department of Buildings and Provincial Councils.

As in general civil engineers' scope of duties consist the following,

- Obtaining annual construction programme of every ministries of provincial council,
- Pre site visit with other consultant and client representative,
- Prepare structural drawings according to the architectural drawings,
- Progress monitoring,
- Site inspections,
- Coordinating with divisional engineers,
- Give approvals to material & construction methods,
- Attending to procument works, tender evaluations and monitoring financial and physical progress continuously.

As the Electrical engineer, scope of duties consists the following,

- Deliver high quality detailed engineering design for electrical building services and power distribution systems, including calculations, analysis, schematics, drawings, diagrams, models, specifications and other documents are given to estimation branch;
- Management of project from inception to post construction duties, Designs are doing according to relevant legislations, standards, regulations, guides using knowledge of Lighting , Vertical Transportation ,IT and Communications Infrastructure ,Security , Acoustic , Earthing, , Lightning

Protection ,UPS and Generator , Fire Protection , Building Information Modeling attend all meetings with client, project team, contractors etc.

As the Services engineer, scope of duties consists the following,

- Producing designs, both initial outlines and full plans, of sewerage, water and pump systems and pipe networks according to the architectural drawings,
- Supervise construction activities in close coordination with other consultant,
- Conduct regular site visits and provide technical instructions and guidance to the contractors.

4.2.1.4 Architectural Services Officers

Scope of duties enlisted out from interviewed Architects consists the following,

- Understanding the client's requirement through a detailed discussion,
- Understanding the limitations and potential of the site, characteristics of the site, planning and building regulation,
- Discussing about the expected budget,
- Suggesting possible solutions if the work is renovation or a new construction,
- Presenting the feasibility study, initially, the sketch designs are prepared, if client agreed to the sketch design start to detail designing,
- Preparing the drawing for building approval
- Coordinate with other consultant
- Prepare the detail design drawings,
- Site supervision, give instruction to the contactors, sub contractors, labours, material selection,
- Attend the progress meeting and site meetings.

4.2.1.5 Quantity Surveyors

Scope of duties enlisted out from interviewed quantity surveyor consists the following,

- According to Architects and the engineers drawings prepare the BOQ,
- measure and estimate building and material costs for projects,
- prepare engineering estimate to understanding the project cost,
- administer the tendering process,

- visit project sites to monitor to progress and to check contractor's bill,
- issuing payment certificate for advance, interim and final payments, prepare a statement of final account recording the actual costs of the project,
- coordinate with other construction industry professionals, involve the arbitration work.

4.2.2 Professional's General Observations about Blue Green Sri Lanka Rating system

As in general most of the officers from categories architects, engineers, quantity surveyors are very much focused on the work that they are entitled for the current appointment. However, almost all of them showed that they are confident and be able to use 'The Blue Green Sri Lanka; Green Rating System' whenever it is a requirement as per their scope of work.

4.2.2.1 Engineer's Points of view

The major drawback highlighted by engineers attached to Provincial Councils is that since there are no electrical engineers or services engineers in particular offices, respective fields for energy efficiency, water efficiency could not be filled with due proficiency. These fields contain the higher percentage of the total score summary. Most of the time, electrical requirement is accomplished by technical officers.

Another drawback is that since blue green Sri Lanka guideline is mandatory for all public buildings, fulfilling the requirement to get the approval for design often requires installation of solar panels, carbon dioxide meters, green roofs, additional landscape design and so on. In public building sector, this may not be feasible for every and each building. Also those items can exceed approved budget limitations.

According to 13th interviewee (Table 3-3) the blue green rating system is good for smart building and not suitable for every normal building.

4.2.2.2 Architect's Points of view

Among architects interviewed, 17th and 18th interviewees (Table 3-4) pointed out that this is a good direction for implementing green building in Sri Lanka. It was also noted that this is mainly suitable for large constructions in government buildings.

The major drawback highlighted by architects attached to Provincial Councils is that since there are no electrical engineers or services engineers in particular offices, respective fields for energy efficiency, water efficiency are expected to be filled by Architects by merely giving the responsibility of acquiring green approval to Architect. This brings out the failure of obtaining teamwork approach required for this initiative.

In general the government projects allocated budget is fixed and decided only considering construction cost up to date. To do the green building initial investment cost is high but intend to reduce the operational cost. On comparison with traditional building with green building; operational cost for the latter can be twice as much construction cost is vice versa.

This is also illustrated by Kawauchi and Rausand (1999) by means of 'The Iceberg Principle'.

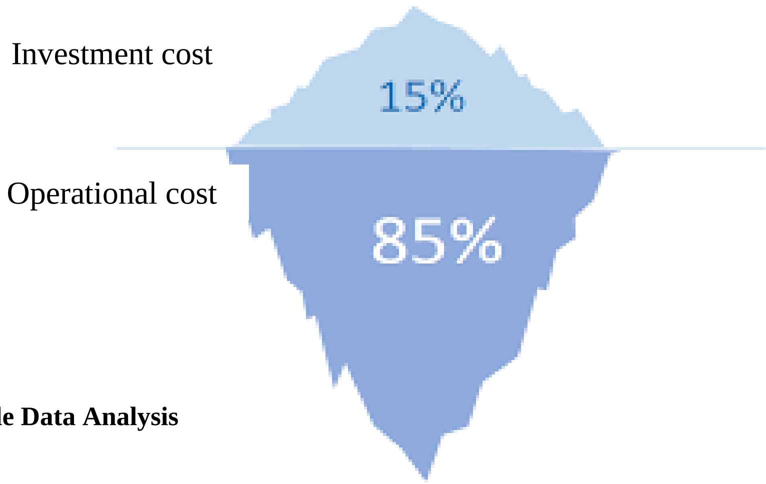

Figure 4-1.The Iceberg Principle Data Analysis

This factor is not accounted in allocating budget. Hence application of green building can reduce clients space requirement to balance the construction cost within a fixed budget which is a disadvantage to client.

Application of green building rating system requires effort to make a report, which is not accounted for consultants' fee so far. Government architect's role is maximized and no return value for the design team. Assessing fee is high which 1% of the total construction cost is.

Most of the time the design is done to obtain only for minimum marks to get building approval for commencing the project hence real application on green building is in question.

In government sector this applies to all projects even projects commenced after long period of time. This is a redo of works which application of green concepts has not been intended and may cause difficulties due to budget limitations and other restrictions.

4.2.2.3 Quantity surveyor's point of view

According to this document to create the green building, certain special specifications are required which in many cases do not have adequate suppliers.

Since in a government sector projects have limited budget, when adding above special items only small portion for total construction cost is left for achieving the clients' requirement.

4.3 Analysis of the Blue Green Sri Lanka, based on the professional views

Part three of interview guideline (appendix 2) was asked only from the main three categories such as architects, engineers and quantity surveyors. They explained about their engaging parts of the green guideline in detail. Since administrative and accountancy service officers lack detail knowledge about aspects of the green guideline, satisfactory answers for the part three were not given by them.

Comments given by each group of professionals under each criteria in the rating system are presented by referring to the codes used in the marking scheme (Appendix 1) (e.g., EE1, EE2, SM1).

4.3.1 Engineer's comments

EE1 – Based on Electrical engineers feedback, this requirement should change according to Building type, e.g. considering 100m^2 area for both auditorium and school building;

In case of school building this is correct. But for auditorium a specific system is designed to accommodate lighting for each row. So if this is done according to EE1, number of point wiring and conduit increases which is an additional cost to traditional building system. This is not practical and cost is high.

Also sensor lights are not needed every building e.g. School buildings. If this is not incorporated, the respective mark cannot be achieved.

EE2 – Even if building energy consumption of the building is lower than 100KVA, it should be incorporated to design aiming to obtain the given the mark.
Energy management system is not needed for every building. If such system is installed it should be monitored and controlled. As such it is economical for industrial building not for small buildings with lower electricity consumption.

EE3 - Building shall be used the percentages (which indicate the blue green Sri Lanka) of renewable energy. There are two methods to mark the score. One is total solar panel cover shall be percentage of the plot coverage and other one is electricity contract demand shall be met by solar panels.
Based on the interview, electrical engineers do agree with based on contract demand but disagree with installation of solar panels based on Plot area. E.g. comparing a single storey building with a multi storey building with same plot coverage; using solar panels may differ due to different electricity capacity. Hence it is a disadvantage to the single storey building.

EE4 – High performance energy efficiency measured according to the energy consumption of a year. This depends on building type. For example, this cannot be achieved for laboratory building using heavy electrical load equipments.

EE5 – Efficiency of electric illumination measured according to the lighting power density. Some buildings require external light fittings exceeding power 70 W at night times due to their function. e.g – Economic centre - Narahenpita .So, achieving this mark for above type buildings is not possible.

EE6 – According to load change the power factor. This is not possible at the design stage but only possible after detail design stage, hence correct factor could not be calculated at the time of applying for approval.

EE7- To achieve this mark, appointment of an independent expert consultant on energy system in the initial stage of the project to take advice on system installation and operation is must.
Required consultant above is not available in government sector. Chartered electrical engineer/ engineers signs on behalf of this which is acceptable by UDA. However this does not fulfill the actual need.

EE8 – To obtain the marks maintenance crew shall be mobilized in the site three months prior to completion of construction and allocation of a separate office building for maintenance work.
In public sector general budget includes only construction costs. So provision for a maintenance crew becomes an additional cost. Also this is not required for every type of building.

WE2 - Do not need treatment plant for every building. If building area is too small & produces small percentage of waste water it does not necessarily need to use treatment plant. If it is not possible this mark cannot be achieved.

WE3 - EMS monitoring system and water management and supervision system should be installed. EMS monitoring system is not effective for small building

4.3.2 Architects' comments

SM1- Government architects have no chance to involve in the site selection since ownership of the land belongs to the government sector. It is better if clients could initiate the project and select the suitable sites with Consultants.

SM2 –If this is not a Brownfield land, there is no chance to get these 3 marks. Since as mentioned above consultants have no chance in the site selection, due marks cannot be achieved.

SM3 - Building should located 01km from a residential zone and if at least ten community facilities are available 1km from the building. Difficult to achieve this mark to below given site. e.g. Comfort center for Sripada. This project is intended to provide facilities to seasonal pilgrims and is 2km on the way to Sripada. Achieving this mark is impossible as there are no community amenities with parking within reach of 1km radius.

SM5- Open areas shall be of consisting of endemic and indigenous plants.Before introducing this aspect, suppliers to endemic plants have to identified and promoted. Otherwise, more forest damages will be caused in supplying these items.

SM9, SM10- UDA Green rating system has conflicting contrary ideas on its own aspects with UDA regulations. E.g. If it is aiming to encourage public vehicles and to minimize using private vehicles, why have to provide parking according to UDA regulations like 1 parking for 100sq.m. for public buildings; is not compatible each other.

In Residential Buildings, providing public parking like car pools and van pools is not practical. Sometimes green rating system is not complying with the present government policies and objectives. Ex- provision electrical charging points for electrical cars while government discourage the electric cars.

SM12 – Green roof is not compatible with some areas regulations; Eg- Kurunegala urban council limit- roof slope 30 & roof should be blue colour.

MR2 - Use recycled material of > 2 % of the total value of the building.UDA has to propose, the materials, and locations, how to get reuse material. Still no provisions are included in government construction BSR for above items.

MR5 - Use of 100% of total timber requirement through certified quality timber products. In case timber is not used, MR5 marks is not attainable.

MR6 - List of Building Materials >2.5 green value, this clause in not included in standard documents; hence there is no referencing point.

EQ1- Practically CO_2 measuring meters are not needed for every building. For a example more openable single storey small building

EQ8- Designing a direct view paths 1.2m from the finished floor level of 60% of the total building area. Scope is not well identified or defined.

EQ5, EQ6, EQ8 state obtaining really good environment by promoting natural lighting and ventilation. However EQ3 suggests using A/C which score more marks over latter three options in combination.

Giving point for A/C, must add minimum point also. A/c must encourage when it is really necessary only (Auditorium, cold stores,etc)

IN1- Scope in not well defined. Thus the mark is divided to the architectural structural, mechanical and electrical sections. Hence full marks are not achievable to the maximum.

SC1-If not applied for the PPC this mark is not achievable.PPC is not needed for every building.

4.3.3 Quantity surveyor's Comments

MR2- To achieve the mark Use of recycled material of > 2% or 5% of the total value of the building is necessary.

According to the government procedure, re used material is not used. Need approval procedure to check quality of reuse material and should be included in the BSR.

MR5 – use of 100% total timber requirement through certified quality timber products.if we don't use timber for our design we can't achieve this mark.

MR6- according to the CIDA specifications of Green value measurement of the building, use of material with > 2.5% green value more than 20% of total material cost. no defined material list which indicating the green values .

4.4 Analysis of the Blue Green Sri Lanka, based on the Criteria of the marking scheme

As per the literature review LEED (USGBC,2009). ,BREEAM (BREEAM, 2006; BRE Ltd., 2006; Cole, 2001),CASBEE (CASBEE, 2006) and GREENSL® rating Systems (GBCSL,2009) were discussed and categorized under the different criteria. Such as LEED defines sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality, innovation in design (USGBC 2009c; USGBC 2009d).

Similarly in Blue Green Sri Lanka rating system consists with seven criteria which are Energy efficiency, Sustainable site planning and management, Building materials and resources, Quality of internal environment of the building, Water efficiency, Green innovation and Socio – cultural compatibility.
The responses of the interviewees under the major criteria of Blue Green Sri Lanka are given as below.

4.4.1 Energy Efficiency

In the Green guideline, energy efficiency criteria is from EE1 to EE8 and the explanations for those marking points were only given by two electrical engineers out of the five interviewees. According to the electrical engineers this criteria is not effective to all the buildings and it should be varied to the scale and type of the building. However, energy management system is needed for a factory building which needs high-energy capacity, buildings such as school or small quarters do not need that system. As a result of this, marks cannot be achieved when related to the small buildings. Furthermore adding solar power, energy management system for that building is only exceeded the budget without gaining the actual purpose of the green rating system.

4.4.2 Sustainable Site Planning and Management

Mainly the architects gave the answers for the most of the marking points in the criteria from SM1 to SM13. Even though there are 13 points the architects don't pay attention to achieve the all the marks hence they prefer some selected points. All the five interviewees architects thoroughly mentioned that they have less capability in site selecting because all land were selected by the government party. Due to the incapability of the site selection, many problems were occurred and some marks are lost initially. For a example the marks in SM2 can not be achieved for every land.18th interviewee highlighted that there should be an optional marking system to fulfill the marks which can not be obtained at the beginning of the project.

4.4.3 Materials and Resource Management

The responses for MR1 to MR5 marking points were given by the architect and the quantity surveyors. All the interviewed quantity surveyors had a major problem, that the incorporating method of re use material for the estimation, boq and procument system. Moreover, re use material suppliers should be introduced and approved by the government.

Even though marks are allocated for the usage of quality timber products, the interviewed architects mentioned that they faced great problem in using the certified timber. When related to the public sector most of the doors and windows are designed by aluminium. Therefore, there should be an additional method to measure that point. The 19th and 20th interviewees are in the provincial council prefer to use regionally available materials for the projects. If it is done as mentioned above regional material suppliers should be uplifted by the government.

4.4.4 Quality of Internal Environment of the building

Architects and the electrical engineers basically responded EQ1 to EQ9.18th interviewee had a major problem that the direction of a building is not clearly measured in this criteria even it is one of the prominent factors in the design process. lack of options to minimize the effect, cause for the building is not discussed though the direction of the building is not suitable for the land.

4.4.5 Water Efficiency

Only the service engineer out of the five engineers responded for the water efficiency criteria. However treatment plant are established for all the buildings, according to interviewee it is only needed for the required building which are above the more capacity level. Introducing energy management system for limit leakage and wastage is highly effective to the large scale project.

4.4.6 Green Innovation

Five marks are given under seven sections such as introduction new power generations, introduction of landscape design for interior and exterior of the building, introduction of endothermic techniques for buildings, introduction of new material, introduction of self cleaning surface for building exterior, introduction of low energy ventilation system and introduction of new structural design. However only architects responded for this section. Even though the architects design an innovative project, only one mark can be achieved.

4.4.7 Socio – Cultural Compatibility

This section is found out compatibility to the existing architectural context and social context. Obtaining the preliminary planning clearance to get marks in this section is the major problem to the architects. It is not necessary to get the preliminary planning clearance each and every building.

4.5 General view about Blue Green Sri Lanka

Analyzing the collected data from professional such as Architects, Engineers, and quantity surveyors the remarks could be used as a guide to improve the relevant document. Finally, this process will help the implementing authorities to understand how to amend green rating system.

- If government introduces guidelines like these, all offices need necessary staff and awareness of green building concepts. Currently Provincial councils have limited professionals regarding this scope.

- Processing fee is very high – only assessing fee constitutes as much as 1% of construction cost. Even the consultants engaged in preparation of reports do not claim this much as part of the consultancy fee.

- Importance in focusing on objective of going green is not accomplished in total. The actual focus in only directed towards obtaining approval in building process rather than achieving a holistic green building.

- Accredited green consultant is not compulsory in this rating system which is a major drawback. Since all other professionals do not have specific training or awareness regarding green it is vital to have accredited green consultant from a professional body.

- The allocation of marks and criteria deviate from the main objective to reduce carbon footprint to help the environment which is measuring factor of current sustainable approach.

- If this is an online process it can reduce printing. This reduces paper wastage printing cost and carbon emission from printers.

- The green rating system is becoming just report and a part of approval system. Other than that attitude vice it should be developed.

- Main error - Low marks for achieve the architect's design. There are 5 marks for the green innovations. But it's for all design team. Building orientation is important thing for the design.

- To building approval and green building approval process are occurred pararaly. In some situation late the green building approval. So building approval also late. But government can't hold the annually scheduled project. So before getting approval construction works are started.

4.6 Discussion

Considering the views of the construction professionals following factors affecting the implementation of Blue Green Sri Lanka Green Guideline. There are negative factors and positive factors could be identified as follows.

Table 4-1 Factors Influencing of Blue Green Sri Lanka

Negative Factors	Positive Factors
Lack of awareness	environmental responsibility
Lack of technology and expertise	Improvements in employee
Complex and costly (Processing fee high)	Reduction in operation cost
documentation procedure	Can increase market demand
High initial cost	

Blue Green Sri Lanka green guide line based on LEED system. LEED credit system was originally developed for the United States even though currently it is used worldwide. Therefore most people believe that the credit requirements are unsuitable for the local context.

According to the findings of this research, Brownfield Redevelopment (SM2) under the Sustainable Sites (Appendix- 1) category was given negative comments by the respondents. Brownfield are the damaged sites where development is complicated due to environmental contamination. Therefore the reason for the non compatibility could be identified as the unavailability of lands defined as 'brownfield sites' in Sri Lanka.

Technical feasibility, which includes the knowledge, expertise and equipment to accomplish the credit requirements, was evaluated with the professional views and can be interpreted as follows. According to the results of respondent's comments some credit requirements tend to possess low technical feasibility in Sri Lankan context. Renewable Energy (EE3) under the category of Energy efficiency was identified as difficult to achieve with the available technology in Sri Lanka. Further, the credits for Recycled Content (MR2) under the Building Materials and Resources category cannot be attained locally as such materials are locally impossible to find. Even to control Indoor air Pollutant Sources (EQ2), the required materials and equipment were found unavailable in the country.

The initial cost or the additional cost incurred to implement a particular Blue Green Sri Lanka credit requirement is a decisive factor affecting the adoption,

According to the professionals'' responses, Green Power , Renewable Energy , and Optimize Energy Performance under the Energy Efficiency category received very high initial costs involved in achieving these credits includes highly technical equipment as well as processes. Further, introducing Innovative Wastewater Technologies, high initial costs for their implementation.

4.7 Summary

This chapter basically analyzed the findings of semi structured interviews carried out for the selected professionals. Professionals were selected under five categories which related to the public building sector. The selected professionals were Administrative professionals, Accountancy professionals, Engineering professionals, Architectural professional and Quantity Surveying professionals.

The semi structured interviews were conducted to obtain their knowledge and contribution to the construction field in addition Blue Green Guideline. Furthermore their ideas, aspects, positive and negative comments on Blue Green Guideline were considered. Under each type of professions selected all the findings were summarized and further analyzed.

This research study will be an eye opener to improve the various aspects that is given in the Blue Green Sri Lanka, Green Rating System, and how to improve the document. Firstly, this could be considered as another way of sharing the relevant details among different parties. Secondly after analyzing the collected data, the conclusions could be used as a guide to improve the relevant document. Finally, this process will help the implementing authorities to understand how to amend the set of aspects of Blue Green Sri Lanka, the necessity of creating awareness among the officers who are directly involved and those who are indirectly involved in the process.

The next chapter, will conclude this whole study and show up the recommendations.

5 CONCLUSION AND RECOMMENDATION

5.1 Summary of the Study

Discovering the possibilities of implementation of an energy and environmental sensitive building design is greatly in need today, due to the growth of higher energy demand in construction industry in terms of rapid urbanization. The formation of different sustainable design concepts has led the world to realize the necessity of addressing the above needs in more responsible manner.

The intention of the study is to examine the issues relating to construction industry practices and how to incorporate concept of the 'Blue Green Sri Lanka Green Rating System' towards the Sustainable development in Sri Lankan Government sector buildings.

The study flows through five chapters and the First Chapter overview its' structure. It contends, the background study, research problem, aim & objectives, methodology, scope & limitations and the chapter breakdown.

Chapter Two; literature review, explored the theoretical background of the green rating systems which are practicing in other countries. At the same time this chapter discussed the sustainable development, green building and green rating systems. The objectives of this chapter is to overview and analyze the current environmental building evaluation methods used in different countries in terms of their characteristics and limitations in measuring building sustainability. The three main green rating systems; BREEAM (Building Research Establishment Environmental Assessment Method) which was the first environmental building assessment method, CASBEE (Comprehensive Assessment System for Building Environmental Efficiency) and LEED (Leadership in Energy and Environmental Design). The LEED Green Building Rating System is a voluntary standard for sustainable buildings. Even though a green rating system was introduced to Sri Lanka in 2009 it was not mandatory. It was introduced by based on the LEED Rating System. Thus in 2017, Blue Green Sri Lanka rating system was applied in both the government and the semi government buildings which is mandatory. The guide line and scoring system has been examined in internationally admitted methodology and seven categories as in LEED. They are, Energy Efficiency, Sustainable Site Planning and Management, Building Materials and Resources, Quality of Interior Environment of the Building, Water Efficiency, Green Innovation and Socio – Cultural Compatibility.

The methodology includes research design, research settings and the process of data analysis method which are elaborate in Chapter Three. A questioner has been arranged to collect the data to identify the government sector professionals who are engaged in building and development related works. It includes the officers of the Sri Lanka Administrative Service, the officers of the Sri Lanka Accountancy service, Sri Lanka Engineering Service, and Sri Lanka Architectural Service who are executive professionals in the government sector,

Subsequently, a semi structured interview with pre-determined questions developed through the literature review were conducted for industry professionals to identify the grounded theory on green rating system. A series of structured interviews has been conducted with these officials to collect and record the data except for the above questioner.

Chapter Four described the questioner findings and analysis of data acquired from the research study.

5.2 Conclusions

From the study findings it can be concluded that, implementing of Blue Green Sri Lanka Green Guideline for Public Buildings, shall be changed according to the requirements and national policies of the country. The domains of services, namely, Sri Lanka Engineering Service, Sri Lanka Accountancy Service, and Architectural service and Sri Lanka Administrative Service. It was evident that the Sri Lanka Administrative Service is the most influential, where they were equipped with a higher power of decision making process for particular project.

As observed within the data analysis, it is evident that the officials of Sri Lana Engineering Service, and Sri Lanka Architectural Service are equipped with the most comprehensive knowledge about the Green Rating System. Further, they have the most sufficient knowledge on financial allocations which is required to successfully implement better green concepts that accompany new technologies. For a particular project, fund allocation is primarily based on the basic client requirements. Thus, new implementation of technologies and design concepts becomes very limited as the budgets have already been allocated at the inception stage of the project; which is been done by the officers in Sri Lanka Administrative Service.

Green building concept is been implemented with a target of reducing the active Carbon foot print, while addressing the domains of; reduced operational costs, improved indoor air quality, and so on it is difficult to achieve the targets, further targeting, reduced impact on the environment, increased occupant health and productivity, reduced operational costs, improved indoor air quality, etc. A particular green rating tool provides the basic structural framework in order to achieve the above mentioned aspects. Thus, a green rating tool not only address the building design, but also addresses a range of domains varying from site selection to construction administration and contractor selection, which further extends up to the post construction and monitoring process. Thus, the ratings serve as a checklist to ensure that a building or project actually meets energy reduction and environmental protection goals.

Rating systems encourage and promote green design. As many existing programs offer multiple levels of certification, the design/building community is encouraged to continually strive for new sustainable goals. As many of the popular green rating tools such as LEEDS, require the active participation of a Green Building Consultant who shall be ideally an Architect or an Engineer. Such personnel’s participation shall be accountable from the inception to the completion of a particular project. This is a mandatory requirement of most of the green rating tools. Though the situation is such, the present systems implemented within the Blue Green tool do not promote such mandate.

Thus, the vast depth of the subject shall be properly conveyed and communicated to the stakeholders within a project. It is clearly evident that the implementation an mandate of the Green rating system within public buildings in 2017, has been executed without offering proper knowledge to the stakeholders. Thus, during its implementation, the officers of the Sri Lanka Administrative Service nor the officers of the Sri Lanka Accountancy service were not be able to execute the guidelines with a proper aim and vision of achieving green building targets and concepts. However, it is worth noting that the officers of the Sri Lanka Engineering Service, and Sri Lanka Architectural Service have the most comprehensive knowledge of the subject.

The fairness of fees and options provided within the basis of the fee scale is noticeably questionable during the study. For an instance, the processing fee required will be 1% from the total budget of the project. The scope of work defined for the specified fee includes only the evaluation of the green report. This do not include an appointment of an accredited green consultant throughout the process, advising the design team throughout the whole design, construction and operational stages of a building. It is clearly evident that only a report is prepared for the sake of regulatory approvals. The proper implementation and execution of sustainable design concepts are not addressed to the project, making the whole system useless.

Another noted complication arisen was the government policy of budgetary approvals. Accordingly, government allocates money for a particular project at the beginning of a financial year. According to the policy, the allocated money must be spent within the same year. If not, the allocated money amount will be transferred back to the government. The complication occurs during project approval from regulatory body, the UDA, which requires the green report as a prerequisite. If the said report is failed, then the project cannot be proceeded, thus the whole target of the particular project is failed and may be dragged into the next financial year. This therefore creates a conflict of interest between two different government bodies who ultimately are focused on a common goal; i.e serving to the public.

Another concluding note would be the mark allocation weightages which provides less attention to the building design process. The building design is a key factor which affects the sustainable nature of a building. A properly designed building dramatically reduces the need of artificial air conditioning systems. Further, it is not only the architect, but also the other members of the design team; the Structural, MEP, QS, etc, guided by the green consultant appointed by the Green Guidelines, shall be closely collaborated to design the building properly. Thus, during the evaluation of the project, a high weightage shall be given to the design phase of the building, which is clearly practiced by other green rating tools.

5.3 Recommendations

Before this rating system is made mandatory, there should be a trial period and obtain the feedback from the professionals attached to a specific project. It is mandatory for the professionals to be engaged in Continuing Professional Development Programs. The professional service of architects and relevant MEP engineers are severely needed within the country's construction sector. Government consultants (architect, engineer) role is larger than before. The whole rating system should be evaluated by a team of professional consultant headed by an architect. Thus, the existing government frameworks shall allow such decision making and vest powers to the above mentioned professionals.

The marks are given for the use of regional materials which was a good implementation. However, marks are given for the use of endemic plants which is harder to be executed practically as the nature of plants severely depend on specific landscape features of the site. Further, the availability of such plants is also a concern in terms of practical implementation. Thus, the government should promote plant nurseries to cater the demand generated by the new green building initiative and its evaluation.

As it is known, the solar panels are measured in the rating system. It has the highest marks in the evaluating process. Due to the dollar crisis and issues related to tropical weather patterns of Sri Lanka, there should be a threshold level implemented while evaluating. This level shall be assessed and enforced by a technical institutions. On the other hand, the government should have options or take the responsibility to promote the local productions such as solar panels, bricks and endemic plants.

Awareness programmes should be conducted especially in the sector of administrative service and the accounts service. At the same time, if there are any demands for revisions as observed by the sector stakeholder, those issues must be answered or developed positively.

Sri Lankan green rating system is not divided according to the categories such as residential building, industrial buildings, school buildings and new buildings. This green rating system is also not suitable for the all the scales projects. It should be differ according to the size of the building and need project categorization.

5.4 Limitations of the Study

The conclusion of this study was reached basically depending on the answers provided by officers of government services such as administrative service, accountancy service, engineering service, architect service and quantity surveyors. But if you go in to the depth with separately under different scales and types of projects, the results will be more definite.

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7 APPENDICES

Appendix 1 – Marking Scheme

SCORE SUMMARY				
No	Item	Marks	Applicant	UDA
EE	**Energy Efficiency**	**27**		
Design				
EE1	Zoning of lighting sources/ equipment	02		
EE2	Electricity sub metering	02		
EE3	Renewable Energy	08		
EE4	High performance energy efficiency	05		
EE5	Efficiency of Electrical illumination	02		
EE6	Power factor Correction	02		
Improvement and Quality improvement				
EE7	Improvement and operation of Energy Efficiency	04		
Evaluation of accuracy and maintenance				
EE8	Sustainable Maintenance	02		
SM	**Sustainable Site Planning and Management**	**23**		
Site Planning				
SM1	Site Selection	04		
SM2	Abandoned (Brown field) Site Re Development	03		
SM3	Development Density and Community Coordination/management / involvement	01		
SM4	Preparation of Environmental Safeguard plan	01		
SM5	Laying and improvement of green ground cover	02		
Construction Management				
SM6	Mitigation of construction pollution	01		
SM7	Quality assurance in building construction	01		
SM8	Workers facilities	01		
Transportation				
SM9	Minimizing the use of private vehicles and encouraging public transport usage	02		

SM10	Parking capacity	02		
SM11	Rainwater drainage plan – Quantity and quality control	02		
SM12	Green cover and roofs	02		
SM13	User's manual for building users	01		
MR	**Materials and Resource Management**	**20**		
Recycling and re-use of materials				
MR1	Re- use and selection of materials	02		
MR2	Material containing recycled substance	02		
MR3	Re- use of existing building	02		
Sustainable Use of Resources				
MR4	Regionally available materials for building construction	03		
MR5	Sustainable timber	03		
Waste Management				
MR6	Use of High – value green building materials	02		
MR7	Construction waste Management	02		
Green Products				
MR8	Refrigerants & clean Agents	03		
EQ	**Quality of Internal Environment of the Building**	**13**		
Internal Air Quality				
EQ1	Monitoring and controlling of CO2	02		
EQ2	Indoor air pollutants	02		
The Optimum Temperature				
EQ3	Designing and installation of optimum temperature control units	02		
EQ4	Air change effectiveness	01		
The optimum level of visual light and sound				
EQ5	Day light	02		
EQ6	Controlling the glare of intake sunlight	01		
EQ7	Electric Light Level	01		
EQ8	Internal and external Views	01		
EQ9	Internal noise level	01		
WE	**Water Efficiency**	**10**		
Rain water collection and water recycling				
WE1	Rain water Harvesting	02		
WE2	Waste water recycling and efficient	04		

	use			
Enhancement of efficiency				
WE3	Water metering and water leaks identification system	02		
WE4	Water efficiency tool equipment	02		
IN	**Green Innovation**	**05**		
IN1	Utilization of innovations	05		
SC	**Socio – Cultural Compatibility**	**02**		
SC1	Design and building of socially and culturally compatible buildings	02		
	Total	**100**		

Appendix 2 - Interview Guideline

<u>Part One;</u>

1. Profession - Example: Architect
2. Class as per the government grading - Class iii
3. Educational Qualifications - Graduate Level

The aim of this part is to categories the professionals based on their profession, professional experience, and qualification and grading of employment in government sector.

<u>Part Two;</u>

1. Are you involved in the Government Construction related works at present as per your current appointment - directly / indirectly involving

2. Briefly explain how your involvement to the building construction related works as per your current appointment - the current appointment and the involvements in the Government Construction related works.

3. The Blue Green Sri Lanka booklet introduced a new set of green ratings as a mandatory requirement to the follow in government buildings. Do you have any comment over the document? - The awareness and a comment.

The aim of this part is to measure their involvement in government sector construction works, their capacity in decision making in respect to such works and their awareness in 'The Blue Green Sri Lanka – green building guidelines for government constructions'.

Part Three;

- As an officer in the Government sector of Sri Lanka how do you comment on the green rating system introduced in the Blue Green Sri Lanka for Government Constructions, which is based on the following aspects.

1. Energy Efficiency
2. Sustainable Site Planning and Management
3. Materials and Resource Management
4. Quality of Internal Environment of the building
5. Water Efficiency
6. Green Innovations
7. Socio – Cultural Compatibility

- A comment based on (AR/FR/PR/BR) the knowledge and applications were expected

Part three aims to abstract the application of above aspects in construction, their limitations, effectiveness and viability of above aspects in the rating system.

Part Four;

This research study will be an eye opener to improve the various aspects that is given in the Green rating system, Blue Green Sri Lanka for Government constructions, and how to improve the document. What would be your reaction over this interview based questioner and the research study?

It is expected to get the comments and opinions over the significance of this type of studies and the impact over the development of similar regulations.

Part Five;

Remarks;   Researchers' remarks after the questioner based interview.